

# Influence of economic expectation on choosing a university: a case study in Industrial Engineering

## Expectativas económicas y su influencia sobre la elección de la universidad: estudio de caso en Ingeniería Industrial

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#### ABSTRACT:

In this research, we analyze the playing role of growth in the technical careers supply, salary expectations and reputation of the university on the decision to choose Industrial Engineering. The study was conducted using secondary information on wages, population and enrollment in Colombia during the years 2007-2015. The main conclusions reveal that graduates from most expensive universities tend to earn significantly higher wages than graduates of other universities. However, the high cost of education involves rates of return much lower than those of universities cheaper.

**Keywords:** Economic expectations, choosing a university, industrial engineering.

#### RESUMEN:

En esta investigación analizamos el papel que juegan la ampliación de la oferta, las expectativas salariales y la reputación de la universidad sobre la decisión de elegir Ingeniería Industrial. El estudio se realizó utilizando información secundaria de los salarios, la población y matriculados en Colombia durante los años 2007 - 2015. La principal conclusión revela que los egresados de universidades costosas tienden a ganar mayores salarios que el resto a medida que pasa el tiempo, aunque la alta inversión que supone los estudios hace que tenga tasas de retorno mucho menores.

**Palabras clave:** Expectativas económicas, elección de la universidad, ingeniería industrial.

## 1. Introduction

The transition from secondary education to higher education involves for students a decision that defines their occupational future in their adolescence (Villada et al., 2002). Given the psychological insecurity that the student faces, this decision may be influenced by factors such as family beliefs, social reputation, salary expectations, among others (Ghansah et al., 2016;

Martin, Simmons, & Yu, 2014; Taylor, 2007).

In this sense, (Carnasciali, Thompson, & Thomas, 2013) analyze the influence of socializers, self-identified competence, and media sources on choosing a career and indicate that gender and parental educational achievement levels affect students' choice of engineering. As well, (Piñero Ramírez, 2015) in his research on the Rational Action Theory concludes that individual characteristics (e.g., social origin, sex and school history) are the main factor that determines the career choice. Specifically in Bogota, we find the study of (Pineda Barón, 2015) who using a Logit Multinomial Model, concludes that this the career choice depends on the genre, mother's education, family income, and the results of Saber 11 Test and wage expectations.

On the other hand, when the option of studying at a public university not is available, families need financial assistance to pay the cost of higher education; this involves the uncertainty of whether or not such investment will be worthwhile. In addition, there is a latent question—tacitly or explicitly—of how many years the student will be attending higher education before getting into the job market.

Likewise, choosing a specific university can be an important decision for the candidate. In this context, we find the study of (Dunnett, Moorhouse, Walsh, & Barry, 2012) who examines the impact of fee changes on how students weigh up their university choices. They affirm that “students from families where there is no history of attending university will experience more disutility from the higher fees” (p.199)

Specifically, in the case of young people who wish to study Industrial Engineering, several questions can bearising such as follows: should they pursue a technical or a university degree? Which university should they choose? Will become a worthwhile investment? In this research, we analyze the influence of an increase in the offer of technical careers, student's salary expectations and the reputation of the university on the decision to choose Industrial Engineering as a professional alternative in Colombia.

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## 2. Methodology

The study was made using secondary information of private Colombian universities obtained from (Observatorio Laboral -MEN, 2015), looking for salary information, from (DANE, 2015) for population statistics, and from (SNIES- MEN, 2015) for enrollments information. We analyzed the available data for the period 2007 – 2015.

The variables analyzed were: number of enroll students, career, number of industrial engineering programs, universities, affordability, graduate incomes, wage increase per year of experience, employability rate.

The first stage consisted of evaluating the growth of technical and technological careers in relation to university careers during the study period in order to evaluate the trend in the preference of high school graduates.

Later, the study focused on the area of industrial engineering and we compare the average wage (in current Colombian pesos COP) of a graduate in technical or technology career with the average wage of a university graduate. In this case, the variable wage was built on the average monthly salary reported each year and it was adjusted based on the years of experience of the graduate.

The next stage of the analysis was focused on the students enrolled in Industrial Engineering in 51 private Colombian universities for which complete information was available. For this purpose, the universities were grouped by cluster analysis based on the tuition cost of the year 2014. The cluster analysis was applied using the SPSS software and three groups/clusters were defined: 12 universities were grouped as the most expensive, 22 universities at intermediate cost and 17 universities as economic.

Subsequently, students' preference for these three types of universities was analyzed according to the number of students who applied, were admitted and enrolled in Industrial Engineering by

universities over the study period. This was done to compare the salary differences in relation to the cost of the tuition of the institution where students attended the course.

Finally, an economic analysis of the alternative of studying Industrial Engineering was carried out in a horizon of 10 years since the student enrolls in the career until he completes 5 years working as a graduate; that is, we assume a scenario of 5 years studying and 5 years working. The investment in the studies was calculated on the basis of the tuition fee reported by the universities for the year 2014 and this value was adjusted annually assuming an annual inflation rate of 5%. Revenues were calculated since the sixth year on the basis of the average salary of a graduate of the year 2014 adjusted for inflation in the previous 5 years. From year 7, the salary was annually adjusted based on the growth rate of the experience curve. The monetary values are expressed in Colombian Pesos (COP).

The discount rate used was the lowest market charged by the (ICETEX, 2017) that was 3.66% for the year 2014. This rate only applies to poor students, who technically could only apply to affordable universities. However, to carry out the study under equal conditions, in all cases ICETEX rate was applied. After calculating the cash flows for each year and university, the net present value and the internal rate of return on investment were calculated.

### 3. Results

To carry out the study, the first step was to examine the evolution of access to higher education in Colombia. For that, the population enrolled in universities and in technical and technology careers in the period 2007-2015 was evaluated. This population was contrasted with the population of the country between the ages of 17 and 21, which are the age at which young people enter higher education (see Table 1).

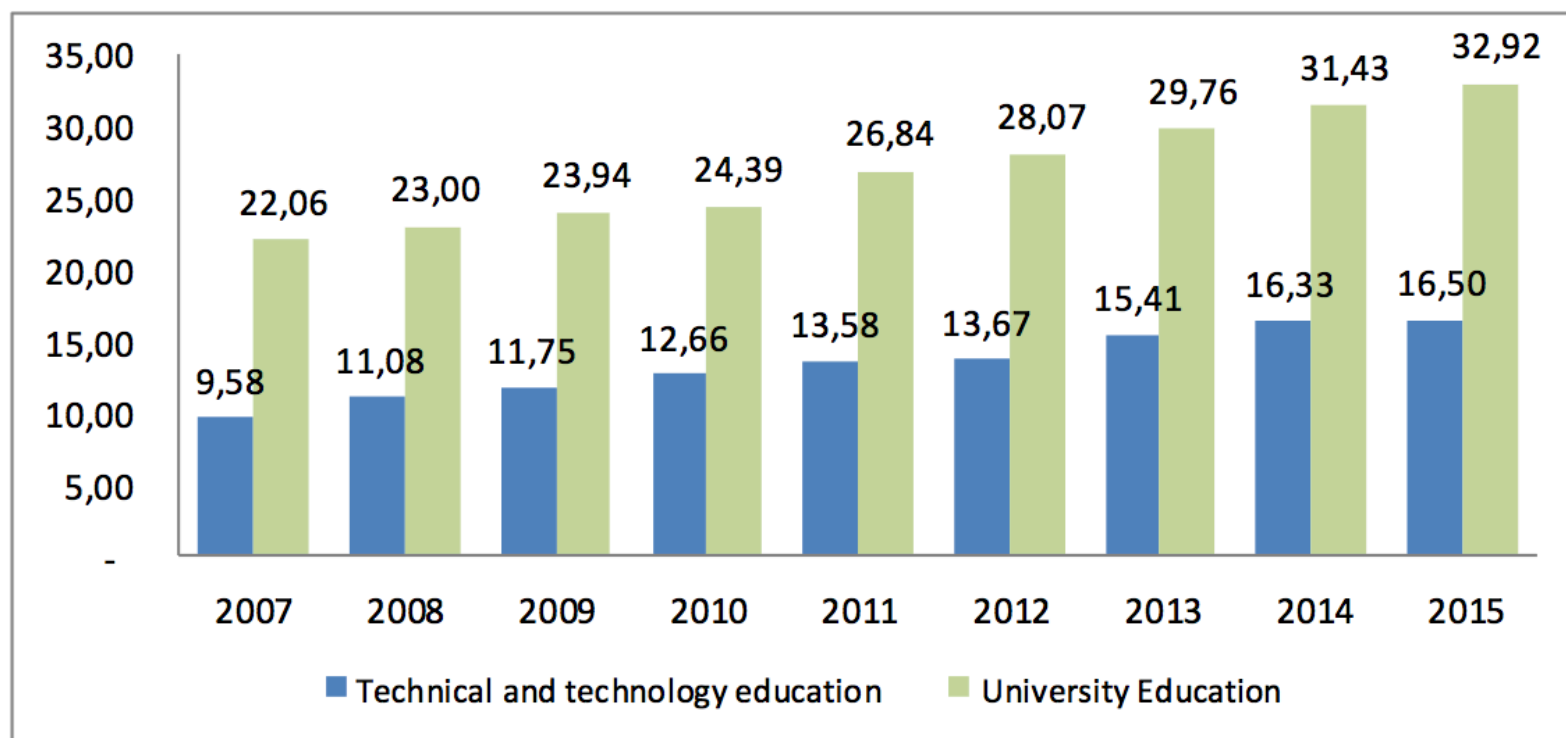
**Table 1:** Coverage of higher education in Colombia

Year	Enrolled per year		Total Enrolled per year	Population between 17 and 21 years	Coverage rate
	Technical and technology education	University Education			
2007	395.437	910.228	1.305.665	4.125.881	31,65%
2008	463.980	963.167	1.427.147	4.187.317	34,08%
2009	498.382	1.015.608	1.513.990	4.241.585	35,69%
2010	542.627	1.045.133	1.587.760	4.284.916	37,05%
2011	586.471	1.159.512	1.745.983	4.319.415	40,42%
2012	593.684	1.218.816	1.812.500	4.342.603	41,74%
2013	670.930	1.296.123	1.967.053	4.354.649	45,17%
2014	711.291	1.369.149	2.080.440	4.356.453	47,76%
2015	717.521	1.431.983	2.149.504	4.349.823	49,42%

Source: SNIES - MEN, DANE

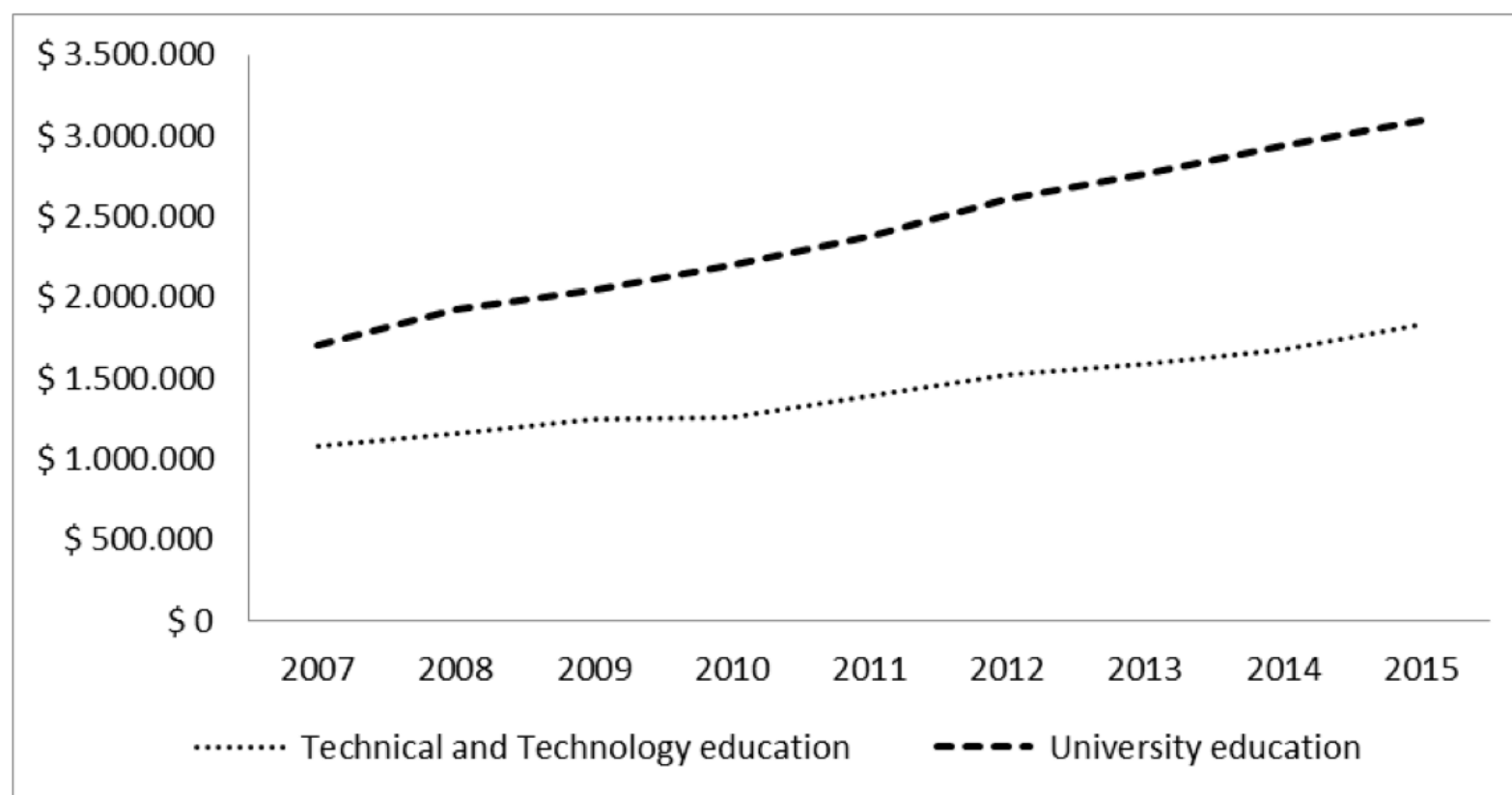
With this information was calculated the rate of coverage of higher education in Colombia differentiated by technical, technology and university education. The results shown in figure 1 indicate that in the group of people who opt for higher education, the university remains in time as the principal option.

**Figure 1:** Coverage rate by Institution



This information allowed the analysis of the evolution in average salaries of graduates of technical and technological careers and of universities in areas related to industrial engineering during the study period (see Figure 2). The analysis shows that not only the salaries of university graduates are much higher than that of technical career graduates, but that this tends to increase in a greater proportion over time. This can be an element that discourages the preference for technical and technological careers.

**Figure 2:** Undergraduate average wage in COP



After analyzing the differences between technical and university graduates, the focus was on evaluating the behavior of the market segment that is inclined to study Industrial Engineering

in Colombia in private universities. To do this, a cluster analysis was initially carried out to classify universities according to the value of tuition for 2014 (see Table 2).

**Table 2:** Industrial engineering career by university tuition fee

Cluster Number		Average Tuition fee in 2014 *	Average wage in 2014 *
More Expensive	Mean	7.064.476	2.033.856
	Standard deviation	2.302.656	290.245
	N	12	12
	Minimum	5.057.350	1.573.126
	Maximum	13.144.000	2.419.651
Intermediates	Mean	3.788.760	1.698.348
	Standard deviation	470.704	267.856
	N	22	22
	Minimum	3.184.000	1.300.667
	Maximum	4.780.000	2.440.914
Cheapest	Mean	2.479.698	1.766.226
	Standard deviation	348.473	288.684
	N	17	17
	Minimum	1.599.950	1.205.750
	Maximum	2.910.000	2.147.820
* Values in COP			

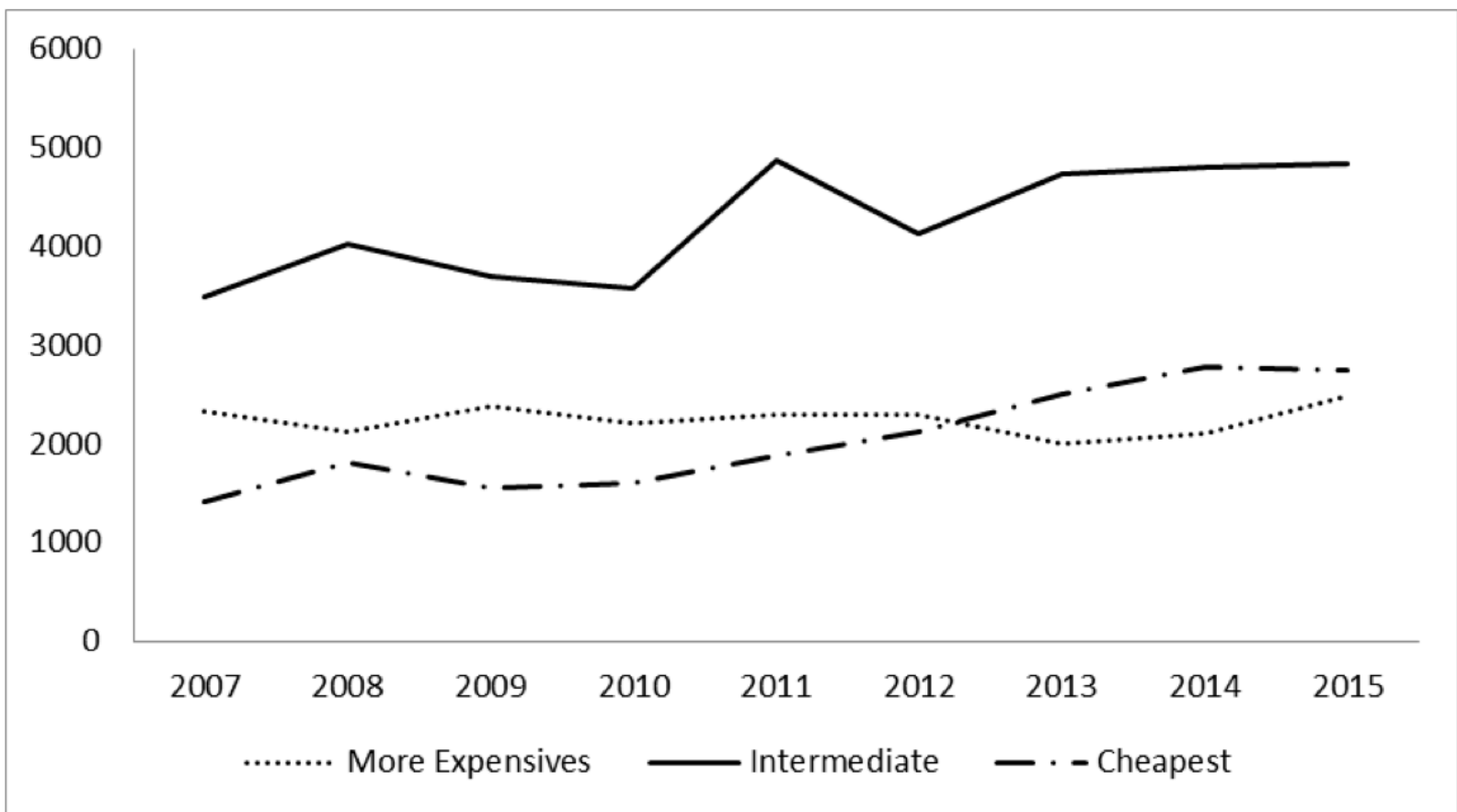
On the basis of the classification, stand out the most expensive group of universities because they have the greatest dispersion in the data, since the value of the standard deviation represents more than one-third of the mean. Once the classification was made, the evolution of the Industrial Engineering stakeholders in each type of university was analyzed, separated by phases of the process. It is important to stress that in Colombia for an applicant to enter a university must submit his application to be evaluated by examinations and / or interviews. Once that phase passes, the candidate is advised of the admission to the program, but not all those who are admitted eventually enroll because it usually happens that they run for several universities.

**Table 3:** Number of Industrial Engineering students by process stage

University by tuition fee	Students by process	2007	2008	2009	2010	2011	2012	2013	2014	2015
More Expensive	Students who applied	4924	5169	5458	4877	5276	5598	5495	5465	6385
	Acknowledged Students	3014	3632	3747	3180	3947	4047	4174	4174	4473
	Enrolled Students	2320	2126	2384	2209	2290	2289	1995	2106	2476
Intermediates	Students who applied	4482	6218	6014	6091	6968	7247	9082	8601	8487
	Acknowledged Students	3742	5170	4688	4619	5872	5179	6054	6133	6620
	Enrolled Students	3483	4024	3694	3569	4873	4123	4733	4799	4836
Cheapest	Students who applied	2070	1933	2648	2738	3428	3803	3707	4371	4202
	Acknowledged Students	1943	1659	2340	2354	2903	2871	3031	3309	3108
	Enrolled Students	1411	1800	1549	1608	1873	2114	2496	2782	2740

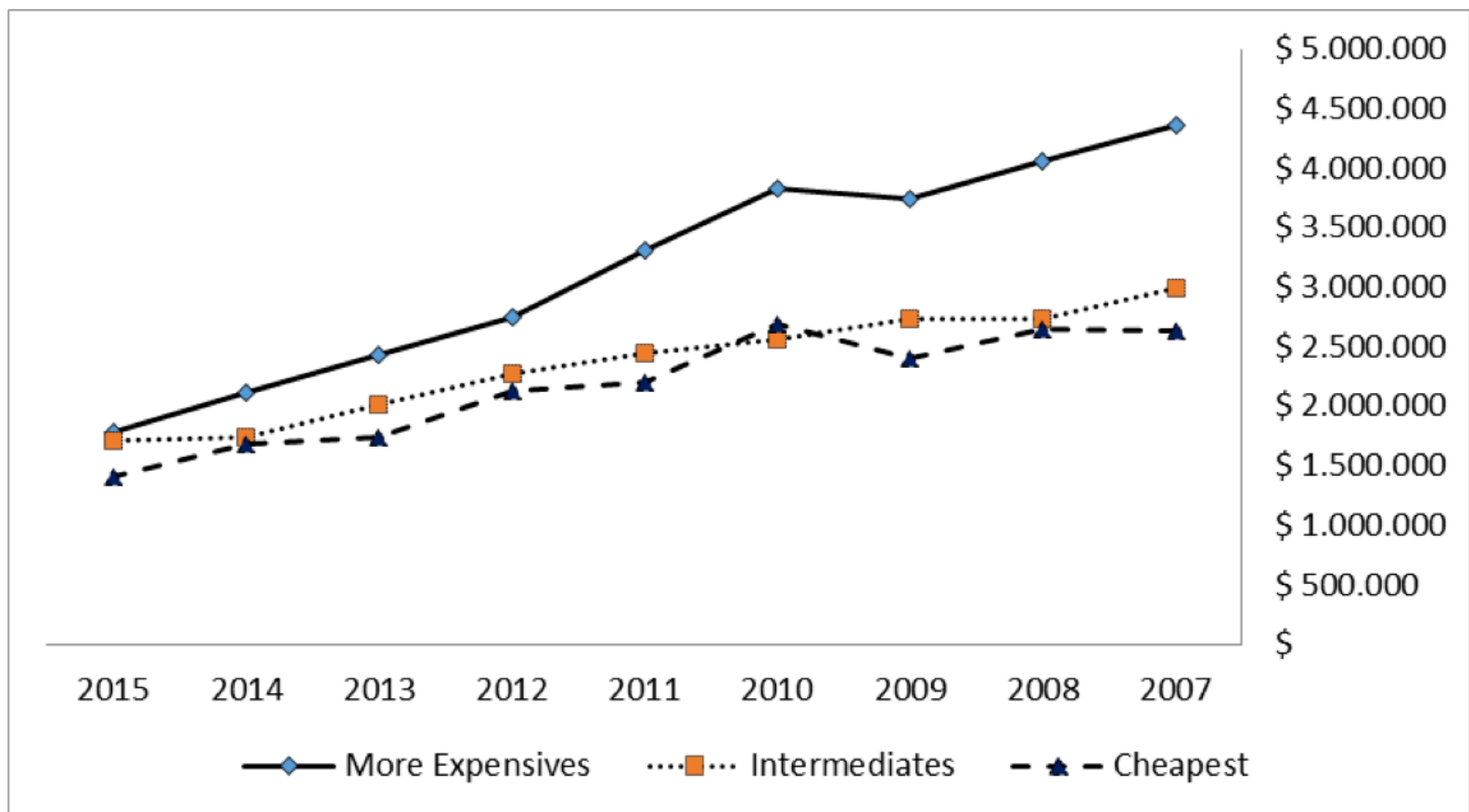
In figure 3 the evolution of the number of Industrial Engineering students during the study period classified by the tuition fee is showed. It is clear that universities at a cost of intermediate tuition cost capture the largest proportion of the market and maintain a positive trend. It is also observed that the cheaper universities maintain a growing trend, and 2013 began to capture a greater proportion than the more expensive universities. Besides, the most expensive universities have been stable in the time managing between 2000 and 2500 students per year.

**Figure 3:** Enrolled students in industrial engineering by university tuition fee



On the other side, from the information previously shown in Table 2, it is observed that the average salary received by the new graduate for the year 2014 is not necessarily directly related to the cost of enrollment. Also, there is no significant difference in the average salary of the recent graduate. To evaluate the behavior over time of this variable, we performed this analysis during the study period but comparing the average salary for the year 2015 (Y axis) depending on the year of graduation (X axis) (see Figure 4).

**Figure 4:** Wage in 2015 by year of graduation in COP



As showed in figure 4, there are no significant differences in the salaries of the recent graduates, but as time goes on, graduates from more expensive universities tend to earn significantly higher salaries than graduates of other universities. On the other hand, graduates of universities with intermediate or cheap tuition fees tend to receive equivalent salaries as the years pass.

In order to evaluate the economic scenario that has a candidate of Industrial Engineering in Colombia based on the information analyzed so far, an economic analysis of the investment that a person has to make in his career was made, taking as a temporal horizon 10 years from the beginning of study. The cash flows obtained, the net present value of the investment and the internal rate of return were calculated as showed in table 4.

**Table 4:** Economic expectation for an industrial engineering in Colombia

		University by tuition fee		
		More Expensive	Intermediates	Cheapest
Average tuition fee in COP (2014)		7.064.476	3.788.760	2.479.698
Tuition fee*		12,07	6,15	4,02
Average wage in COP (2014)		2.033.856	1.698.348	1.766.226
Employability rate		87,51	84,03	82,27
NPV** in COP (10 years)		79.167.418	86.999.412	104.934.732
IRR *** in COP (10 years)		20,98%	30,98%	43,51%
Tuition fees during the career in COP	Year 1	-14.128.952	-7.577.520	-4.959.396
	Year 2	-14.835.399	-7.956.396	-5.207.366
	Year 3	-15.577.169	-8.354.216	-5.467.734
	Year 4	-16.356.028	-8.771.927	-5.741.121
	Year 5	-17.173.829	-9.210.523	-6.028.177
Income in the first graduate years in COP	Year 6	31.149.279	26.010.848	27.050.425
	Year 7	35.487.594	29.633.509	30.817.872
	Year 8	40.712.756	33.996.720	35.355.469
	Year 9	44.491.848	37.152.408	38.637.280
	Year 10	48.235.981	40.278.904	41.888.732
* In number of minimum wage in 2014; ** Net Present Value; *** Internal Rate of Return				

As can be noted, although the people who study industrial engineering in the most expensive universities earn significantly higher wages over time than the rest of the graduates, the high investment involved in the studies makes the return rates much lower than the rest.

It is important to note here that if a differentiated rate is applied to the market, the gap would



be much higher, perhaps leading to economic advice do not recommend to study in an expensive university. Finally, it can be observed that the most economically profitable option is offered by studies in the cheapest universities. Besides, it is observed that the employability rate is equivalent to any of the universities.

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## 4. Conclusions

From the research carried out, it can be concluded that although the number of students enrolled in technical and technological careers tends to grow in proportional form to those enrolled in universities, the average wage received by university graduates tends to increase in a higher proportion in the long-term.

It is also observed that universities with an intermediate tuition cost capture the largest proportion of the market and hold an increasing trend throughout the study.

Although there are no significant differences in the wages of just industrial engineering graduates, graduates of more expensive universities tend to earn significantly higher wages than graduates of other universities over time. However, the high cost of studies in those universities makes the investment have rates of return much lower than the rest of universities.

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