
**POLITECNICO DI TORINO**

**COLLEGIO DI INGEGNERIA GESTIONALE**
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# Driving Forces Analysis for European Lifelong Learning Programs: a Hedonic Pricing Method Application

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# Abstract

The scope of this thesis is to analyze what are the main driving forces for prices of continuing education programs offered by business schools and universities. To this aim, the hedonic pricing method has been applied to a sample of 1342 masters and open courses collected from European business schools and universities. Regression models, including linear and logarithmic models, have been built in order to examine the effects on the price by variables including, among the others, duration, language, format, experience required, existence of accreditations, certifications, project works, stages, etc. Different main determinants have been found for different categories of programs; however, some common factors have been highlighted. Such factors are related to the duration, the language and the format of programs analyzed. It has been indeed demonstrated that longer durations are generally associated with higher prices; programs held in English cost, on average, more than programs held in other languages; and online programs are offered at a significantly lower price with respect to residential and blended programs.

# 1. Introduction

The sector of continuing education has changed remarkably over the last years. Technology and digitalization have indeed brought significant improvements in the concept of higher education. More specifically, thanks to the advent of the internet, online programs have spread considerably, either substituting traditional residential programs or complementing them, as in the case of blended programs. In this context, moreover, new forms of programs have emerged, for instance MOOCs (Massive Online Open Courses), which, taking as advantage the web revolution, are reshaping the environment of higher education [1].

This technological breakthrough has brought radical changes in both the experience perceived by participants and in the business model of universities and business schools [2]. The former aspect has been largely analyzed by the literature [3], [4], [5], while, concerning the change in business models, some peculiarities should be highlighted as regards the differences in setting up residential and online programs. On one hand, the cost of organizing online programs is certainly higher due to the need for servers, software, IT technicians and the indirect cost of dealing with changes in the organization structure [6]. On the other hand, online programs are characterized by a low, or even null, marginal cost due to their replicability. Such programs allow indeed to remove geographical and physical barriers since they can be offered to an unlimited number of participants located in different continents [7].

Moreover, the recent COVID-19 pandemic has surely caused a further shake-up in the sector of education [8], bringing out the need for a high-quality learning experience. Hence, the importance of smart learning has emerged as a replanning of learning experience rather than a simple digital transposition of lectures [9].

Finally, globalization has paved the way for new markets [10]. Nowadays, it is not unusual for European universities and business schools to address programs to developing countries such as China, Brazil and United Arab Emirates, where established schools are lacking and there is a progressive increase in demand for higher education [11]. Furthermore, thanks to the increasing English-speaking population, the market for continuing education programs has become more competitive, due to the increase in the number of programs in English offered also by universities and business schools established in non-English-speaking countries.

This study will analyze how the price charged for continuing education programs is affected by the abovementioned factors, with reference to format, language and countries in which programs take place. The focus will be also extended to other price drivers, such as duration, topic, accreditations, certifications, stage opportunities, et cetera.

# 2. Data and methodology

## 2.1. Study area

The study has been conducted among a sample of 1342 European masters and open courses collected from 35 business schools and technical universities. Because of the different characteristics observed while building the database, masters and open courses have been assigned to four different datasets: open courses offered by business schools, masters offered by business schools, open courses offered by technical schools and masters offered by technical schools.

## 2.2. Data collection

### *2.2.1. Open courses provided by business schools*

Open courses have been selected from 15 business schools, chosen according to the Financial Times European Business Schools Ranking[1] for the year 2019, and integrated with Italian business schools, in order to represent a better geographical benchmark for *Politecnico di Torino Specializing Masters Programmes and Lifelong Learning School*. A total amount of 760 open courses have been collected together with their respective variables. Variables of the dataset are described in Table 1.

[1] http://rankings.ft.com/businessschoolrankings/european-business-school-rankings-2019

Table 1. Description of variables for open courses held by business schools

| Variable name | Description | Unit | Expected sign |
|---|---|---|---|
| **PRICE** | Open courses price | € | |
| **TRIPLE_CROWN** | Existence of a Triple Crown Accreditation[2] | 0,1 | + |
| **DAYS** | Number of days of which an open course is composed | days | + |
| **REGION** | Geographical area in which open courses take place | categorical | |
| *SOUTH_EUROPE* | *Courses held in Spain or Italy* | *0,1* | *?* |
| *CENT_EUROPE* | *Courses held in France, Switzerland or Germany* | *0,1* | *?* |
| *NORTH_EUROPE* | *Courses held in the United Kingdom* | *0,1* | *?* |
| *EXTRA_EUROPE* | *Courses held outside Europe* | *0,1* | *+* |
| **FORMAT** | Modality through which a course is delivered | categorical | |
| *RESIDENTIAL* | *Courses provided entirely in a face-to-face mode* | *0,1* | *?* |
| *ONLINE* | *Courses which can wholly be attended online* | *0,1* | *-* |
| *BLENDED* | *Courses composed by online and residential parts* | *0,1* | *?* |
| **ENG** | If the open courses are held in English or not | 0,1 | + |
| **CERTIFICATION** | Grant of a certification[3] | 0,1 | + |
| **TOPIC** | Subject matter of the course | categorical | |
| *GENERAL_MANAG* | *Courses about general management* | *0,1* | *?* |
| *FUNCTIONAL* | *Functional courses* | *0,1* | *?* |
| *VERTICAL* | *Vertical courses* | *0,1* | *?* |

The table reports the name and description of variables, their unit measures and the expected effect on the final price: + and – represent respectively increasing and decreasing expected effects on the dependent variable PRICE, while the sign "?" indicates an undetermined expected sign. Three different types of variables can be distinguished: dichotomous variables

[2] Triple Crown Accreditation is a combination of the accreditations awarded by the three most influential business school accreditation organizations: the Association to Advance Collegiate Schools of Business (AACSB), the Association of MBAs (AMBA) and EFMD Quality Improvement System (EQUIS).

[3] Examples of certifications are Project Management Professional (PMP®) and Lean Six Sigma Green Belt.

(TRIPLE_CROWN, ENG and CERTIFICATION), which can only assume values equal to zero or one; categorical variables (REGION, FORMAT and TOPIC), that include groups of binary variables, and quantitative variables (DAYS and PRICE), which are measured in days[4] and euros respectively.

Concerning the topic, it is important to highlight the difference between the categories of topics collected. Courses have been divided according to three macro-topics, i.e. *functional courses*, aimed at building knowledge in fields such as finance, marketing or supply chain, whose general knowledge does not change in relation to the industrial sector to which a company belongs; *vertical courses*, aimed at forming attendees about management in relation to a specific sector, such as real estate, healthcare or food and beverage; and courses aimed at providing formation about *general management*.

Furthermore, indications referring to sub-topics as the ones mentioned above have been collected too, in order to be used to extrapolate additional information.

### *2.2.2. Masters provided by business schools*

Master programs have been collected from 17 business schools, chosen according to the criteria selected in the case of open courses, with some narrow differences due to the diversity of programs offered by each business school. For each master, the following variables have been gathered, as shown in Table 2.

[4] For those courses whose duration was expressed in hours or weeks, an equivalence of 8 hours per day and 5 days per week has been adopted.

Table 2. Description of variables for masters held by business schools

| Variable name | Description | Unit | Expected sign |
|---|---|---|---|
| **PRICE** | Price of the master | € | |
| **TRIPLE_CROWN** | Existence of a Triple Crown Accreditation | 0,1 | + |
| **MONTHS** | Number of months of which a master is composed | days | + |
| **REGION** | Geographical area in which masters take place | categorical | |
| *SOUTH_EUROPE* | *Masters held in Spain or Italy* | *0,1* | *?* |
| *CENT_EUROPE* | *Masters held in France, Switzerland or Germany* | *0,1* | *?* |
| *NORTH_EUROPE* | *Masters held in the United Kingdom* | *0,1* | *?* |
| *EXTRA_EUROPE* | *Masters held outside Europe* | *0,1* | *+* |
| **BLENDED** | Whether the master is provided in a blended format or not | 0,1 | ? |
| **STRUCTURE** | Structure through which a master is provided | categorical | |
| *FULL-TIME* | *Masters which require a full-time attendance* | *0,1* | *?* |
| *PART_TIME* | *Masters which can be attended part-time* | *0,1* | *?* |
| *MODULAR* | *Masters which allow to choose modules* | *0,1* | *?* |
| **ENG** | If masters are held in English or not | 0,1 | + |
| **EXPERIENCE** | Minimum job experience required to join the master | years | + |
| **STAGE** | Existence of a stage or internship opportunity | 0,1 | + |
| **COMP_VISIT** | Existence of company visits | 0,1 | + |
| **YEAR_ABROAD** | Opportunity to spend a year abroad | 0,1 | + |
| **D_DEGREE** | Release of a double degree diploma | 0,1 | + |
| **INT_WEEK** | Opportunity to do an international trip | 0,1 | + |
| **TYPE** | Typology of master | categorical | |
| *MASTER* | *Specializing master* | *0,1* | *-* |
| *MBA* | *Master in Business Administration* | *0,1* | *+* |
| *EMBA* | *Executive Master in Business Administration* | *0,1* | *+* |
| *GEMBA* | *Global Executive Master in Business Administration* | *0,1* | *+* |
| **TOPIC** | Subject matter of the master | categorical | |
| *GENERAL_MANAG* | *Masters about general management* | *0,1* | *?* |
| *FUNCTIONAL* | *Functional masters* | *0,1* | *?* |
| *VERTICAL* | *Vertical masters* | *0,1* | *?* |

As exhibited by the table, the main differences with respect to variables collected for open courses are:

- the substitution of the categorical variable FORMAT with a single binary variable named BLENDED, due to the fact that no online masters have been collected;
- the introduction of a categorical variable indicating the structure of the master;
- a variable that indicates the minimum job experience required for joining a master program;
- indications about stages, company visits, years abroad, double degrees and international weeks;
- a categorical variable used to distinguish between diverse typologies of masters. Generally, specializing masters and MBAs are designed for recently graduated students or workers, while EMBAs and GEMBAs are thought to offer focused and specific formation to executives, with the latter being designed in order to offer an international view on business administration.

Finally, it should be mentioned that, also in this case, indications referring to sub-topics have been gathered.

### *2.2.3. Open courses provided by technical schools*

Two distinct datasets have been built for programs offered by technical schools too. The dataset created for open courses hosts data concerning 173 courses provided by nine different universities. Due to the lack of an officially recognized ranking of European technical universities, as it was for the case of the Financial Times ranking, technical schools have been chosen according to geographic proximity, in case of Italian universities, and international

reputation. Variables collected for open courses provided by technical universities are described in Table 3.

Table 3. Description of variables for open courses held by technical schools

| Variable name | | Description | Unit | Expected sign |
|---|---|---|---|---|
| **PRICE** | | Open courses price | € | |
| **HOURS** | | Number of hours of which an open course is composed | hours | + |
| **REGION** | | Geographical area in which open courses take place | categorical | |
| | *SOUTH_EUROPE* | *Courses held in Spain or Italy* | *0,1* | *?* |
| | *CENT_EUROPE* | *Courses held in France, Switzerland or Germany* | *0,1* | *?* |
| | *NORTH_EUROPE* | *Courses held in Netherlands or UK* | *0,1* | *?* |
| **ONLINE** | | If the course is entirely delivered online | 0,1 | |
| **ENG** | | If the open courses are held in English or not | 0,1 | + |
| **PROJECT** | | Existence of one or more project works | 0,1 | + |
| **TOPIC** | | Subject matter of the course | categorical | ? |

The table presents some slight differences with respect to the dataset built for open courses offered by business schools:

- a variable showing university accreditation is missing due to the lack of a recognized organization, as it was for the Triple Crown Accreditation;
- no open courses which take place outside Europe have been collected;
- only completely online or residential courses have been collected;
- differently from open courses and masters held by business schools, open courses held by technical schools have not been divided into macro-topics due to the greater diversity that characterizes each course. A plurality of topics has instead been identified, more precisely fifteen. They include topics such as environment, construction, cybersecurity et cetera.

### *2.2.4. Masters provided by technical schools*

Masters held by technical schools and universities, in the end, have been selected from 11 Italian and Swiss universities, chosen according to the criteria used in the case of open courses provided by technical schools. The summary of variables in the dataset is shown in Table 4.

Table 4. Description of variables for masters held by technical schools

| Variable name | Description | Unit | Expected sign |
|---|---|---|---|
| **PRICE** | Price of the master | € | |
| **MONTHS** | Number of months of which a master is composed | months | + |
| **SWI** | Whether the master is held by a Swiss or Italian university | 0,1 | + |
| **FORMAT** | Modality through which a master is delivered | | ? |
| *RESIDENTIAL* | *Masters provided entirely in a face-to-face mode* | *0,1* | *?* |
| *BLENDED* | *Masters composed by online and residential parts* | *0,1* | *?* |
| *ONLINE* | *Masters which can wholly be attended online* | *0,1* | *-* |
| **STRUCTURE** | Structure through which a master is provided | | |
| **FULL-TIME** | Masters which require a full-time attendance | 0,1 | ? |
| **PART-TIME** | Masters which can be attended part-time | 0,1 | ? |
| **MODULAR** | Masters which allow the choice of different modules | 0,1 | ? |
| **ENG** | If masters are held in English or not | 0,1 | + |
| **EXPERIENCE** | Minimum job experience required to join the master | years | + |
| **STAGE** | Existence of a stage or internship opportunity | 0,1 | + |
| **PROJECT** | Existence of one or more project works | 0,1 | + |
| **TYPE** | Typology of master | | |
| *MASTER_1* | *First-level master* | *0,1* | *-* |
| *MASTER_2* | *Second-level master* | *0,1* | *+* |
| *MAS* | *Master of Advanced Studies* | *0,1* | *?* |
| *DAS* | *Diploma of Advanced Studies* | *0,1* | *?* |
| *CAS* | *Certificate of Advanced Studies* | *0,1* | *?* |
| **TOPIC** | Subject matter of the master | categorical | ? |
| **UNIVERSITY** | University which provides the master | categorical | ? |

The major change with respect to variables collected in the previous datasets is represented by the variable related to geographical indications. The typology of university masters, in fact, is peculiar of Italian universities and represents a master program to be followed after having concluded the university path, as implemented by the Bologna process[5] [12]. The majority of European countries, instead, does not consider the existence of such masters. In those countries the term *master* is associated to master's degrees and it is used to indicate a formation program to be undertaken after the release of a bachelor diploma. The only exception is embodied by Switzerland, where it is customary for universities to offer specialization programs to be initiated after the master's degree. Hence, since Italy and Switzerland are the only countries which offer such a typology of programs, the geographical distinction has been labeled through a binary variable named SWI, equal to one for masters held by Swiss universities and zero for Italian universities programs.

Nevertheless, a difference between the two countries still exist, and it is depicted by the classification system used for master programs: Italian masters are divided into first-level and second-level masters while Swiss programs can be partitioned into MAS, CAS and DAS[6]. This information is contained in the variable TYPE of the dataset.

[5] The Bologna Process is a declaration that includes a series of agreements between European countries aimed at setting standards in higher-education qualifications. Actually, the Bologna Process was not implemented equally by signatory countries, thus leaving considerable differences in their education systems.

[6] Masters of Advanced Studies (MAS) are addressed to participants who have already achieved a master's degree and, usually, have previous work experience. Among Swiss programs, Masters of Advanced Studies are the most similar to Italian masters. Certificates of Advanced Studies (CAS) are usually shorter programs and tackle more specialized topics. Many CAS programs are sometimes combined in MAS. Diplomas of Advanced Studies (DAS) are in-between MAS and CAS. They usually last one year and require a final written examination and, most of the times, an oral dissertation.

Furthermore, as for open courses held by technical universities, topics have not been clustered. Instead, 18 different topics have been collected, from cybersecurity and IoT to biomedicine and healthcare.

Lastly, due to the exiguous number of universities analyzed, information regarding the university which offer the masters have been collected too, in order to evaluate possible influences played by individual universities on the final price.

## 2.3. Hedonic pricing method

Masters and open courses are characterized by a plurality of features, such as duration, language, place, structure, format, topic et cetera. These factors are responsible for the variation in the price of the program, so that, when these characteristics change, a correspondent change in price occurs, according to a certain ratio. The instrument that is often used for evaluating these changes in price is the hedonic pricing method. The hedonic pricing method is based on the premise according to which the prices of different items are functions of measurable characteristics. Even if this method finds it best application in the housing market due to the plurality of internal and external factors affecting housing transaction prices [13], [14], it is however widely applied in a wide range of industrial sectors. The traditional hedonic pricing model is the following:

$$P = f(x_{1,}x_{2,}, \dots, x_n) \qquad (1)$$

where $P$ is the price and $x_{1,}x_{2,} \dots, x_n$ are variables indicating characteristics of the good or service. These characteristics are usually related to the price variation by applying multiple regression. However, there is no traditional guidance on which are the exact relations between these variables and the

price, since the relation depends on the distribution of the variables collected in a dataset. In this study, for each dataset, linear and semi-logarithmic models will be developed, with the objective of finding the most exact representation of the price change for each category of learning course. In particular, when the relationship between variables and price is assumed to be linear, the hedonic pricing model is expressed as:

$$PRICE = \alpha + a_1 x_1 + a_2 x_2 + \cdots + a_n x_n \quad (2)$$

where $a$ is the constant and $a_1, a_2, \ldots, a_n$ are coefficients for each predictor $x_1, x_2, \ldots, x_n$. When the relationship is assumed to be logarithmic, instead, the model takes the following form:

$$logPRICE = \beta + b_1 log x_1 + b_2 log\, x_2 + \cdots + b_m log x_m + b_{m+1} x_{m+1} + \cdots + b_n x_n \quad (3)$$

where $\beta$ is the constant and $b_1, b_2, \ldots, b_m$ represent the price elasticity with respect to each log-transformed predictor, while variables $x_{m+1}, \ldots, x_n$ are not log-transformed.

# 3. Results and discussion

## 3.1. Open Courses provided by Business Schools

### *3.1.1. Correlation analysis and t-test*

The first dataset consists of 760 open courses offered by business schools, characterized by an average price equal to €5071,40 and an average duration of 6,02 days (Table 5). Among them, 454 (59,74%) courses are provided by triple-crowned business schools, 222 (29,21%) are held in English, 97 (12,76%) grant a certification and 490 (64,47%) are held in Southern Europe. The majority of courses, 553 (72,76%), are dispensed in a residential mode, and a considerable slice of dataset consisting of 602 (79,21%) courses is composed by functional courses (Table 6).

In order to evaluate the factors that cause a significant change on the final price, different kinds of analyses have been carried out for each independent variable, depending on their type.

First of all, a correlation analysis has been performed between the dependent variable PRICE and the only quantitative variable in the dataset, DAYS (Table 7). The result, in line with expectations, exhibits a significant positive price dependence on the number of days that set up an open course (Figure 1).

Then, each categorical variable, namely REGION, FORMAT and TOPIC, has been object of a Bonferroni test[7], with the aim of evaluating eventual differences between the means of each pair of groups internal to these categorical variables.

[7] The Bonferroni test is a correction for multiple comparisons. It consists in correcting the significance level at which null hypotheses are tested by the value $a/m$ where $a$ is the significance level and $m$ is the number of hypotheses tested.

Table 5. Summary statistics for variables PRICE and DAYS

| Variable | Observations | Mean | Standard Deviation. | Min | Max |
|---|---|---|---|---|---|
| **PRICE** | 760 | 5.071 | 5.403 | 488 | 53.958 |
| **DAYS** | 760 | 6.017 | 5.210 | 0,5 | 60 |

Table 6. Summary statistics for dichotomous and categorical variables

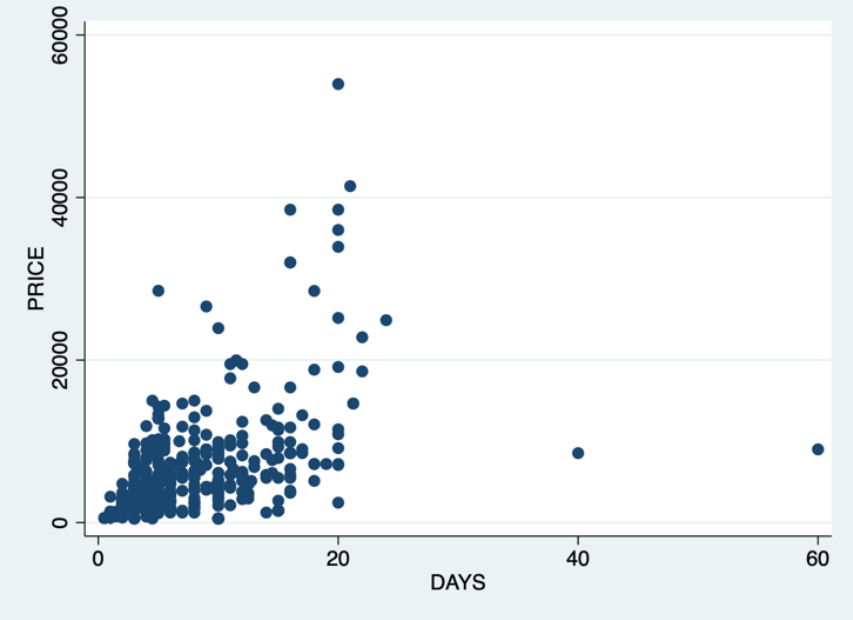
| Dichotomous variable | Frequency | Percentage | Cum. Perc. |
|---|---|---|---|
| **TRIPLE_CROWN** | | | |
| 0 | 306 | 40.26 | 40.26 |
| 1 | 454 | 59.74 | 100.00 |
| **ENG** | | | |
| 0 | 538 | 70.79 | 70.79 |
| 1 | 222 | 29.21 | 100.00 |
| **CERTIFICATION** | | | |
| 0 | 663 | 87.24 | 87.24 |
| 1 | 97 | 12.76 | 100.00 |
| **REGION** | | | |
| CENT_EUROPE | 209 | 27.50 | 27.50 |
| EXTRA_EUROPE | 30 | 3.95 | 31.45 |
| NORTH_EUROPE | 31 | 4.08 | 35.53 |
| SOUTH_EUROPE | 490 | 64.47 | 100.00 |
| **FORMAT** | | | |
| BLENDED | 122 | 16.05 | 16.05 |
| ONLINE | 85 | 11.18 | 27.24 |
| RESIDENTIAL | 553 | 72.76 | 100.00 |
| **TOPIC** | | | |
| FUNCTIONAL | 602 | 79.21 | 79.21 |
| GENERAL_MANAG | 80 | 10.53 | 89.74 |
| VERTICAL | 78 | 10.26 | 100.00 |

Table 7. Correlation analysis for variables PRICE and DAYS

| | **PRICE** | **DAYS** |
|---|---|---|
| **PRICE** | 1.0000 | |
| **DAYS** | **0.5316*** | 1.0000 |

*p-value = 0,0000

Figure 1. Scatter plot for variables PRICE and DAYS

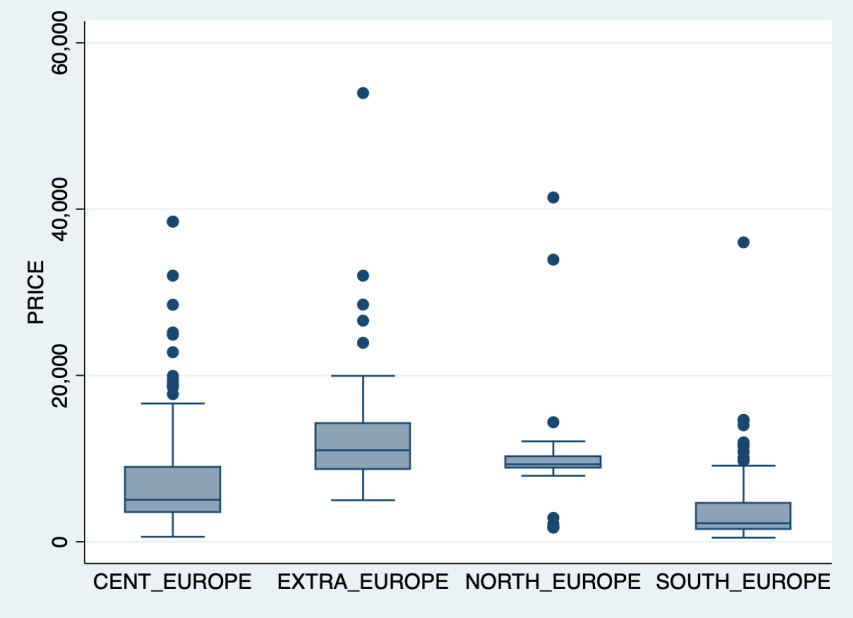



As regards the geographical area, the Bonferroni test highlights a significant difference between the means of all the pairs of groups. More specifically, higher prices are expected, on average, for courses which take place outside Europe, followed by courses held in Northern Europe, central Europe and Southern Europe respectively (Figure 2).

Table 8. Bonferroni test for the categorical variable REGION

| Row Mean - Col Mean | **CENT_EUROPE** | **EXTRA_EUROPE** | **NORTH_EUROPE** |
|---|---|---|---|
| **EXTRA_EUROPE** | 7593.46 | | |
| | 0.000 | | |
| **NORTH_EUROPE** | 3353.12 | -4240.34 | |
| | 0.001 | 0.003 | |
| **SOUTH_EUROPE** | -3511.02 | -11104.5 | -6864.15 |
| | 0.000 | 0.000 | 0.000 |

Figure 2. Boxplot for the categorical variable REGION




Looking at the format (Figure 3), instead, there are significant differences between the means of blended courses and online courses and between the means of residential courses and online courses, while the hypothesis according to which a difference exists between the means of blended and residential courses must be rejected (Table 9).

Figure 3. Boxplot for the categorical variable FORMAT

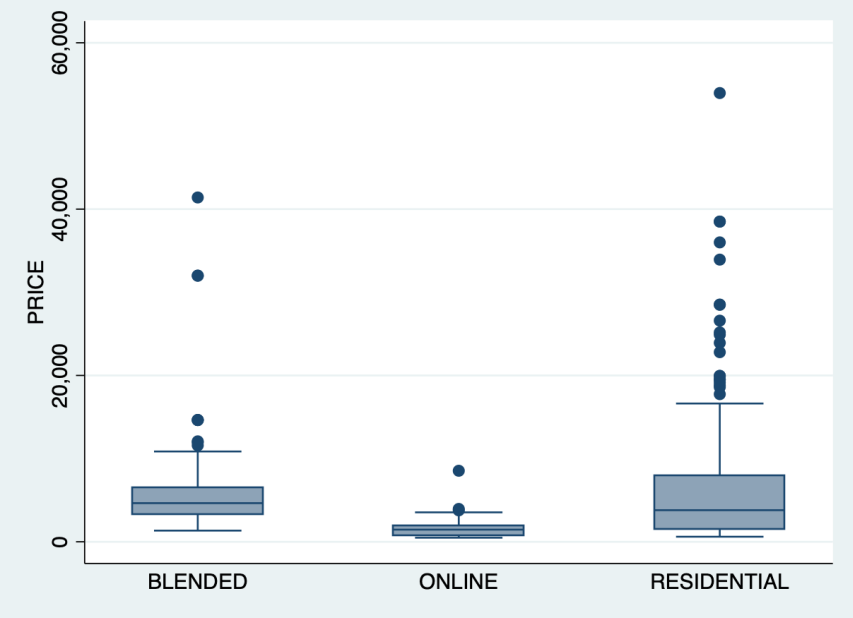


Table 9. Bonferroni test for the categorical variable FORMAT

| Row Mean - Col Mean | **BLENDED** | **ONLINE** |
|---|---|---|
| **ONLINE** | -4117.56 | |
| | 0.000 | |
| **RESIDENTIAL** | -315.724 | 3801.83 |
| | 1.000 | 0.000 |

Concerning topics (Figure 4), moreover, a significant difference is depicted between the means of functional and general management courses and the ones of vertical and general management courses, while the same cannot be stated regarding the difference between the means of functional and vertical courses (Table 10).

Figure 4. Boxplot for the categorical variable TOPIC

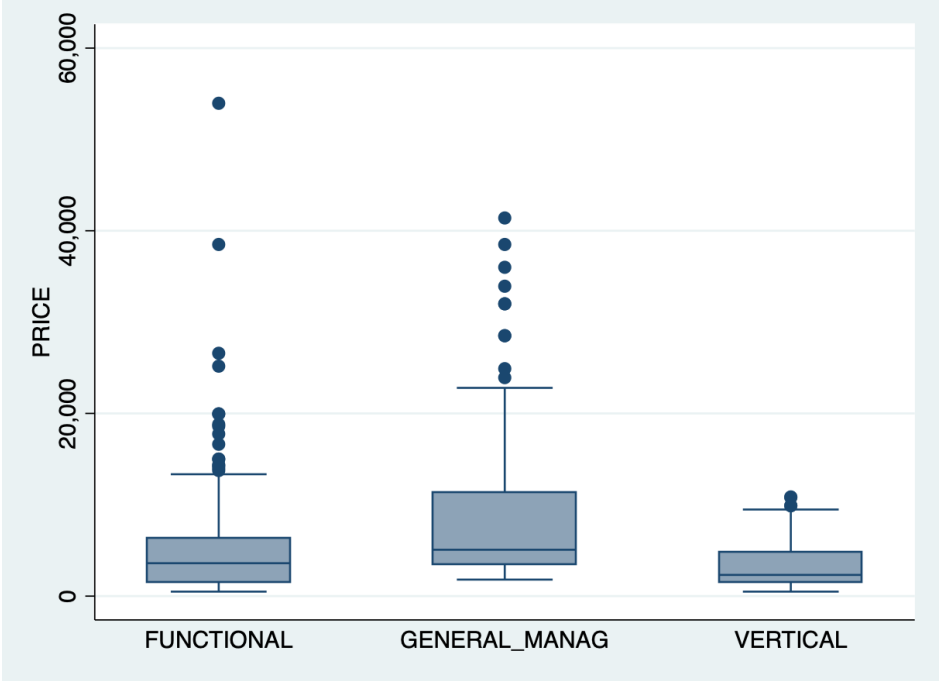



Table 10. Bonferroni test for the categorical variable TOPIC

| Row Mean - Col Mean | **FUNCTIONAL** | **GENERAL_MANAG** |
|---|---|---|
| **GENERAL_MANAG** | 4967.56 | |
| | 0.000 | |
| **VERTICAL** | -1177.9 | -6145.46 |
| | 0.175 | 0.000 |

In the case of topics, additionally, it is interesting to evaluate how the average duration changes when looking at different topics. Table 11 indicates a longer duration for courses about general management, followed by vertical courses and functional courses. Hence, in order to have a more precise analysis of the price variation with respect to topics, a variable called PRICE_PER_DAY has been created and applied in a new Bonferroni test. The output (Table 12) shows the existence of significant differences between the means of all different topics, and, more precisely, a day of a general management course is charged more than a day of a functional course that, in turn, is charged more than a day of a vertical course (Figure 5).

Table 11. Durations of open courses depending on different topics. Duration is expressed in days

| TOPIC | Mean | Standard Deviation | Frequency |
|---|---|---|---|
| **FUNCTIONAL** | 5,76 | 5,02 | 602 |
| **GENERAL_MANAG** | 8,01 | 6,21 | 80 |
| **VERTICAL** | 5,95 | 5,19 | 78 |
| Total | 6,02 | 5,21 | 760 |

Figure 5. Boxplot for the variable TOPIC normalized on duration

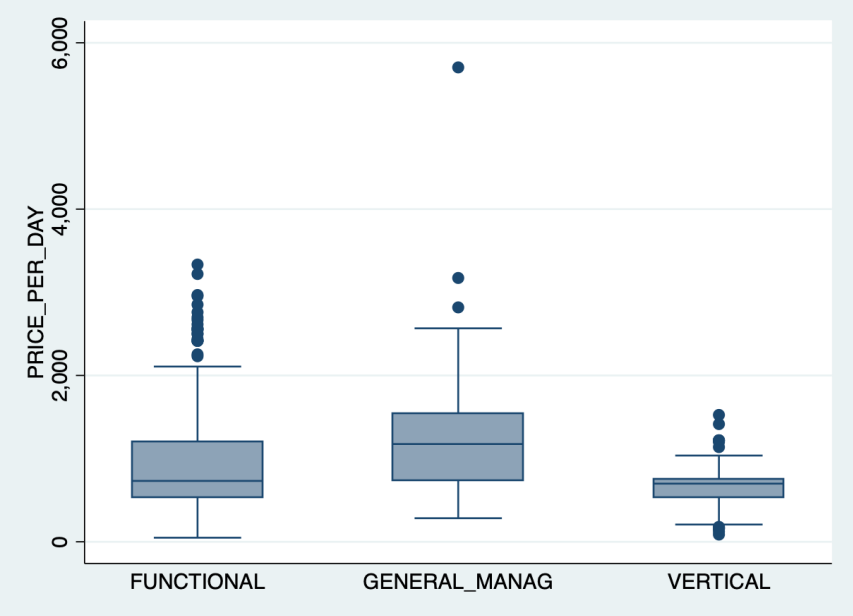


Table 12. Bonferroni test for the variable TOPIC normalized on duration

| Row Mean - Col Mean | **FUNCTIONAL** | **GENERAL_MANAG** |
|---|---|---|
| **GENERAL_MANAG** | 342.553 | |
| | 0.000 | |
| **VERTICAL** | -257.196 | -599.749 |
| | 0.001 | 0.000 |

Finally, in order to evaluate how the price of an open course changes in relation to dichotomous variables, t-tests have been performed for each variable of that kind, i.e. TRIPLE_CROWN, ENG and CERTIFICATION. As displayed in Table 13, all the t-tests exhibit a significant positive influence induced by each individual variable.

Table 13. t-Tests for dichotomous variables

| Dichotomous variable | t-Ratio | p-Value | Standard Error | 95% Confidence Interval |
|---|---|---|---|---|
| **TRIPLE_CROWN** | -10,784 | 0,000 | 372,350 | (-4746.338; -3284.418) |
| **ENG** | -11,697 | 0,000 | 396,950 | (-5422.178; -3863.674) |
| **CERTIFICATION** | -14,113 | 0,000 | 523,036 | (-8408.235; -6354.693) |

The categorical variables have then been reordered according to the values of the means displayed by the outputs shown above, in order to provide a better and more direct visualization in the following outputs. Furthermore, for an easier reading of the following outputs, it should be kept in mind that baselines for dichotomous variables consist in setting the value of the binary variable to zero, while SOUTH_EUROPE, RESIDENTIAL and FUNCTIONAL have been set as baselines[8] for categorical variables REGION, FORMAT and TOPIC respectively.

[8] The groups with the greater number of observations inside each categorical variable has been selected as baseline.

### *3.1.2. Hedonic pricing regression*

Once the abovementioned updates have been made, a first regression model has been created (Table 14). For this model, all the variables have been used, either quantitative (DAYS), binary (TRIPLE_CROWN, ENG and CERTIFICATION) and categorical (REGION, FORMAT and TOPIC), with these latter being displayed by respective groups.

Table 14. Regression model for open courses held by business schools

| Source | SS | df | MS | Number of obs | = | 760 |
|---|---|---|---|---|---|---|
| | | | | F(11, 748) | = | 133.19 |
| Model | 1.4668e+10 | 11 | 1.3335e+09 | Prob > F | = | 0.0000 |
| Residual | 7.4891e+09 | 748 | 10012209.1 | R-squared | = | 0.6620 |
| | | | | Adj R-squared | = | 0.6570 |
| Total | 2.2158e+10 | 759 | 29193190.7 | Root MSE | = | 3164.2 |

| PRICE | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| TRIPLE_CROWN | 1863.16 | 341.7914 | 5.45 | 0.000 | 1192.175 | 2534.144 |
| DAYS | 495.7408 | 23.24439 | 21.33 | 0.000 | 450.1088 | 541.3728 |
| ENG | 1410.135 | 350.2679 | 4.03 | 0.000 | 722.5097 | 2097.76 |
| CERTIFICATION | 3419.738 | 423.5506 | 8.07 | 0.000 | 2588.248 | 4251.227 |
| REGION_CODES | | | | | | |
| CENT_EUROPE | 255.8759 | 407.1133 | 0.63 | 0.530 | -543.3447 | 1055.097 |
| NORTH_EUROPE | 4190.079 | 692.5345 | 6.05 | 0.000 | 2830.536 | 5549.621 |
| EXTRA_EUROPE | 5149.855 | 741.6596 | 6.94 | 0.000 | 3693.873 | 6605.836 |
| FORMAT_CODES | | | | | | |
| ONLINE | -4008.674 | 379.6318 | -10.56 | 0.000 | -4753.944 | -3263.403 |
| BLENDED | 426.8319 | 364.0041 | 1.17 | 0.241 | -287.7593 | 1141.423 |
| TOPIC_CODES | | | | | | |
| VERTICAL | -849.7198 | 404.6199 | -2.10 | 0.036 | -1644.046 | -55.39401 |
| GENERAL_MANAG | 2658.039 | 389.0318 | 6.83 | 0.000 | 1894.315 | 3421.763 |
| _cons | -130.3837 | 237.7151 | -0.55 | 0.584 | -597.0517 | 336.2844 |

The output shows a satisfying coefficient of determination, or R-squared (66,20%), which indicates the fact that nearly two thirds of the variance of the dependent variable PRICE are predicted by the independent variables applied. It is also interesting to see that all predictors, with the exception of groups related to blended courses and courses held in central Europe, exhibit a p-

value lower than 0,05, meaning that each variable contributes significantly to the price variation, with the sign of such contribution given by the sign of the coefficient for each variable. Results are also in line with expectations, since they show that:

- triple-crowned business schools offer on average more expensive courses;
- the price grows with the duration of the course (nearly 500€ per day);
- courses held in English cost on average around 1400€ more than courses in other languages;
- the release of a certification contributes positively to the variation of the price;
- courses which take place in Southern Europe are cheaper than the ones attended in the rest of the world, even if this difference is not significant for courses held in central Europe;
- the analysis of topics reflects what already demonstrated by the Bonferroni test, with the lack of a significant difference between blended and residential courses, while the negative contribution by the group ONLINE is confirmed;
- courses about general management are on average more expensive than functional and vertical courses.

Table 15 displays the standardized coefficients, or standardized betas, obtained by multiplying each coefficient by its corresponding standard deviation and dividing by the standard deviation of the dependent variable PRICE. Standardized betas are useful to determine which variables have the greater effect on the variation of price, both positively and negatively. The output highlights a remarkable influence played by the duration (beta = 0,48), followed by the release of a certification and the geographical area, especially for courses that are provided in Northern Europe and outside Europe.

Concerning the format, the model is highly influenced by courses dispended online, while, about topics, it can be stated that only general management courses have the potential to heavily influence the price.

Table 15. Regression model with standardized beta coefficients

| Source | SS | df | MS | Number of obs | = | 760 |
|---|---|---|---|---|---|---|
| | | | | F(11, 748) | = | 133.19 |
| Model | 1.4668e+10 | 11 | 1.3335e+09 | Prob > F | = | 0.0000 |
| Residual | 7.4891e+09 | 748 | 10012209.1 | R-squared | = | 0.6620 |
| | | | | Adj R-squared | = | 0.6570 |
| Total | 2.2158e+10 | 759 | 29193190.7 | Root MSE | = | 3164.2 |

| PRICE | Coef. | Std. Err. | t | P>\|t\| | Beta |
|---|---|---|---|---|---|
| TRIPLE_CROWN | 1863.16 | 341.7914 | 5.45 | 0.000 | .1692272 |
| DAYS | 495.7408 | 23.24439 | 21.33 | 0.000 | .47803 |
| ENG | 1410.135 | 350.2679 | 4.03 | 0.000 | .1187572 |
| CERTIFICATION | 3419.738 | 423.5506 | 8.07 | 0.000 | .2113328 |
| REGION_CODES | | | | | |
| CENT_EUROPE | 255.8759 | 407.1133 | 0.63 | 0.530 | .0211597 |
| NORTH_EUROPE | 4190.079 | 692.5345 | 6.05 | 0.000 | .1534965 |
| EXTRA_EUROPE | 5149.855 | 741.6596 | 6.94 | 0.000 | .1857157 |
| FORMAT_CODES | | | | | |
| ONLINE | -4008.674 | 379.6318 | -10.56 | 0.000 | -.233988 |
| BLENDED | 426.8319 | 364.0041 | 1.17 | 0.241 | .0290187 |
| TOPIC_CODES | | | | | |
| VERTICAL | -849.7198 | 404.6199 | -2.10 | 0.036 | -.0477581 |
| GENERAL_MANAG | 2658.039 | 389.0318 | 6.83 | 0.000 | .1510749 |
| _cons | -130.3837 | 237.7151 | -0.55 | 0.584 | . |

The possible existence of collinearity has been analyzed by means of the Variance Inflation Factor (VIF)[9]. The low values displayed for all the predictors deny any possible collinearity among variables (Table 16).

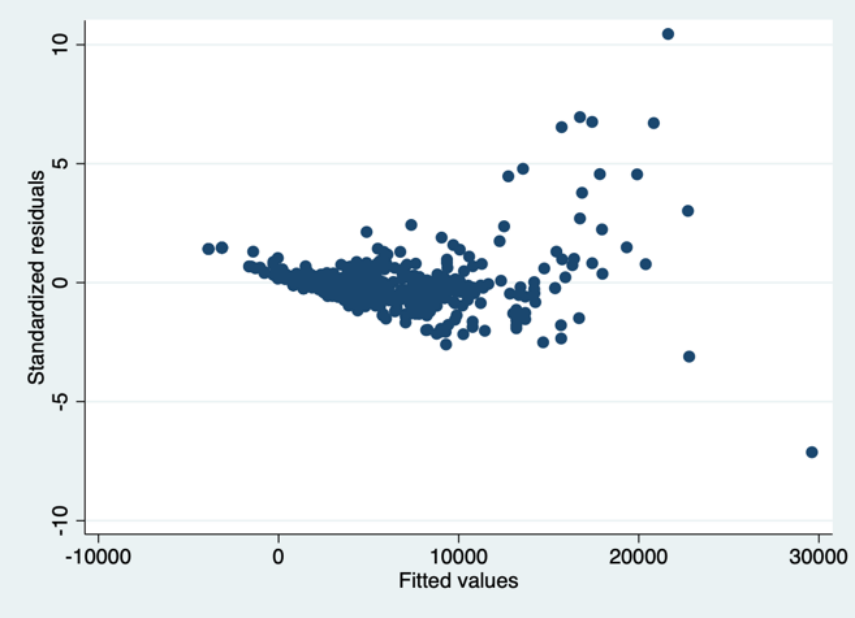
[9] The Variance Inflation Factor is an index used to quantify the effects of collinearity in multiple regression analyses. It measures how much the variance of a regression coefficient is due to collinearity with other variables. There is not a precise rule that states which values of VIF are connected with high multicollinearity; however, a rule of thumb is that multicollinearity is high for VIFs greater than 10.

Table 16. Variance Inflation Factors for independent variables

| Variable | VIF | 1/VIF |
|---|---|---|
| TRIPLE_CROWN | 2.13 | 0.468861 |
| DAYS | 1.11 | 0.899434 |
| ENG | 1.93 | 0.519287 |
| CERTIFICAT~N | 1.52 | 0.659550 |
| REGION_CODES | | |
| 2 | 2.51 | 0.398671 |
| 3 | 1.42 | 0.702056 |
| 4 | 1.58 | 0.631670 |
| FORMAT_CODES | | |
| 2 | 1.09 | 0.920228 |
| 3 | 1.36 | 0.737820 |
| TOPIC_CODES | | |
| 2 | 1.14 | 0.873715 |
| 3 | 1.08 | 0.924218 |
| Mean VIF | 1.53 | |

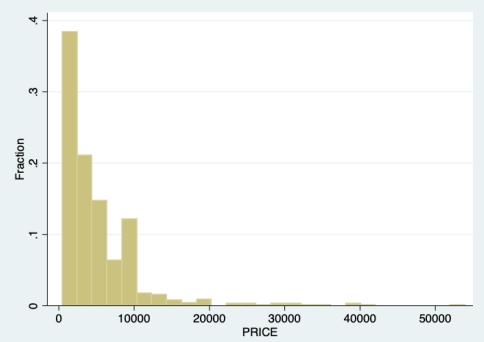
Looking at the analysis of residuals, however, a specification issue emerges. As depicted in Figure 6, residuals are not normally distributed. They instead follow a divergent trend that becomes more evident for greater prices. In this case, the model is said to be affected by heteroskedasticity, which can be explained as a different degree of fit for courses with a lower price, which are present in bigger number in the dataset, with respect to courses with a higher price.

Figure 6. Plot of standardized residuals according to the regression model of Table 14



This trend could be inspected also by looking at histograms for variable PRICE and DAYS, that are the only quantitative variables that compose the model (Figure 7 and 8, left). Both histograms show higher frequencies for lower prices (respectively days) and a progressive decrease in frequencies for higher prices (respectively days). An additional confirmation of this non-normal distribution is given by the analysis of percentiles (Figure 7 and 8, right), whose related values exhibit much greater dispersions for higher percentiles with respect to lower ones.

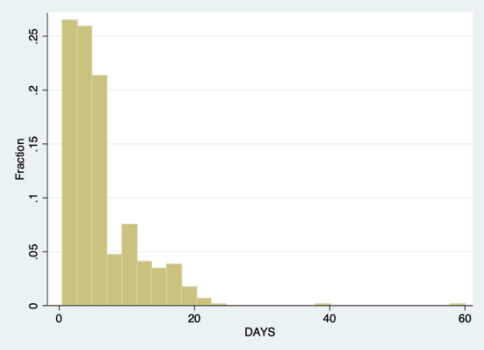
Figure 7. Frequency distribution and percentiles values for PRICE




PRICE

| | Percentiles | Smallest | | |
|---|---|---|---|---|
| 1% | 488 | 488 | | |
| 5% | 963 | 488 | | |
| 10% | 1464 | 488 | Obs | 760 |
| 25% | 1464 | 488 | Sum of Wgt. | 760 |
| 50% | 3660 | | Mean | 5071.397 |
| | | Largest | Std. Dev. | 5403.072 |
| 75% | 6771 | 38500 | | |
| 90% | 9756 | 38500 | Variance | 2.92e+07 |
| 95% | 12834 | 41400 | Skewness | 3.591793 |
| 99% | 32000 | 53958 | Kurtosis | 22.50881 |

Figure 8. Frequency distribution and percentiles values for DAYS




DAYS

| | Percentiles | Smallest | | |
|---|---|---|---|---|
| 1% | 1 | .5 | | |
| 5% | 2 | .5 | | |
| 10% | 2 | .5 | Obs | 760 |
| 25% | 2 | .5 | Sum of Wgt. | 760 |
| 50% | 4 | | Mean | 6.017434 |
| | | Largest | Std. Dev. | 5.210042 |
| 75% | 8 | 22 | | |
| 90% | 13.5 | 24 | Variance | 27.14454 |
| 95% | 16 | 40 | Skewness | 2.812423 |
| 99% | 21 | 60 | Kurtosis | 20.34615 |

In order to solve this specification issue and deal with normally distributed variables, a logarithmic transformation has been made for variables PRICE and DAYS.

A new regression model has then been developed, with the only difference being represented by the substitution of variables PRICE and DAYS with logPRICE and logDAYS respectively (Table 17).

Table 17. Logarithmic regression model for open courses held by business schools

| Source | SS | df | MS | Number of obs | = | 760 |
|---|---|---|---|---|---|---|
| | | | | F(11, 748) | = | 328.90 |
| Model | 477.956625 | 11 | 43.4506023 | Prob > F | = | 0.0000 |
| Residual | 98.8173903 | 748 | .132108811 | R-squared | = | 0.8287 |
| | | | | Adj R-squared | = | 0.8262 |
| Total | 576.774015 | 759 | .759913064 | Root MSE | = | .36347 |

| logPRICE | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| TRIPLE_CROWN | .4547287 | .0390523 | 11.64 | 0.000 | .3780635 | .5313939 |
| logDAYS | .6495321 | .0186021 | 34.92 | 0.000 | .6130135 | .6860506 |
| ENG | .1742192 | .0402376 | 4.33 | 0.000 | .0952272 | .2532113 |
| CERTIFICATION | .3229298 | .0489532 | 6.60 | 0.000 | .2268277 | .4190319 |
| REGION_CODES | | | | | | |
| CENT_EUROPE | .1046063 | .0467398 | 2.24 | 0.026 | .0128494 | .1963631 |
| NORTH_EUROPE | .5334513 | .0797497 | 6.69 | 0.000 | .3768914 | .6900113 |
| EXTRA_EUROPE | .5312786 | .0852101 | 6.23 | 0.000 | .3639991 | .698558 |
| FORMAT_CODES | | | | | | |
| ONLINE | -1.108215 | .0435475 | -25.45 | 0.000 | -1.193704 | -1.022725 |
| BLENDED | .1151701 | .0418572 | 2.75 | 0.006 | .0329984 | .1973417 |
| TOPIC_CODES | | | | | | |
| VERTICAL | -.2907685 | .0464293 | -6.26 | 0.000 | -.3819158 | -.1996212 |
| GENERAL_MANAG | .2092849 | .0445369 | 4.70 | 0.000 | .1218526 | .2967172 |
| _cons | 6.847479 | .0340223 | 201.26 | 0.000 | 6.780688 | 6.914269 |

The new model is drastically different from the previous one and could look tough to read at first sight. In order to understand it, it is important to underline some crucial points:

- all the coefficients have decreased remarkably, due to the change in the dependent variable function, which is now expressed as a logarithm of price;
- the intercept is now given by the logarithm of price when all the dependent variables are set to zero or are represented by their baselines;
- the coefficient of the variable logDAYS indicates the percentage variation in price for a percentage variation in the number of days;

- as concerns all the other variables, the coefficient represents the percentage variation in price in relation to the change in the binary variables.

Besides the abovementioned points, the first thing that stands out is that all the variables used in the log-log regression model exhibit a significant influence on the price of the course. The only factors with a negative contribution, relatively to the chosen baselines, are the online format and the vertical structure.

Furthermore, the R-squared has considerably increased, and it indicates nearly an 83% explanation of the variance of the price. The analysis of standardized betas confirms the influence shown by the duration, that has even increased after the logarithmic transformation of the predictor DAYS (Table 18).

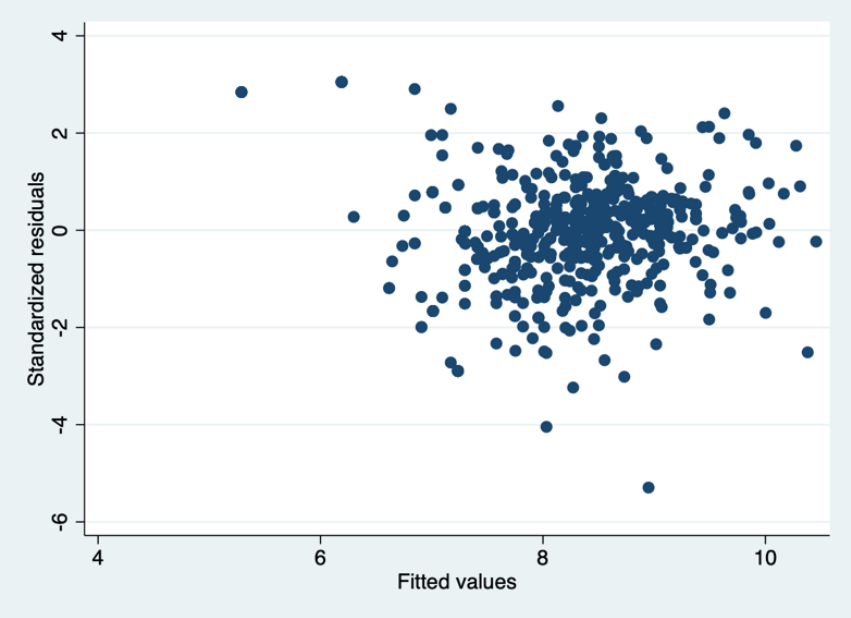
Table 18. Logarithmic regression model with standardized beta coefficients

| Source | SS | df | MS | Number of obs | = | 760 |
|---|---|---|---|---|---|---|
| | | | | F(11, 748) | = | 328.90 |
| Model | 477.956625 | 11 | 43.4506023 | Prob > F | = | 0.0000 |
| Residual | 98.8173903 | 748 | .132108811 | R-squared | = | 0.8287 |
| | | | | Adj R-squared | = | 0.8262 |
| Total | 576.774015 | 759 | .759913064 | Root MSE | = | .36347 |

| logPRICE | Coef. | Std. Err. | t | P>\|t\| | Beta |
|---|---|---|---|---|---|
| TRIPLE_CROWN | .4547287 | .0390523 | 11.64 | 0.000 | .2559949 |
| logDAYS | .6495321 | .0186021 | 34.92 | 0.000 | .5616346 |
| ENG | .1742192 | .0402376 | 4.33 | 0.000 | .0909398 |
| CERTIFICATION | .3229298 | .0489532 | 6.60 | 0.000 | .1236919 |
| REGION_CODES | | | | | |
| CENT_EUROPE | .1046063 | .0467398 | 2.24 | 0.026 | .0536163 |
| NORTH_EUROPE | .5334513 | .0797497 | 6.69 | 0.000 | .1211239 |
| EXTRA_EUROPE | .5312786 | .0852101 | 6.23 | 0.000 | .1187503 |
| FORMAT_CODES | | | | | |
| ONLINE | -1.108215 | .0435475 | -25.45 | 0.000 | -.4009365 |
| BLENDED | .1151701 | .0418572 | 2.75 | 0.006 | .0485311 |
| TOPIC_CODES | | | | | |
| VERTICAL | -.2907685 | .0464293 | -6.26 | 0.000 | -.1012925 |
| GENERAL_MANAG | .2092849 | .0445369 | 4.70 | 0.000 | .0737272 |
| _cons | 6.847479 | .0340223 | 201.26 | 0.000 | . |

However, the most notable improvement compared to the previous regression model concerns the degree of fit of the log-log model. The residuals plot, in fact, has completely been reshaped, as displayed in Figure 9. Residuals are now more normally distributed and heteroskedasticity has remarkably decreased.

Figure 9. Plot of standardized residuals according to the regression model of Table 17




With the aim of identifying potential changes in collinearity between predictors, the variance inflation factor (VIF) has newly been computed. The related output exhibits again a slow multicollinearity between variables, index that predictors are not highly correlated with each other (Table 19).

Finally, notwithstanding the transformation of the regression model, it should however be noted that the distribution of residuals is still characterized by some imperfections that violate the assumption of normality. First of all, even if the heteroskedasticity issue that affected the first model has been considerably corrected, a partial heteroskedasticity phenomenon still remains.

Moreover, Cameron & Trivedi's decomposition of IM-test[10] also exhibits high kurtosis and skewness[11] in the distribution of residuals, meaning that the distribution does not follow a perfectly shaped normal curve.

Table 19. Variance Inflation Factors for independent variables applied in the logarithmic model

| Variable | VIF | 1/VIF |
|---|---|---|
| TRIPLE_CROWN | 2.11 | 0.473886 |
| logDAYS | 1.13 | 0.885311 |
| ENG | 1.93 | 0.519213 |
| CERTIFICAT~N | 1.53 | 0.651474 |
| REGION_CODES | | |
| 2 | 2.51 | 0.399092 |
| 3 | 1.43 | 0.698550 |
| 4 | 1.58 | 0.631421 |
| FORMAT_CODES | | |
| 2 | 1.08 | 0.922775 |
| 3 | 1.36 | 0.736248 |
| TOPIC_CODES | | |
| 2 | 1.14 | 0.875552 |
| 3 | 1.07 | 0.930477 |
| Mean VIF | 1.53 | |

Table 20. Cameron & Trivedi's decomposition of IM-test

| Source | chi2 | df | p |
|---|---|---|---|
| Heteroskedasticity | 316.41 | 54 | 0.0000 |
| Skewness | 37.89 | 11 | 0.0001 |
| Kurtosis | 10.12 | 1 | 0.0015 |
| Total | 364.42 | 66 | 0.0000 |

Anyway, values for kurtosis, skewness and heteroskedasticity might be mainly due to the high population of the dataset, which brings with it the unavoidable presence of some outliers. This said, it can be concluded that the log-log

[10] IM-test, or White test, is a test aimed at identifying whether the variance of errors in a regression model is constant or not. In the former case, the model is said to be homoscedastic, while, in the latter, there is the presence of heteroskedasticity.

[11] Skewness and kurtosis measure the shape of probability distributions. In particular, the skewness measures the symmetry of a probability distribution referred to its mean, while the kurtosis gives a measure of the flatness of the distribution.

regression model can be selected for a realistic representation of the price change in the case of open courses held by business schools.

Trying to go further in this analysis, also individual topics have been analyzed, with the objective of demonstrating additional influence played by subjects on the final price. As explained in Chapter 2 when illustrating variables collected in the dataset, courses have been assigned values related to macro-topics (functional, vertical and general management) and to what could be called sub-topics, indicating more exactly what are the main subjects taught in each course (e.g. business law, finance or project management).

In order to analyze eventual significant influences on the price of open courses, t-tests have been performed for each variable indicating a different subject. Concerning functional courses, curiously, the only two variables which suggest a significant positive influence on the price are strategy and leadership and change management (Table 21). Although they still represent functional subjects, they are also the more connected with the general management topic. This would confirm the results exhibited by previously shown regression models, according to which courses about general management are more expensive than functional courses.

The same approach has been followed for vertical courses, i.e. those courses whose aim is to train participants working in a specific industrial sector. In this case, t-tests show a positive significant contribution to the price variation played by the variable related to courses about real estate management, while courses about fashion management seem to have a negative influence on the price (Table 22).

Table 21. T-tests for topics of functional courses. Significative variables are indicated in bold

| Dichotomous variable | t-Ratio | p-Value | Standard Error | 95% Confidence Interval |
|---|---|---|---|---|
| **Leadership & Change Man.** | **-4,4643** | **0.0000** | **471,0** | **(-3027.5; -1177.6)** |
| **Strategy** | **-2,6778** | **0.0076** | **761,6** | **(-3535.1; -543.7)** |
| **Supply Chain & Manufact.** | **2,1055** | **0.0357** | **661,9** | **(93.7; 2693.7)** |
| Social Impact & Sustainab. | 1,6451 | 0.1005 | 1162,9 | (-370.7; 4196.8) |
| Marketing & Sales | 1,4684 | 0.1425 | 489,2 | (-242.4; 1679.1) |
| Digital Transf. & Innovation | 1,4590 | 0.1451 | 506,3 | (-255.6; 1732.9) |
| Project Management | 1,3640 | 0.1731 | 909,2 | (-545.4; 3025.6) |
| Human Res. & Coaching | 1,3198 | 0.1874 | 755,3 | (-486.5; 2480.1) |
| Finance & Accounting | -0,9664 | 0.3342 | 516,3 | (-1512.8; 515.0) |
| Data Analytics | 0,6554 | 0.5125 | 848,1 | (-1109.8; 2221.4) |
| Business Law | 0,5447 | 0.5862 | 1205,1 | (-1710.2; 3023.0) |
| Entrepreneurship | 0,4709 | 0.6379 | 1066,5 | (-1592.3; 2596.6) |
| Int. Business & Economics | -0,1742 | 0.8617 | 1299,7 | (-2778.9; 2326.0) |

Table 22. T-tests for topics of vertical courses. Significative variables are indicated in bold

| Dichotomous variable | t-Ratio | p-Value | Standard Error | 95% Confidence Interval |
|---|---|---|---|---|
| **Real Estate** | **-2,8024** | **0.0064** | **760,4** | **(-3645.4; -616.5)** |
| **Fashion** | **2,4205** | **0.0179** | **1216,9** | **(521.8; 5369.0)** |
| Public Administration | 1,8527 | 0.0678 | 1030,3 | (-143.2; 3960.9) |
| Luxury | -0,9497 | 0.3453 | 2116,5 | (-6225.5; 2205.4) |
| Energy | 0,6115 | 0.5427 | 1004,1 | (-1385.9; 2613.9) |
| Sport | 0,5166 | 0.6069 | 1523,0 | (-2246.5; 3820.2) |
| Healthcare | 0,4116 | 0.6818 | 706,6 | (-1116.4; 1698.1) |

### *3.1.3. Discussion*

Regression models performed in this chapter have returned interesting results. Both models have demonstrated that all variables applied give a significant contribution to the price variation of open courses provided by business schools. The main drivers affecting the price have been found to be the duration of the course, the existence of a Triple Crown Accreditation for the business school and the format of the program, whose expected price decreases considerably for online courses.

Notwithstanding the similarity concerning results exhibited by the two models, the logarithmic transformed model appears to be the best in terms of fit. The log-log model indeed mitigates the bias caused by higher-priced courses, offering a better representation of price drivers.

Interestingly, the analysis of individual topics supports the results exhibited by the regression models. It has been demonstrated, in fact, that open courses about general management present a significantly higher price compared to other courses. Hence, the findings according to which, among functional courses, topics which are responsible for a higher expected price are strategy and leadership, enhance the results found in the regression analysis.

## 3.2. Masters provided by Business Schools

### *3.2.1. Correlation analysis and t-test*

The dataset built for masters offered by business schools consists of 262 masters characterized by an average price of €29.012,12. The average duration is 14,26 months, even if it is important to highlight that 151 (57,63%) masters have a length equal to 12 months. The average job experience required amounts to 0,88 years, but it should be pointed out that 83 masters do not provide data about it and 131 (73,18% of observations) masters do not require experience to enroll (Table 23). Among the 262 programs, then, 98 (37,40%) are supplied by business schools awarded with a Triple Crown Accreditation, 40 (15,27%) are channeled in a blended mode and 136 (51,91%) are held in English. Furthermore, the majority of masters, 178 (67,94%), takes place in Southern Europe, while the remaining ones are divided between Central Europe, Northern Europe and the rest of the world. As concerns the format, 178 (67,94%) programs require a full-time dedication, while, regarding the typology, 199 (75,95%) are specializing masters. Moreover, the dataset consists of 150 (57,25%) functional masters, 62 (23,66%) masters about general management and 50 (19,08%) vertical masters. Finally, 81 masters (30,92%) give the opportunity to do a stage, 56 (21,37%) involve company visits, 71 (27,10%) allow participants the choice to frequent a year abroad, 15 (5,73%) offer a double degree program and 59 (22,52%) involve international weeks or tours in other countries (Table 24).

Table 23. Summary statistics for variables PRICE, MONTHS and EXPERIENCE

| Variable | Observations | Mean | Standard Deviation | Min | Max | Mode (Obs.) |
|---|---|---|---|---|---|---|
| **PRICE** | 262 | 29012,12 | 23628,77 | 1159 | 185150 | |
| **MONTHS** | 262 | 14,26 | 5,01 | 4 | 36 | 12 (151) |
| **EXPERIENCE** | 179 | 0,88 | 1,82 | 0 | 10 | 0 (131) |

Table 24. Summary statistics for dichotomous and categorical variables

| Dichotomous variable | Frequency | Percentage | Cum. Perc. |
|---|---|---|---|
| **TRIPLE_CROWN** | | | |
| 0 | 164 | 62.60 | 62.60 |
| 1 | 98 | 37.40 | 100.00 |
| **ENG** | | | |
| 0 | 126 | 48.09 | 48.09 |
| 1 | 136 | 51.91 | 100.00 |
| **BLENDED** | | | |
| 0 | 222 | 84.73 | 84.73 |
| 1 | 40 | 15.27 | 100.00 |
| **STAGE** | | | |
| 0 | 181 | 69.08 | 69.08 |
| 1 | 81 | 30.92 | 100.00 |
| **COMP_VISIT** | | | |
| 0 | 206 | 78.63 | 78.63 |
| 1 | 56 | 21.37 | 100.00 |
| **YEAR_ABROAD** | | | |
| 0 | 191 | 72.90 | 72.90 |
| 1 | 71 | 27.10 | 100.00 |
| **D_DEGREE** | | | |
| 0 | 247 | 94.27 | 94.27 |
| 1 | 15 | 5.73 | 100.00 |
| **INT_WEEK** | | | |
| 0 | 203 | 77.48 | 77.48 |
| 1 | 59 | 22.52 | 100.00 |
| **REGION** | | | |
| SOUTH_EUROPE | 178 | 67.94 | 67.94 |
| CENT_EUROPE | 43 | 16.41 | 84.35 |
| NORTH_EUROPE | 15 | 5.73 | 90.08 |
| EXTRA_EUROPE | 26 | 9.92 | 100.00 |
| **STRUCTURE** | | | |
| FULL_TIME | 178 | 67.94 | 67.94 |
| PART_TIME | 58 | 22.14 | 90.08 |
| MODULAR | 26 | 9.92 | 100.00 |
| **TYPE** | | | |
| MASTER | 199 | 75.95 | 75.95 |
| MBA | 26 | 9.92 | 85.88 |
| EMBA | 28 | 10.69 | 96.56 |
| GEMBA | 9 | 3.44 | 100.00 |
| **TOPIC** | | | |
| VERTICAL | 50 | 19.08 | 19.08 |
| FUNCTIONAL | 150 | 57.25 | 76.34 |
| GENERAL_MANAG | 62 | 23.66 | 100.00 |

The analysis of correlations between continuous variables shows a high correlation between experience required and price, while a low correlation factor is displayed between price and duration. Low correlation is exhibited also between the independent variables MONTHS and EXPERIENCE. Correlation factors are exhibited in Table 25, while Figure 10 graphically displays the relation between the abovementioned variables.

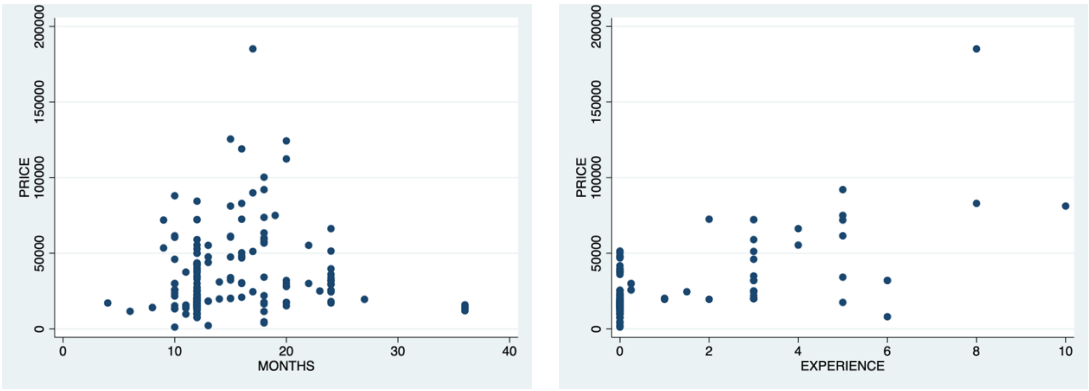
Table 25. Correlation matrix for quantitative variables PRICE, MONTHS and EXPERIENCE

| | PRICE | MONTHS | EXPERIENCE |
|---|---|---|---|
| **PRICE** | 1.0000 | | |
| **MONTHS** | 0.1535** | 1.0000 | |
| **EXPERIENCE** | 0.6558* | 0.1575** | 1.0000 |

*correlation significant at the 0,01 level (2-tailed)

** correlation significant at the 0,05 level (2-tailed)

Figure 10. Scatter plots for MONTHS and PRICE (left) and EXPERIENCE and PRICE (right)



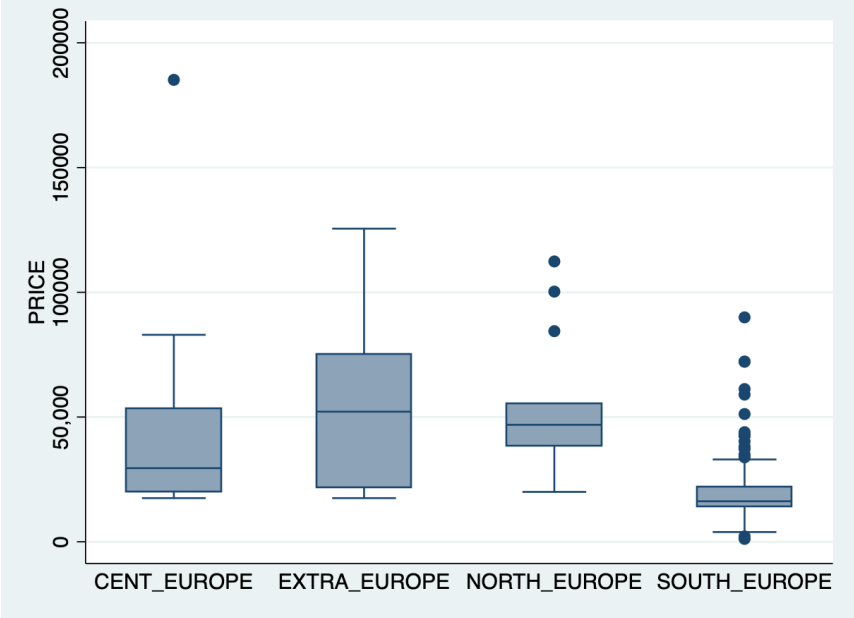

As done in the case of open courses, Bonferroni tests have been carried out for categorical variables with the purpose of studying potential differences among groups pertaining to the same variable.

The Bonferroni test for the variable REGION (Table 26) depicts a significant difference between all pairs of means, with the exception of NORTH_EUROPE and CENT_EUROPE and NORTH_EUROPE and EXTRA_EUROPE (Figure 11).

Table 26. Bonferroni test for the categorical variable REGION

| Row Mean - Col Mean | **CENT_EUROPE** | **EXTRA_EUROPE** | **NORTH_EUROPE** |
|---|---|---|---|
| **EXTRA_EUROPE** | 16026.8 | | |
| | 0.007 | | |
| **NORTH_EUROPE** | 12693.1 | -3333.71 | |
| | 0.199 | 1.000 | |
| **SOUTH_EUROPE** | -19346.4 | -35373.2 | -32039.5 |
| | 0.000 | 0.000 | 0.000 |

Figure 11. Boxplot for the categorical variable REGION

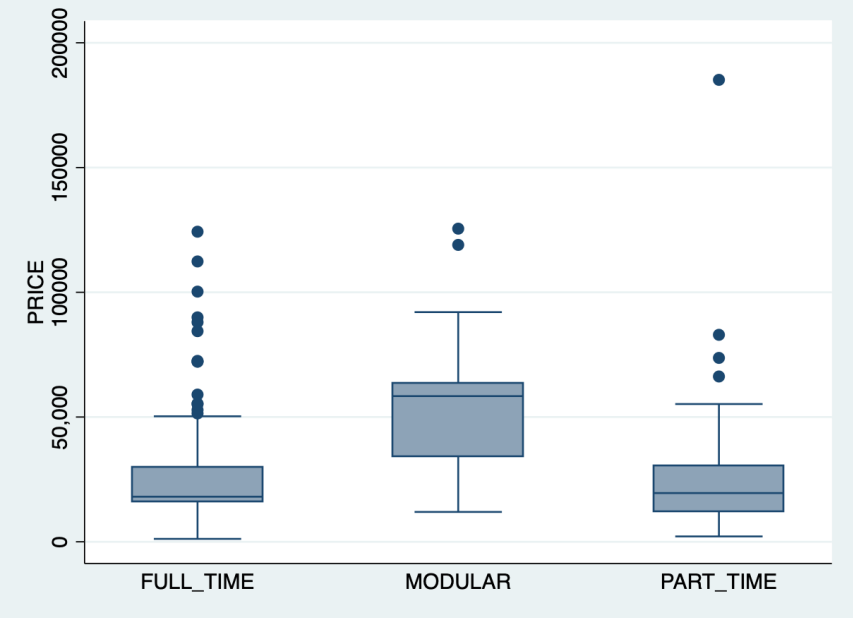



In the case of the structure of masters (Figure 12), the Bonferroni test exhibits a significant difference between means of modular masters and both full-time and part-time masters, while the hypothesis according to which there is a difference between average price of full-time and part-time masters must be rejected (Table 27).

Table 27. Bonferroni test for the categorical variable STRUCTURE

| Row Mean - Col Mean | **FULL_TIME** | **MODULAR** |
|---|---|---|
| **MODULAR** | 28471 | |
| | 0.000 | |
| **PART-TIME** | -375.073 | -28846.0 |
| | 1.000 | 0.000 |

Figure 12. Boxplot for the categorical variable STRUCTURE




Concerning the type of masters (Figure 13), it is possible to notice that there is a significant difference about all pairs of means, with the exception of the pair MBA-EMBA, where, even if the difference between the average price seems to be remarkably in favor of EMBAs, this cannot be stated at a confidence interval of 95% (Table 28).

Figure 13. Boxplot for the categorical variable TYPE

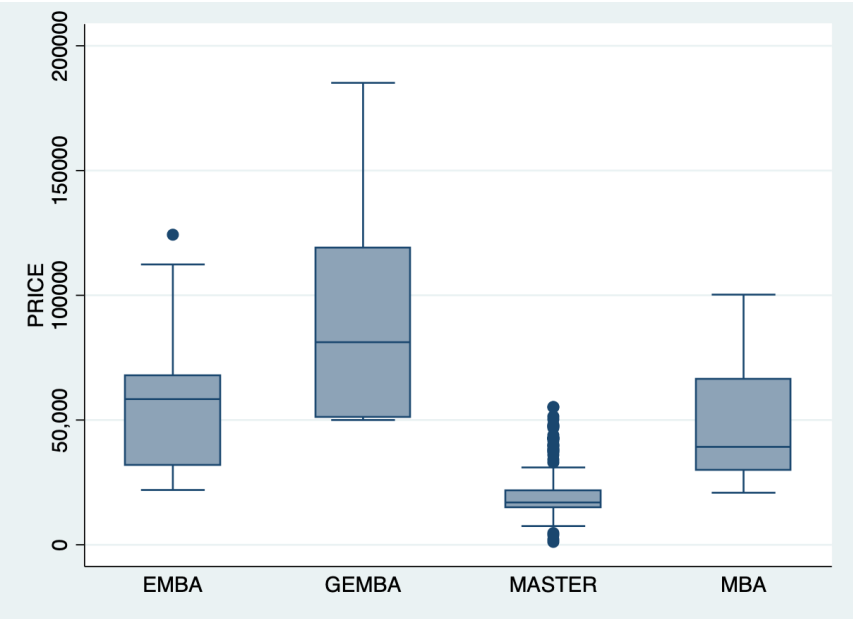


Table 28. Bonferroni test for the categorical variable TYPE

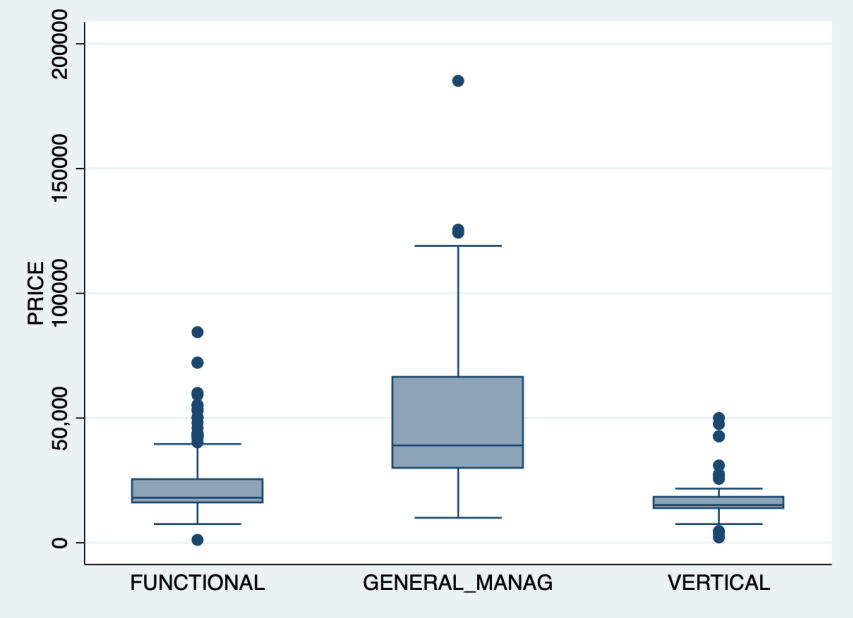
| Row Mean - Col Mean | EMBA | GEMBA | MASTER |
|---|---|---|---|
| **GEMBA** | 34220.6 | | |
| | 0.000 | | |
| **MASTER** | -35205.5 | -69426.1 | |
| | 0.000 | 0.000 | |
| **MBA** | -8700.29 | -42920.9 | 26505.2 |
| | 0.317 | 0.000 | 0.000 |

A similar discussion can be referred to the variable TOPIC (Figure 14), where the only pair of non-significantly different means is constituted by vertical and functional masters, despite the considerable difference in the mean values. The mean price of general management masters is instead significantly greater if compared with both vertical and functional masters (Table 29).

Table 29. Bonferroni test for the categorical variable TOPIC

| Row Mean - Col Mean | FUNCTIONAL | GENERAL_MANAG |
|---|---|---|
| **GENERAL_MANAG** | 28812.5 | |
| | 0.000 | |
| **VERTICAL** | -5293.25 | -34105.8 |
| | 0.309 | 0.000 |

Figure 14. Boxplot for the categorical variable TOPIC



As in the case of open courses, a further analysis has been performed on topics, in order to depict eventual influences played by duration in determining the price change caused by topics. Table 30 shows that masters on general management are generally longer than functional and vertical masters, whose mean durations can be practically assumed to be equal. Therefore, no relevant information has been added with regard to the difference between the means of vertical and functional masters, which still remain non-significant, as demonstrated by the Bonferroni test performed for topics with respect to price per month (Table 31).

Table 30. Durations of masters depending on different topics. Duration is expressed in months

| TOPIC | Mean | Standard Deviation | Frequency |
|---|---|---|---|
| **FUNCTIONAL** | 13,47 | 48,38 | 150 |
| **GENERAL_MANAG** | 16,82 | 45,54 | 62 |
| **VERTICAL** | 13,46 | 50,76 | 50 |
| Total | 14,26 | 50,09 | 262 |

Figure 15. Boxplot for the variable TOPIC normalized on duration

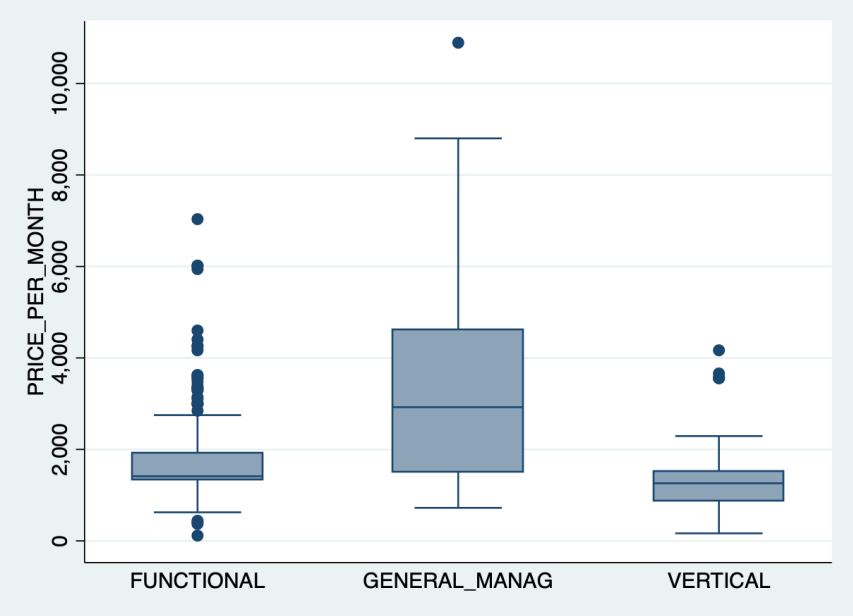


Table 31. Bonferroni test for the variable TOPIC normalized on duration

| Row Mean - Col Mean | **FUNCTIONAL** | **GENERAL_MANAG** |
|---|---|---|
| **GENERAL_MANAG** | 1489.56 | |
| | 0.000 | |
| **VERTICAL** | -392.736 | -1882.3 |
| | 0.295 | 0.000 |

Finally, t-tests have been performed for dichotomous variables as illustrated in Table 32. According to expectations, the existence of a Triple Crown Accreditation, the English language and the opportunity of spending a year abroad and doing an international week have a positive influence on the final price of the master. The related t-ratios and p-values demonstrate that these influences are also significant. However, looking at the table, stages and company visits seem to have a negative influence on the price. This might be due to the fact that the majority of programs which offer opportunities of doing stages and company visits are specializing masters, that, as demonstrated by the Bonferroni test, are the category of programs with the lower average price.

Table 32. t-Tests for dichotomous variables

| Dichotomous variable | t-Ratio | p-Value | Standard Error | 95% Confidence Interval |
|---|---|---|---|---|
| **TRIPLE_CROWN** | -12,117 | 0.0000 | 2416,438 | (-34038.1; -24521.6) |
| **ENG** | -8,801 | 0.0000 | 2569,516 | (-27673.2; -17553.8) |
| **STAGE** | 4,0149 | 0.0001 | 3070,922 | (6288.7; 18382.8) |
| **YEAR_ABROAD** | -3,1336 | 0.0019 | 3230,201 | (-16482.8; -3761.4) |
| **COMP_VISITS** | 2,6217 | 0.0093 | 3521,532 | (2298.1; 16166.8) |
| **INT_WEEK** | -2,3197 | 0.0211 | 3465,795 | (-14864.3; -1215.1) |
| **BLENDED** | -0,5591 | 0.5766 | 4064,039 | (-10274.9; 5730.4) |
| **D_DEGREE** | 0,0415 | 0.9670 | 6295,493 | (-12135.6; 12657.7) |

Finally, categorical variables have been reordered by following the same approach described in the case of open courses. It should be pointed out that SOUTH_EUROPE, FULL-TIME, MASTER and FUNCTIONAL have been selected as

baselines for the respective categorical variables REGION, STRUCTURE, TYPE and TOPIC.

### *3.2.2. Hedonic pricing regression*

Differently from the procedure adopted when analyzing open courses, in this case the first regression model has been constructed by using a stepwise approach, consisting in several attempts aimed at obtaining the right tradeoff between reaching a high R-squared and building a model with a certain number of good predictors. The result of this procedure is shown in Table 33. The variables applied in the model are the binary variables ENG and TRIPLE_CROWN and the categorical variables REGION, STRUCTURE, TYPE, TOPIC.

Table 33. Regression model for masters held by business schools

| Source | SS | df | MS | Number of obs | = | 262 |
|---|---|---|---|---|---|---|
| | | | | F(10, 251) | = | 60.80 |
| Model | 1.0314e+11 | 10 | 1.0314e+10 | Prob > F | = | 0.0000 |
| Residual | 4.2579e+10 | 251 | 169637442 | R-squared | = | 0.7078 |
| | | | | Adj R-squared | = | 0.6962 |
| Total | 1.4572e+11 | 261 | 558318552 | Root MSE | = | 13024 |

| PRICE | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| TRIPLE_CROWN | 15043.82 | 3071.085 | 4.90 | 0.000 | 8995.437 | 21092.2 |
| ENG | 4893.768 | 2053.278 | 2.38 | 0.018 | 849.9196 | 8937.617 |
| REGION_CODES | | | | | | |
| CENT_EUROPE | -3548.213 | 3377.96 | -1.05 | 0.295 | -10200.97 | 3104.545 |
| NORTH_EUROPE | 12867.59 | 4468.157 | 2.88 | 0.004 | 4067.735 | 21667.45 |
| EXTRA_EUROPE | 4287.924 | 3801.501 | 1.13 | 0.260 | -3198.98 | 11774.83 |
| TYPE_CODES | | | | | | |
| MBA | 17048.26 | 3210.747 | 5.31 | 0.000 | 10724.83 | 23371.7 |
| EMBA | 23713.78 | 3369.285 | 7.04 | 0.000 | 17078.11 | 30349.46 |
| GEMBA | 51252.17 | 4946.868 | 10.36 | 0.000 | 41509.51 | 60994.83 |
| TOPIC_CODES | | | | | | |
| VERTICAL | 1055.256 | 2190.052 | 0.48 | 0.630 | -3257.964 | 5368.476 |
| GENERAL_MANAG | 7156.216 | 2655.958 | 2.69 | 0.008 | 1925.412 | 12387.02 |
| _cons | 12383.37 | 1386.323 | 8.93 | 0.000 | 9653.062 | 15113.68 |

At first sight, the absence of MONTHS and EXPERIENCE as independent variables could impress, but their actual contribution to the regression model was minimal in every different attempt made. This could be explained by the following reasons:

- concerning MONTHS, as seen at the beginning of this chapter, more than 50% of masters have a duration equal to 12 months, thus making difficult to depict a significant difference between each other;
- concerning EXPERIENCE, instead, it has been noted that a remarkable number of masters is not backed with data related to the minimum job experience required and, moreover, the majority of observations shows a minimum experience equal to zero years, thus giving less power to the weight of masters requiring a certain number of years of experience.

Turning back to the output, it is again observable a high R-squared (70,78%), meaning that a good percentage of variance is explained by the variables applied. Concerning those variables, it can be stated that, at a 95% confidence interval:

- masters held by business schools awarded with a Triple Crown Accreditation cost on average around €15.000 more than masters offered by other business schools;
- masters held in English cost around €5000 more than masters held in other languages;
- masters which take place in Northern Europe have a higher price compared to masters held in Southern Europe, while the hypothesis whereby there is a significant influence played by masters that take place in central Europe and outside Europe must be rejected, even if the model suggests respectively a negative and a positive effect on the final price;

- the price changes considerably with the typology of the master, with higher prices charged respectively for GEMBAs, EMBAs and MBAs with respect to specializing masters (baseline);
- the significant difference between functional and general management masters has been confirmed, as well as the lack of a significant difference between functional and vertical programs.

The table of standardized betas (Table 34) indicates that the greater effects on the dependent variable are caused by the Triple Crown Accreditation and by the different types of masters, both with positive coefficients. Other variables with a noteworthy effect on the price are related to the English language, the Northern Europe as region and the general management as topic, all with a positive effect.

Table 34. Regression model with standardized beta coefficients

| Source | SS | df | MS | Number of obs | = | 262 |
|---|---|---|---|---|---|---|
| | | | | F(10, 251) | = | 60.80 |
| Model | 1.0314e+11 | 10 | 1.0314e+10 | Prob > F | = | 0.0000 |
| Residual | 4.2579e+10 | 251 | 169637442 | R-squared | = | 0.7078 |
| | | | | Adj R-squared | = | 0.6962 |
| Total | 1.4572e+11 | 261 | 558318552 | Root MSE | = | 13024 |

| PRICE | Coef. | Std. Err. | t | P>\|t\| | Beta |
|---|---|---|---|---|---|
| TRIPLE_CROWN | 15043.82 | 3071.085 | 4.90 | 0.000 | .3086605 |
| ENG | 4893.768 | 2053.278 | 2.38 | 0.018 | .1036779 |
| REGION_CODES | | | | | |
| CENT_EUROPE | -3548.213 | 3377.96 | -1.05 | 0.295 | -.0557255 |
| NORTH_EUROPE | 12867.59 | 4468.157 | 2.88 | 0.004 | .1267592 |
| EXTRA_EUROPE | 4287.924 | 3801.501 | 1.13 | 0.260 | .0543598 |
| TYPE_CODES | | | | | |
| MBA | 17048.26 | 3210.747 | 5.31 | 0.000 | .2161279 |
| EMBA | 23713.78 | 3369.285 | 7.04 | 0.000 | .3106532 |
| GEMBA | 51252.17 | 4946.868 | 10.36 | 0.000 | .3958055 |
| TOPIC_CODES | | | | | |
| VERTICAL | 1055.256 | 2190.052 | 0.48 | 0.630 | .0175832 |
| GENERAL_MANAG | 7156.216 | 2655.958 | 2.69 | 0.008 | .1289681 |
| _cons | 12383.37 | 1386.323 | 8.93 | 0.000 | . |

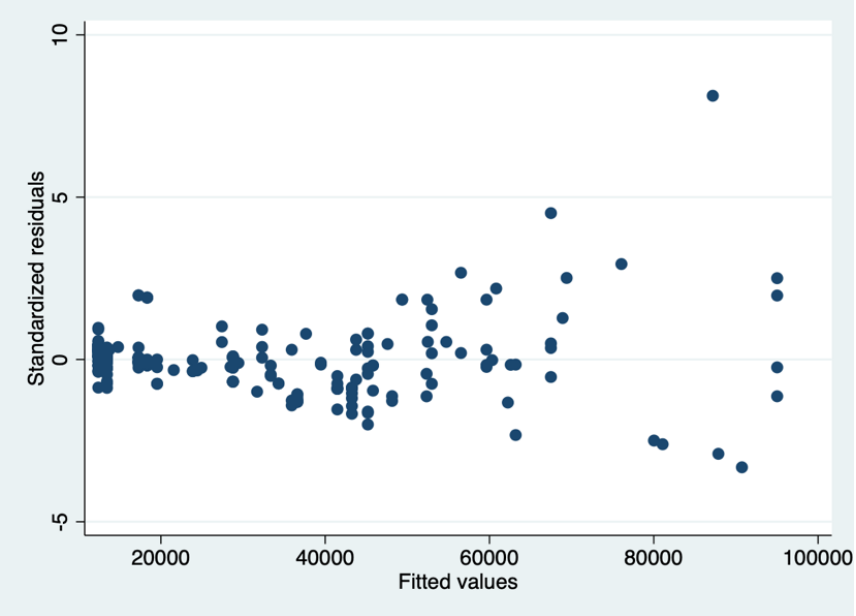
The table of variance inflation factors, moreover, does not depict any high collinearity among the independent variables used in the regression model.

Table 35. Variance Inflation Factors for independent variables

| Variable | VIF | 1/VIF |
|---|---|---|
| TRIPLE_CROWN | 3.41 | 0.293204 |
| ENG | 1.63 | 0.615203 |
| REGION_CODES | | |
| 2 | 2.42 | 0.413620 |
| 3 | 1.66 | 0.600866 |
| 4 | 2.00 | 0.501219 |
| TYPE_CODES | | |
| 2 | 1.42 | 0.702628 |
| 3 | 1.67 | 0.597549 |
| 4 | 1.25 | 0.797626 |
| TOPIC_CODES | | |
| 2 | 1.14 | 0.874195 |
| 3 | 1.97 | 0.508111 |
| Mean VIF | 1.86 | |

However, as shown in the analysis of open courses provided by business schools, also this regression model exhibits a substantial existence of heteroskedasticity, as illustrated in Figure 16.

Figure 16. Plot of standardized residuals according to the regression model of Table 33



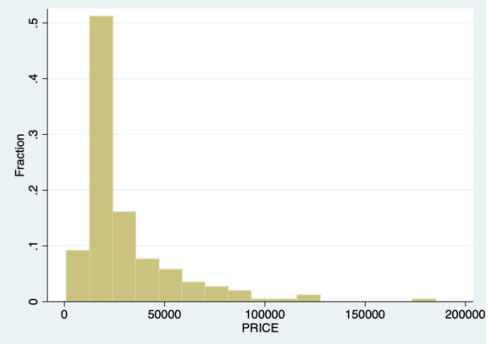
It can be easily seen that residuals are randomly distributed for an interval that includes prices between zero and around 40.000€, while they tend to diverge for expected prices greater than 40.000€. The phenomenon is confirmed by Cameron & Trivedi's test, that highlights a significant existence of heteroskedasticity (Table 36).

Table 36. Cameron & Trivedi's decomposition of IM-test

| Source | chi2 | df | p |
|---|---|---|---|
| Heteroskedasticity | 178.52 | 40 | 0.0000 |
| Skewness | 30.77 | 10 | 0.0006 |
| Kurtosis | -31408.77 | 1 | 1.0000 |
| Total | -31199.48 | 51 | 1.0000 |

The distribution of observed values for the variable PRICE suggests once again a logarithmic transformation, since it is evident that higher frequencies are observed for lower prices (Figure 17). In order to build a regression model with more normally distributed variables, also distributions and percentiles of variables MONTHS and EXPERIENCE have been analyzed (Figure 18).

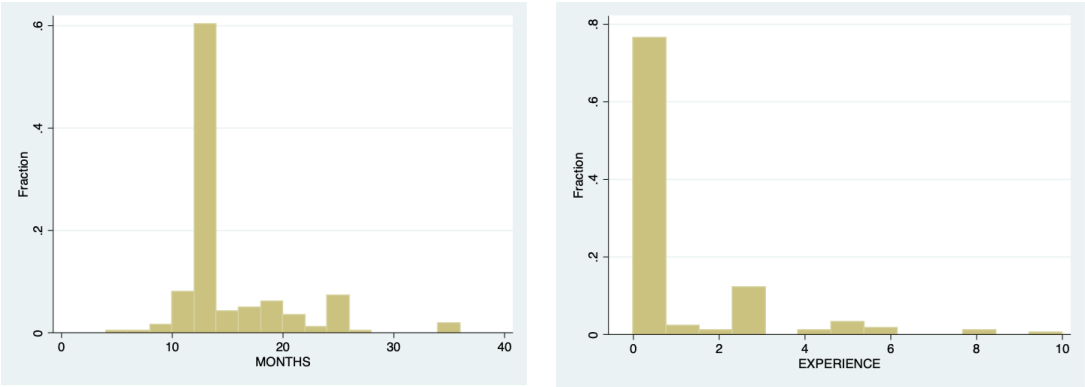
Figure 17. Frequency distribution and percentiles values for PRICE




PRICE

| | Percentiles | Smallest | | |
|---|---|---|---|---|
| 1% | 3900 | 1159 | | |
| 5% | 10000 | 2150 | | |
| 10% | 13298 | 3900 | Obs | 262 |
| 25% | 16000 | 4700 | Sum of Wgt. | 262 |
| 50% | 19250 | | Mean | 29012.12 |
| | | Largest | Std. Dev. | 23628.77 |
| 75% | 33855 | 119000 | | |
| 90% | 59000 | 124288.4 | Variance | 5.58e+08 |
| 95% | 73700 | 125500 | Skewness | 2.612903 |
| 99% | 124288.4 | 185150 | Kurtosis | 12.53493 |

Figure 18. Histograms for MONTHS (left) and EXPERIENCE (right)




Stepwise backward regression has newly been carried out and the related outcome is displayed in Table 37. Despite several transformations have been applied to both variables, with the goal of finding possible significant contributions to the price which were not evident from the previous model, no significant influences have been found for experience and duration.

Table 37. Logarithmic regression model for masters held by business schools

| Source | SS | df | MS | | |
|---|---|---|---|---|---|
| | | | | Number of obs | = 262 |
| | | | | F(10, 251) | = 66.78 |
| Model | 83.4876401 | 10 | 8.34876401 | Prob > F | = 0.0000 |
| Residual | 31.380756 | 251 | .125022932 | R-squared | = 0.7268 |
| | | | | Adj R-squared | = 0.7159 |
| Total | 114.868396 | 261 | .440108797 | Root MSE | = .35359 |

| logPRICE | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| TRIPLE_CROWN | .5516698 | .0833731 | 6.62 | 0.000 | .3874699 | .7158698 |
| ENG | .2816943 | .0557419 | 5.05 | 0.000 | .1719128 | .3914757 |
| REGION_CODES | | | | | | |
| CENT_EUROPE | -.1613866 | .0917041 | -1.76 | 0.080 | -.3419941 | .0192209 |
| NORTH_EUROPE | .1931869 | .1213005 | 1.59 | 0.113 | -.0457096 | .4320833 |
| EXTRA_EUROPE | -.0233111 | .1032022 | -0.23 | 0.821 | -.2265637 | .1799416 |
| TYPE_CODES | | | | | | |
| MBA | .4996474 | .0871646 | 5.73 | 0.000 | .3279802 | .6713146 |
| EMBA | .7000005 | .0914685 | 7.65 | 0.000 | .5198569 | .8801442 |
| GEMBA | .9126922 | .1342964 | 6.80 | 0.000 | .6482008 | 1.177184 |
| TOPIC_CODES | | | | | | |
| VERTICAL | -.0644204 | .059455 | -1.08 | 0.280 | -.1815147 | .0526738 |
| GENERAL_MANAG | .1312067 | .0721033 | 1.82 | 0.070 | -.0107979 | .2732113 |
| _cons | 9.534692 | .0376356 | 253.34 | 0.000 | 9.46057 | 9.608814 |

The main updates with respect to the first regression model are the following:

- the R-squared has slightly increased and is equal to 0,7268, indicating that the model obtained after the logarithmic transformation provides a slightly greater explanation of the variance of the price for masters held by business schools;
- there are not significant differences between geographical areas in which masters take place, while the first model showed a significant difference between masters held in Southern Europe and masters held in central Europe;
- the significant difference between functional courses and courses about general management has been lost.

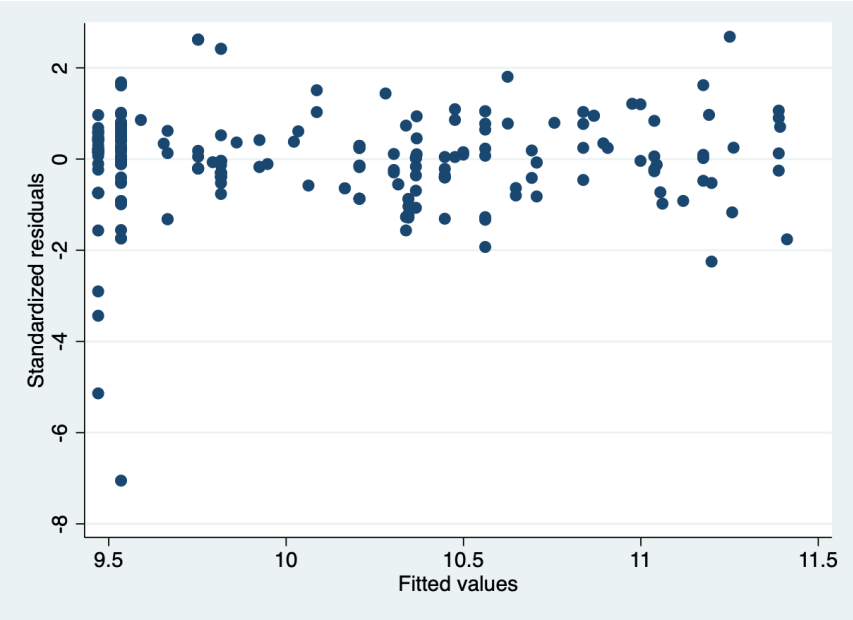
Table 38. Logarithmic regression model with standardized beta coefficients

| Source | SS | df | MS | Number of obs | = | 262 |
|---|---|---|---|---|---|---|
| | | | | F(10, 251) | = | 66.78 |
| Model | 83.4876401 | 10 | 8.34876401 | Prob > F | = | 0.0000 |
| Residual | 31.380756 | 251 | .125022932 | R-squared | = | 0.7268 |
| | | | | Adj R-squared | = | 0.7159 |
| Total | 114.868396 | 261 | .440108797 | Root MSE | = | .35359 |

| logPRICE | Coef. | Std. Err. | t | P>\|t\| | Beta |
|---|---|---|---|---|---|
| TRIPLE_CROWN | .5516698 | .0833731 | 6.62 | 0.000 | .4031469 |
| ENG | .2816943 | .0557419 | 5.05 | 0.000 | .2125601 |
| REGION_CODES | | | | | |
| CENT_EUROPE | -.1613866 | .0917041 | -1.76 | 0.080 | -.0902761 |
| NORTH_EUROPE | .1931869 | .1213005 | 1.59 | 0.113 | .067783 |
| EXTRA_EUROPE | -.0233111 | .1032022 | -0.23 | 0.821 | -.0105258 |
| TYPE_CODES | | | | | |
| MBA | .4996474 | .0871646 | 5.73 | 0.000 | .2256085 |
| EMBA | .7000005 | .0914685 | 7.65 | 0.000 | .3266137 |
| GEMBA | .9126922 | .1342964 | 6.80 | 0.000 | .2510469 |
| TOPIC_CODES | | | | | |
| VERTICAL | -.0644204 | .059455 | -1.08 | 0.280 | -.0382319 |
| GENERAL_MANAG | .1312067 | .0721033 | 1.82 | 0.070 | .0842201 |
| _cons | 9.534692 | .0376356 | 253.34 | 0.000 | . |

Moreover, the table of standardized betas shows that a high influence on the price is played by the type of the master, by its language and by the existence of a Triple Crown Accreditation for the business school (Table 38).
While the regression output does not reveal remarkable differences compared to the previous one, the plot of standardized residuals has been remarkably reshaped, and it now exhibits a more normally distributed plot (Figure 19).

Figure 19. Plot of standardized residuals according to the regression model of Table 37




Neglecting the four outliers in the bottom left of the graph, it can be stated that residuals do not follow any trend, therefore they are randomly distributed. A confirmation is given by the Cameron & Trivedi's test (Table 39), which does not suggest any existence of heteroskedasticity, skewness and kurtosis, meaning that the distribution of residuals is much closer to a perfectly shaped normal distribution.

Table 39. Cameron & Trivedi's decomposition of IM-test

| Source | chi2 | df | p |
|---|---|---|---|
| Heteroskedasticity | **7.33** | **40** | **1.0000** |
| Skewness | **5.37** | **10** | **0.8654** |
| Kurtosis | **1.83** | **1** | **0.1763** |
| Total | **14.53** | **51** | **1.0000** |

Finally, a further analysis has been performed in order to demonstrate an eventual influence played by specific topics or subjects. In the case of functional masters, the t-tests conducted for dichotomous variables returned that the only topics which significantly affect the price variation are leadership and strategy and organization. Interestingly, this result reflects the findings of the correspondent analysis for open courses (Chapter 3.1), confirming that programs about strategy and leadership are the most expensive among the functional programs (Table 40).

Table 40. T-tests for topics of functional courses. Significative variables are indicated in bold

| Dichotomous variable | t-Ratio | p-Value | Standard Error | 95% Confidence Interval |
|---|---|---|---|---|
| **Leadership** | **-4,4407** | **0.0000** | **5352,0** | **(-34342.6; -13190.4)** |
| **Strategy & Organization** | **-2,3888** | **0.0182** | **3651,8** | **(-15939.6; -1506.9)** |
| Human Resources Manag. | 1,7659 | 0.0795 | 4652,3 | (-977.9; 17409.3) |
| Marketing & Sales | 1,7381 | 0.0843 | 3185,2 | (-758.0; 11830.7) |
| Finance | -1,4443 | 0.1508 | 2807,4 | (-9602.4; 1493.0) |
| Business Law | 1,1714 | 0.2433 | 4455,2 | (-3585.1; 14022.7) |
| Project Management | 1,1204 | 0.2643 | 5270,8 | (-4510.2; 16321.5) |
| Supply Chain & Operations | 1,0484 | 0.2962 | 4950,3 | (-4592.8; 14972.2) |
| International Business | -0,9925 | 0.3226 | 4460,9 | (-13242.9; 4387.8) |
| Auditing & Consulting | 0,8125 | 0.4178 | 6914,5 | (-8045.9; 19281.7) |
| Business Analyt. & Big Data | -0,6693 | 0.5044 | 4961,2 | (-13124.2; 6483.6) |
| Sustainability & Social Inn. | 0,2430 | 0.8084 | 5292,1 | (-9172.0; 11743.6) |
| Digitalization | 0,2253 | 0.8221 | 3155,3 | (-5524.4; 6946.1) |
| Entrepreneurship & Innov. | 0,0596 | 0.9525 | 3284,3 | (-6294.3; 6686.0) |

The analysis of vertical topics, then, gave as result a significant influence caused by luxury management and healthcare management, with the former having a positive influence on price and the latter having a negative influence. Full results are displayed in Table 41.

Table 41. T-tests for topics of vertical courses. Significative variables are indicated in bold

| Dichotomous variable | t-Ratio | p-Value | Standard Error | 95% Confidence Interval |
|---|---|---|---|---|
| **Luxury** | **-4,3434** | **0.0001** | **3351,4** | **(-21294.6; -7817.8)** |
| **Healthcare** | **2,6344** | **0.0113** | **3238,3** | **(2020.0; 15042.0)** |
| Fashion | -1,3052 | 0.1980 | 6288,2 | (-20851.0; 4435.7) |
| Food & Beverage | -0,8876 | 0.3792 | 4638,5 | (-13443.6; 5209.0) |
| Energy | 0,5803 | 0.5644 | 6376,5 | (-9120.8; 16521.0) |
| Real Estate | 0,5550 | 0.5815 | 6378,4 | (-9284.8; 16364.6) |
| Art & Media | 0,5160 | 0.6082 | 3548,4 | (-5303.4; 8965.6) |
| Tourism | 0,4481 | 0.6561 | 6385,5 | (-9977.8; 15700.1) |

### *3.2.3. Discussion*

Regression models for masters offered by business schools developed in this chapter present very similar results. Both models demonstrate that the main price drivers for such master programs are the existence of a Triple Crown Accreditation for the business school, the language in which the program is held and its typology. Concerning the latter, expectations have been confirmed, since higher prices have been predicted for global executive MBAs, followed by Executive MBAs, MBAs and specializing master respectively.

Contrary to expectations, however, some variables have did not show significant results. In this sense, it must be mentioned the case of experience, that initially exhibited a positive correlation with price, while the regression models did not confirm this relationship. This might be explained by the high correlation between the variable representing experience and the one connected with types of programs. It has been indeed demonstrated that greater experience is required for MBA programs, especially EMBAs and GEMBAs, compared to specializing masters. Hence, the effects of the variable experience have been in part explained by the categorical variable TYPE.

Other variables originally present in the dataset did not have the expected outcomes. More precisely, binary variables representing stages, company visits, years abroad, double degrees and international weeks have not demonstrated significant contributions to any regression model developed. A possible explanation might lie in the fact that these factors are expected to be a value added for specializing masters, while they do not represent major improvements for an executive master, due to the different age, needs and job experience of participants. Even the duration has not been revealed as a significant price driver. As mentioned at the beginning of the chapter, this might be due to the distribution of values collected for the variable MONTHS, since more than half of the sample presents a duration equal to twelve

months. Thus, it is difficult to infer any hypothesis on the contribution played by the duration on the price of master programs.

Quite interestingly, also the analysis of master programs predicted a higher price for masters on general management compared to functional and vertical programs. It has also been confirmed that, among functional courses, higher contributes to the price are brought by courses about strategy and leadership, i.e. the most comparable to general management courses.

Finally, concerning the fit, the log-transformed model emerges to be the best one because, besides slight improvements regarding the coefficient of determination and the significativity of several predictors, it presents more normally distributed residuals, and it is not characterized by any significant bias.

## 3.3. Open Courses provided by Technical Schools

### *3.3.1. Correlation analysis and t-test*

The third dataset, compared to the previous ones, brings a major shift about the subject matter of courses, together with a focus on a different set of schools analyzed. The dataset contains 173 observations related to open courses offered by technical universities, characterized by an average price equal to €1248,99 and an average duration equal to 53,17 hours (Table 42). The majority of them, 108 (62,43%), are provided by technical universities having an establishment in Northern Europe, followed by Southern Europe universities, 36 (20,81%), and central Europe ones, 29 (16,76%). Then, 79 courses (45,66%) are delivered online, 131 (75,72%) are held in English and 16 (9,25%) involve project works to be delivered throughout the course (Table 43).

Table 42. Summary statistics for variables PRICE and HOURS

| Variable | Observations | Mean | Standard Deviation | Min | Max |
|---|---|---|---|---|---|
| **PRICE** | 173 | 1248,99 | 1.060 | 140 | 8455 |
| **HOURS** | 173 | 53,17 | 49,90 | 4 | 150 |

Courses have been divided into 14 main topics, with the greater number of observations resulted from courses about data science, 37 (21,39%), and telecommunications and ICT, 22 (12,72%). It is immediate to point out the absence of some variables that had characterized the previous two models, for instance the Triple Crown Accreditation, which here is missing due to the fact that this award is provided only for business schools, and the grouping of macro-topics (functional, vertical and general management), in this case not applied due to the plurality and the diversity of courses collected.

Table 43. Summary statistics for dichotomous and categorical variables

| Dichotomous variable | Frequency | Percentage | Cum. Perc. |
|---|---|---|---|
| **ONLINE** | | | |
| 0 | 94 | 54.34 | 54.34 |
| 1 | 79 | 45.66 | 100.00 |
| **ENG** | | | |
| 0 | 42 | 24.28 | 24.28 |
| 1 | 131 | 75.72 | 100.00 |
| **PROJECT** | | | |
| 0 | 157 | 90.75 | 90.75 |
| 1 | 16 | 9.25 | 100.00 |
| **REGION** | | | |
| CENT_EUROPE | 29 | 16.76 | 16.76 |
| NORTH_EUROPE | 108 | 62.43 | 79.19 |
| SOUTH_EUROPE | 36 | 20.81 | 100.00 |

Following the same approach used in previous analyses, continuous variables have been examined through correlation tests, while t-tests have been performed for binary variables and a Bonferroni test has been conducted for the only categorical variable, REGION.

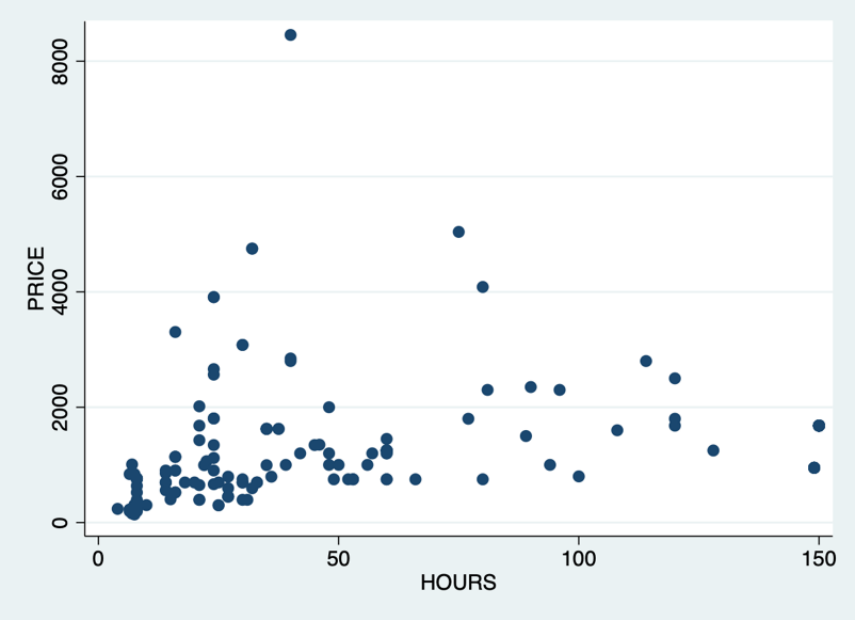
The correlation test between price and duration (Table 44), unlike what observed for open courses held by business schools, does not show a particularly high influence caused by the duration on the price, although an expected positive correlation is evident (Figure 20).

Table 44. Correlation analysis for PRICE and HOURS

| | **PRICE** | **HOURS** |
|---|---|---|
| **PRICE** | 1.0000 | |
| **HOURS** | 0.2570* | 1.0000 |

*p-value = 0,0006

Figure 20. Price variation relative to the duration of open courses

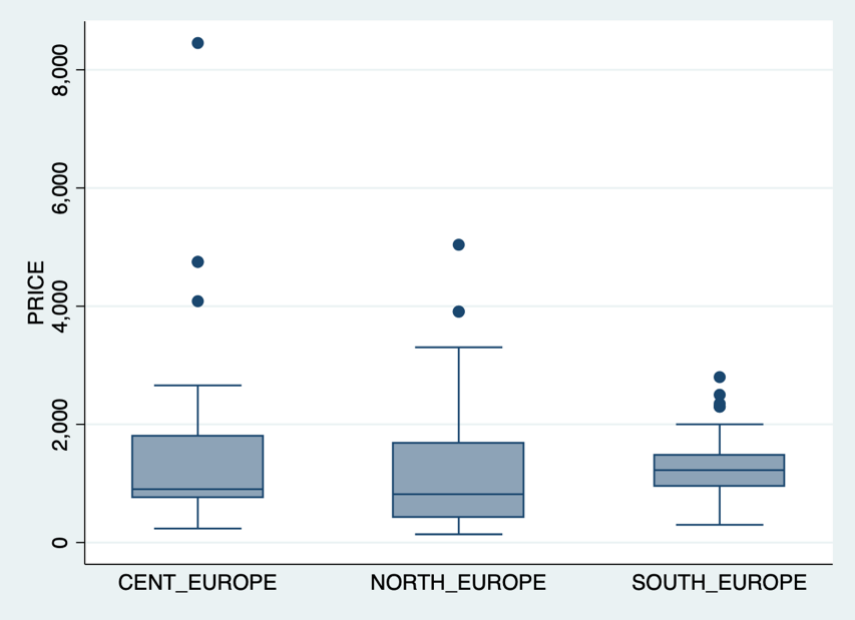



The Bonferroni test performed for the categorical variable REGION does not detect any significant difference between the means of each pair of groups (Figure 21). However, it is noteworthy to mention that the null hypothesis whereby a difference exists between the means of courses held in Northern Europe and courses held in central Europe is rejected with a p-value equal to 0,07, suggesting a difference of around €500 in favor of central European universities (Table 45).

Table 45. Bonferroni test for the categorical variable REGION

| Row Mean - Col Mean | **CENT_EUROPE** | **NORTH_EUROPE** |
|---|---|---|
| **NORTH_EUROPE** | -502.687 | |
| | 0.070 | |
| **SOUTH_EUROPE** | -309.065 | 193.622 |
| | 0.719 | 1.000 |

Figure 21. Boxplot for the categorical variable REGION




Finally, t-tests have been conducted for each dichotomous variable. Results depict that only the variable ONLINE has a significant (negative) influence on the price, while it should be noted that, compared to the analysis of open courses and masters provided by business schools, the language here does not appear to significantly affect the price of open courses. A lack of significance is exhibited by the variable PROJECT too.

Table 46. t-Tests for dichotomous variables

| Dichotomous variable | t-Ratio | p-Value | Standard Error | 95% Confidence Interval |
|---|---|---|---|---|
| **ONLINE** | 5,7492 | 0.0000 | 148,581 | (560.94; 1147.52) |
| **PROJECT** | -0,1027 | 0.9183 | 279,057 | (-579.50; 522.18) |
| **ENG** | 0,0511 | 0.9593 | 188,561 | (-362.57; 381.84) |

### *3.3.2. Hedonic pricing regression*

A first regression model has been developed by taking into consideration all the variables mentioned above, with the exception of individual topics.

The only continuous variable applied is HOURS, while ONLINE, ENG and PROJECT are binary variables and REGION, as already mentioned, is a categorical variable containing different values depending on the geographical area in which schools and universities are established (the baseline is given by open courses provided by Northern European schools).

Table 47. Regression model for open courses held by technical universities

| Source | SS | df | MS | Number of obs | = | 173 |
|---|---|---|---|---|---|---|
| | | | | F(6, 166) | = | 8.49 |
| Model | 45385941.1 | 6 | 7564323.51 | Prob > F | = | 0.0000 |
| Residual | 147980730 | 166 | 891450.18 | R-squared | = | 0.2347 |
| | | | | Adj R-squared | = | 0.2071 |
| Total | 193366671 | 172 | 1124224.83 | Root MSE | = | 944.17 |

| PRICE | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| HOURS | 5.31164 | 1.643292 | 3.23 | 0.001 | 2.067193 | 8.556086 |
| ONLINE | -741.6327 | 169.3288 | -4.38 | 0.000 | -1075.948 | -407.3171 |
| ENG | 553.1157 | 272.5331 | 2.03 | 0.044 | 15.0379 | 1091.193 |
| PROJECT | -197.8091 | 319.9996 | -0.62 | 0.537 | -829.6027 | 433.9845 |
| REGION_CODES | | | | | | |
| SOUTH_EUROPE | 334.8126 | 332.4097 | 1.01 | 0.315 | -321.483 | 991.1083 |
| CENT_EUROPE | 473.0992 | 257.5389 | 1.84 | 0.068 | -35.37465 | 981.5731 |
| _cons | 755.7158 | 320.0451 | 2.36 | 0.019 | 123.8323 | 1387.599 |

The biggest difference compared to previous models is represented by the substantially lower R-squared (23,47%), that explains less than a quarter of the variance that characterizes the dependent variable PRICE. This might be due to:

- the lower number of variables used in this regression model with respect to previous ones;
- the lower number of open courses collected in the dataset;
- the absence of variables able to explain a considerable part of the variance of the dependent variable, as it was for Triple Crown Accreditation.

Anyway, ascertained that, it is observable that variables indicating the duration, the format (online or residential) and the language significantly affect the dependent variable PRICE, while the presence of a project work does not suggest a significant effect on price, as well as the geographical region in which schools are established. More particularly:

- each hour contributes to an average increase in price equal to €5,31, with a positive effect in line with expectations;
- online courses cost, on average, less than residential courses, as it has been observed also in the cases of programs held by business schools;
- open courses held in English have an average price of €553,12 higher than courses held in other languages;
- the contribution offered by the variable REGION resembles the result shown by the previously performed Bonferroni test, according to which any geographical area indicates a significant contribution to the price variation with respect to the others.

Due to the non-significant contribution given by the presence of project works, the related variable has been deleted and a new model has been developed (Table 48).

It can be easily noticed that the main results are the same of the previous model, with an unavoidable but exiguous decrease in the R-squared and an increasing adjusted R-squared, meaning that the variable PROJECT did not improve the model more than it would be expected by chance. The table of standardized beta coefficients for the new model depicts that the variable that mostly influences the price is ONLINE, which has a negative effect on the dependent variable, followed by HOURS and ENG, both with a positive effect on the price.

Table 48. Regression model for open courses held by technical universities (after the deletion of the variable PROJECT)

| Source | SS | df | MS | Number of obs | = | 173 |
|---|---|---|---|---|---|---|
| | | | | F(5, 167) | = | 10.14 |
| Model | 45045304.8 | 5 | 9009060.95 | Prob > F | = | 0.0000 |
| Residual | 148321366 | 167 | 888151.894 | R-squared | = | 0.2330 |
| | | | | Adj R-squared | = | 0.2100 |
| Total | 193366671 | 172 | 1124224.83 | Root MSE | = | 942.42 |

| PRICE | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| HOURS | 5.400655 | 1.633939 | 3.31 | 0.001 | 2.174816 | 8.626494 |
| ONLINE | -728.1308 | 167.6032 | -4.34 | 0.000 | -1059.025 | -397.2367 |
| ENG | 546.7862 | 271.8364 | 2.01 | 0.046 | 10.1076 | 1083.465 |
| REGION_CODES | | | | | | |
| SOUTH_EUROPE | 242.9546 | 296.7945 | 0.82 | 0.414 | -342.9982 | 828.9073 |
| CENT_EUROPE | 481.341 | 256.7173 | 1.87 | 0.063 | -25.48841 | 988.1705 |
| _cons | 749.0489 | 319.271 | 2.35 | 0.020 | 118.7214 | 1379.376 |

Table 49. Regression model with standardized beta coefficients

| Source | SS | df | MS | Number of obs | = | 173 |
|---|---|---|---|---|---|---|
| | | | | F(5, 167) | = | 10.14 |
| Model | 45045304.8 | 5 | 9009060.95 | Prob > F | = | 0.0000 |
| Residual | 148321366 | 167 | 888151.894 | R-squared | = | 0.2330 |
| | | | | Adj R-squared | = | 0.2100 |
| Total | 193366671 | 172 | 1124224.83 | Root MSE | = | 942.42 |

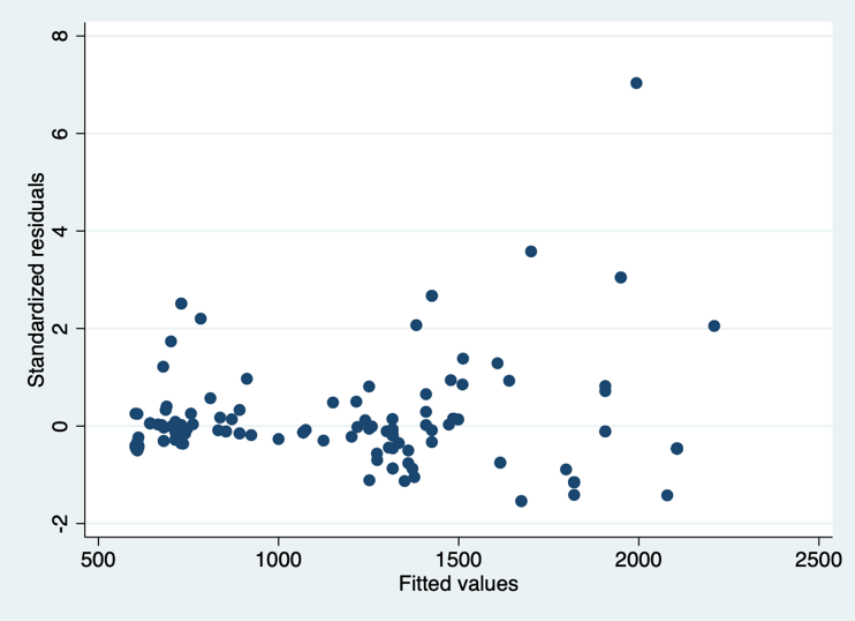
| PRICE | Coef. | Std. Err. | t | P>\|t\| | Beta |
|---|---|---|---|---|---|
| HOURS | 5.400655 | 1.633939 | 3.31 | 0.001 | .2541481 |
| ONLINE | -728.1308 | 167.6032 | -4.34 | 0.000 | -.3430623 |
| ENG | 546.7862 | 271.8364 | 2.01 | 0.046 | .2217502 |
| REGION_CODES | | | | | |
| SOUTH_EUROPE | 242.9546 | 296.7945 | 0.82 | 0.414 | .0932873 |
| CENT_EUROPE | 481.341 | 256.7173 | 1.87 | 0.063 | .1700667 |
| _cons | 749.0489 | 319.271 | 2.35 | 0.020 | . |

The table of VIFs, also in this case, does not show any existence of multicollinearity among variables applied in the last regression model.

Table 50. Variance Inflation Factors for independent variables

| Variable | VIF | 1/VIF |
|---|---|---|
| HOURS | 1.29 | 0.776878 |
| ONLINE | 1.36 | 0.736570 |
| ENG | 2.65 | 0.377918 |
| REGION_CODES | | |
| 2 | 2.83 | 0.353670 |
| 3 | 1.79 | 0.558294 |
| Mean VIF | 1.98 | |

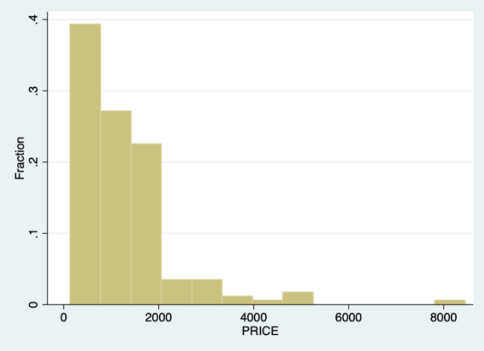
Figure 22. Plot of standardized residuals according to the regression model of Table 48




However, the analysis of residuals (Figure 22) exhibits again a heteroskedasticity issue, with a better fit for open courses with a low or medium price and a worse fit for open courses characterized by higher prices. As observed from the previous analyses, an indication of this phenomenon could be suggested by the distribution of quantitative variables, i.e. PRICE and HOURS. Looking at the related distribution histograms (Figure 23 and 24, left), in fact, it is evident that observations for both variables are not normally distributed, and that higher frequencies are observed for lower prices and lower hours. This is confirmed by data about percentiles, since Figure shows

that differences between smaller percentiles are lower than differences between greater ones (Figure 23 and 24, right).

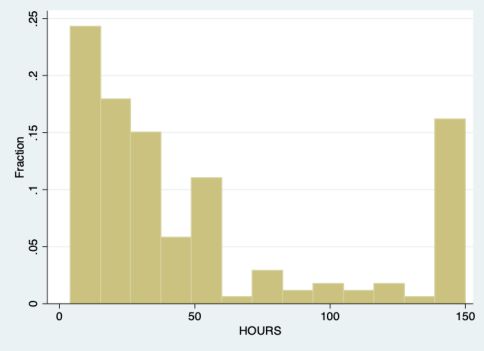
Figure 23. Frequency distribution and percentiles values for PRICE




PRICE

| | Percentiles | Smallest | | |
|---|---|---|---|---|
| 1% | 156.8 | 140 | | |
| 5% | 196 | 156.8 | | |
| 10% | 237.5 | 168 | Obs | 173 |
| 25% | 695 | 168 | Sum of Wgt. | 173 |
| 50% | 995 | | Mean | 1248.99 |
| | | Largest | Std. Dev. | 1060.295 |
| 75% | 1680 | 4750 | | |
| 90% | 2300 | 4750 | Variance | 1124225 |
| 95% | 3080 | 5040 | Skewness | 2.851669 |
| 99% | 5040 | 8455 | Kurtosis | 16.09019 |

Figure 24. Frequency distribution and percentiles values for PRICE




HOURS

| | Percentiles | Smallest | | |
|---|---|---|---|---|
| 1% | 6.5 | 4 | | |
| 5% | 7.5 | 6.5 | | |
| 10% | 7.5 | 6.5 | Obs | 173 |
| 25% | 16 | 6.5 | Sum of Wgt. | 173 |
| 50% | 32 | | Mean | 53.17052 |
| | | Largest | Std. Dev. | 49.89615 |
| 75% | 75 | 150 | | |
| 90% | 150 | 150 | Variance | 2489.626 |
| 95% | 150 | 150 | Skewness | 1.043911 |
| 99% | 150 | 150 | Kurtosis | 2.616934 |

Once again, in order to deal with normally distributed variables, PRICE and HOURS have been transformed into logarithmic variables and a new regression analysis has been run (Table 51).

It is immediate to notice a considerable increase in the R-squared, meaning that the model obtained after the logarithmic transformations better explains the variance of the price of open courses provided by technical universities. Moreover, it is possible to remark the significant difference between courses which take place in central Europe and courses which take place in Northern Europe. However, the significance of the variable ENG has been lost, while the existence of a project work once more does not suggest any significant influence on the price.

The analysis of standardized beta coefficients displays that the variable connected to the duration is the one that mostly influences the price, followed by the variable ONLINE, which contributes negatively to the price variation.

Table 51. Logarithmic regression model for open courses held by technical schools

| Source | SS | df | MS | Number of obs | = | 173 |
|---|---|---|---|---|---|---|
| | | | | F(6, 166) | = | 39.66 |
| Model | 65.3349066 | 6 | 10.8891511 | Prob > F | = | 0.0000 |
| Residual | 45.5806863 | 166 | .274582448 | R-squared | = | 0.5891 |
| | | | | Adj R-squared | = | 0.5742 |
| Total | 110.915593 | 172 | .644858098 | Root MSE | = | .52401 |

| logPRICE | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| logHOURS | .5235414 | .0466961 | 11.21 | 0.000 | .4313465 | .6157362 |
| ONLINE | -.5399935 | .0949785 | -5.69 | 0.000 | -.7275149 | -.352472 |
| ENG | .1426781 | .1512114 | 0.94 | 0.347 | -.1558672 | .4412235 |
| PROJECT | -.185021 | .1773419 | -1.04 | 0.298 | -.5351574 | .1651154 |
| REGION_CODES | | | | | | |
| SOUTH_EUROPE | -.0462408 | .1857172 | -0.25 | 0.804 | -.4129129 | .3204314 |
| CENT_EUROPE | .4419495 | .1449615 | 3.05 | 0.003 | .1557437 | .7281553 |
| _cons | 5.095082 | .2438817 | 20.89 | 0.000 | 4.613572 | 5.576592 |

Table 52. Logarithmic regression model with standardized beta coefficients

| Source | SS | df | MS | Number of obs | = | 173 |
|---|---|---|---|---|---|---|
| | | | | F(6, 166) | = | 39.66 |
| Model | 65.3349066 | 6 | 10.8891511 | Prob > F | = | 0.0000 |
| Residual | 45.5806863 | 166 | .274582448 | R-squared | = | 0.5891 |
| | | | | Adj R-squared | = | 0.5742 |
| Total | 110.915593 | 172 | .644858098 | Root MSE | = | .52401 |

| logPRICE | Coef. | Std. Err. | t | P>\|t\| | Beta |
|---|---|---|---|---|---|
| logHOURS | .5235414 | .0466961 | 11.21 | 0.000 | .6693378 |
| ONLINE | -.5399935 | .0949785 | -5.69 | 0.000 | -.3359283 |
| ENG | .1426781 | .1512114 | 0.94 | 0.347 | .0764009 |
| PROJECT | -.185021 | .1773419 | -1.04 | 0.298 | -.066944 |
| REGION_CODES | | | | | |
| SOUTH_EUROPE | -.0462408 | .1857172 | -0.25 | 0.804 | -.0234432 |
| CENT_EUROPE | .4419495 | .1449615 | 3.05 | 0.003 | .2061738 |
| _cons | 5.095082 | .2438817 | 20.89 | 0.000 | . |

Apart from the increase in the R-squared, the major effects brought by the logarithmic transformations of the variables PRICE and HOURS are actually related to the distribution of residuals. Figure 25 displays a random distribution of residuals, and this represents a remarkably difference from Figure 22. Cameron & Trivedi's test confirms the extinction of heteroskedasticity, while evidence of skewness and kurtosis still remain, even if the latter is weakly significant.

Figure 25. Plot of residuals after the logarithmic transformation of variables PRICE and HOURS

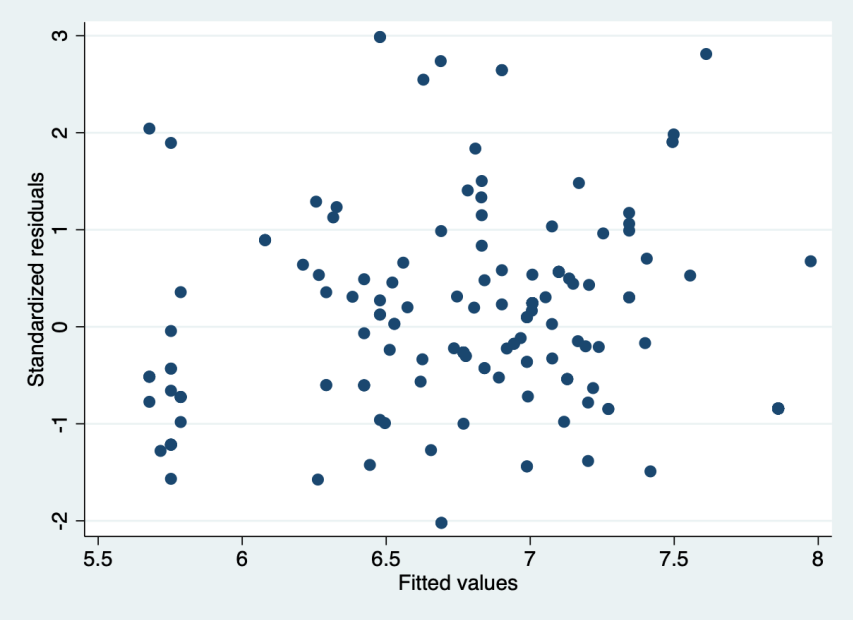



Table 53. Cameron & Trivedi's decomposition of IM-test

| Source | chi2 | df | p |
|---|---|---|---|
| Heteroskedasticity | 25.42 | 18 | 0.1139 |
| Skewness | 20.92 | 6 | 0.0019 |
| Kurtosis | 4.14 | 1 | 0.0418 |
| Total | 50.48 | 25 | 0.0019 |

As concerns the contribution played by topics on the price of open courses held by technical universities, a different procedure has been followed with respect to programs offered by business schools. First of all, it should be

recalled that, as concerns this dataset, topics have not been clustered into macro-topics, but they have been analyzed separately. The analysis has consisted in performing t-tests for each topic collected. Results of t-tests are shown in Table 54.

Table 54. T-tests for topics of open courses held by technical universities. Significative variables are indicated in bold

| Dichotomous variable | t-Ratio | p-Value | Standard Error | 95% Confidence Interval |
|---|---|---|---|---|
| **Cybersecurity** | **-3,6619** | **0.0003** | **370,71** | **(-2089.27; -625.75)** |
| **Data Science** | **3,2694** | **0.0013** | **191,28** | **(247.81; 1002.97)** |
| **AI & Machine Learning** | **-2,5577** | **0.0114** | **339,99** | **(-1540.71; -198.46)** |
| **Telecommunications & ICT** | **-2,4096** | **0.0170** | **238,65** | **(-1046.13; -103.96)** |
| **Industrial** | **-2,3078** | **0.0222** | **313,37** | **(-1341.74; -104.61)** |
| Energy | 1,5554 | 0.1217 | 329,01 | (-137.69; 1161.20) |
| Materials | 1,4462 | 0.1499 | 269,95 | (-142.46; 923.28) |
| Aerospace Engineering | 1,2034 | 0.2305 | 329,94 | (-254.22; 1048.33) |
| Transportation | 0,9244 | 0.3566 | 440,76 | (-462.57; 1277.48) |
| Design | 0,6799 | 0.4975 | 317,78 | (-411.22; 843.34) |
| Environment | 0,3149 | 0.7533 | 271,52 | (-450.47; 621.46) |
| Biomedical | -0,2776 | 0.7816 | 482,48 | (-1086.32; 818.44) |
| Safety & Risk Management | 0,1733 | 0.8627 | 482,55 | (-868.91; 1036.12) |
| Construction | 0,1339 | 0.8936 | 264,78 | (-487.21; 558.12) |

The table illustrates that the topics which significantly affect the price are cybersecurity, artificial intelligence and machine learning, telecommunications and ICT and industrial, all with a positive effect, and data science, with a negative contribution.

However, it can be demonstrated that the results obtained for the topic *data science* are strongly affected by universities which offer the courses. More particularly, Figure displays that this result is heavily biased by a group of 23 online courses about data science held by UCL - University College London (Table 55). Considering that the total number of courses on data science collected in the dataset is 37, it is likely that online courses on data science offered by UCL strongly influence the result displayed above.

Table 55. Distribution of open courses on data science

| University | RESIDENTIAL | ONLINE | Total |
|---|---|---|---|
| ETH Zurich | 2 | 0 | 2 |
| EPFL Lausanne | 1 | 0 | 1 |
| UCL - University College London | 4 | 23 | 27 |
| Universitat Politecnica de Catalunya | 2 | 0 | 2 |
| Università di Bologna | 1 | 0 | 1 |
| Université de Geneve | 2 | 1 | 3 |
| Delft University of Technology | 0 | 1 | 1 |
| Total | 12 | 25 | 37 |

This is confirmed by a t-test performed for the binary variable *Data Science* after having excluded courses held by University College London (Table 56). The result does not demonstrate any significant negative contribution and, actually, the negative t-ratio even suggests a positive influence on the price, even if not significant.

Table 56. t-Test for the variable Data Science after the deletion of courses held by UCL

| Dichotomous variable | t-Ratio | p-Value | Standard Error | 95% Confidence Interval |
|---|---|---|---|---|
| Data Science* | -0,8328 | 0.4068 | 384,38 | (-1082.18; 441.96) |

About the other significant topics, an interesting remark could be made about the fact that three of them, namely cybersecurity, AI and machine learning and telecommunications and ICT represent branches of information technology.

### *3.3.3. Discussion*

As already explained in this chapter, programs provided by technical universities present several dissimilarities compared to the ones offered by business schools. First of all, a fraction of the R-squared is unavoidably lost due to the absence of variables indicating accreditation and topic clustering.

In any case, the log-log regression model is surely the most suitable one. It exhibits a remarkably higher coefficient of determination and a more random distribution of residuals, thus indicating a better fit for predicted values. It has been demonstrated that a remarkable fraction of the price of courses is explained by their duration and their format, i.e. online or residential.

Furthermore, some factors did not show the expected results. In particular, the binary variable indicating whether a course is held in English or not did not provide a significant t-test, it then suggested a weakly significant influence according to the first regression model and again lost a considerable part of significativity in the log-log model. The variable indicating the existence of project works, instead, did never suggest a significant influence on the price of technical courses.

However, it is not unquestionable whether this lack of significativity demonstrated by both variables is due to the small sample of technical courses analyzed and to their diversity, or whether it actually reflects what are the real price drivers for such category of programs.

Finally, the examination of topics interestingly revealed that higher prices have been predicted for courses about ICT and its various branches, more precisely cybersecurity, artificial intelligence, machine learning and ICT.

## 3.4. Masters provided by Technical Schools

### *3.3.1. Correlation analysis and t-test*

The fourth and last regression analysis will be performed on master programs offered by technical schools and universities. The object of the analysis will be a dataset consisting of 154 observations about programs offered by 13 different universities located only in Italy and Switzerland. This represents the major variation if compared to the previous datasets, where the location of business schools, and technical universities was indicated through a cluster of geographical macro-areas. This change is explained by the peculiar nature of Italian masters, which could be defined as specialization courses to be attended after having achieved a bachelor or, most of the time, master's degree, in order to refine knowledge and skills in a specific field. The term "master", instead, is used worldwide to indicate a course to be taken after the attainment of a bachelor's degree, thus being comparable to the Italian master's degrees and giving rise to an ambiguous identification issue involving these two substantially different types of programs. Switzerland, on the other hand, is the only European country whose academic system allows the existence of a similar typology of program, although slightly different from the Italian one, since it includes three main types of programs: MAS, DAS and CAS. Because of the absence of a comparable typology of master courses worldwide, then, the dataset has been built taking only Italian and Swiss programs into account, with a respective amount of 93 (60,39%) and 61 (39,61%) master programs. Italian masters are divided into first-level, 45 (48,39%), and second-level masters, 48 (52,61%), whereas Swiss programs are represented by 14 (22,95%) MAS, 5 (8,20%) DAS and 42 (68,85%) CAS. In general, the average price equals €8353,07, while the average duration is 11,82 months, even if it must be highlighted that 97 masters (62,99%) have a duration of 12 months. The majority of masters (130) provide data about the

minimum job experience required, whose average value is 1,25 years, even if 89 (68,46%) of them do not require any previous experience (Table 57). Moreover, 125 (81,17%) masters are granted in a residential mode, 25 (16,23%) are offered in a blended format and only 4 (2,60%) are entirely channeled online. Concerning the structure, 66 masters (59,46% of observed values) require a full-time attendance and 45 (40,54% of observed values) can be attended part-time, while 43 masters do not provide data about their structure. The dataset is almost perfectly divided into masters held in English, 78 (50,65%), and masters held in other languages, more precisely Italian, German or French, 76 (49,35%). Furthermore, 38 masters (24,68%) allow the opportunity of doing a stage and 35 (22,73%) involve project works. Finally, masters have been grouped into 18 different topics, the most frequent of whom are construction (55) and design (21). More detailed information is exhibited in Table 58.

Table 57. Summary statistics for variables PRICE, MONTHS and EXPERIENCE

| Variable | Observations | Mean | Standard Deviation | Min | Max |
|---|---|---|---|---|---|
| **PRICE** | 154 | 8353,07 | 5.985 | 2000 | 37551,07 |
| **MONTHS** | 154 | 11,82 | 4,80 | 0,5 | 36 |
| **EXPERIENCE** | 130 | 1,25 | 2,00 | 0 | 5 |

From a correlation analysis (Table 59) it emerges that the duration of masters is positively correlated with the price, contrarily to what seen concerning business schools' masters. However, quite surprisingly, no significant correlation has been detected between the price and the minimum years of job experience required to join a master (Figure 26).

Table 58. Summary statistics for dichotomous and categorical variables

| Dichotomous variable | Frequency | Percentage | Cum. Perc. |
|---|---|---|---|
| **ENG** | | | |
| 0 | 76 | 49.35 | 49.35 |
| 1 | 78 | 50.65 | 100.00 |
| **SWI** | | | |
| 0 | 93 | 60.39 | 60.39 |
| 1 | 61 | 39.61 | 100.00 |
| **MODULAR** (122 obs.) | | | |
| 0 | 108 | 88.52 | 88.52 |
| 1 | 14 | 11.48 | 100.00 |
| **STAGE** | | | |
| 0 | 116 | 75.32 | 75.32 |
| 1 | 38 | 24.68 | 100.00 |
| **PROJECT** | | | |
| 0 | 119 | 77.27 | 77.27 |
| 1 | 35 | 22.73 | 100.00 |
| **FORMAT** | | | |
| BLENDED | 25 | 16.23 | 16.23 |
| ONLINE | 4 | 2.60 | 18.83 |
| RESIDENTIAL | 125 | 81.17 | 100.00 |
| **STRUCTURE** (111 obs.) | | | |
| FULL-TIME | 66 | 59.46 | 59.46 |
| PART-TIME | 45 | 40.54 | 100.00 |

Figure 26. Scatter plots for MONTHS and PRICE (left) and EXPERIENCE and PRICE (right)

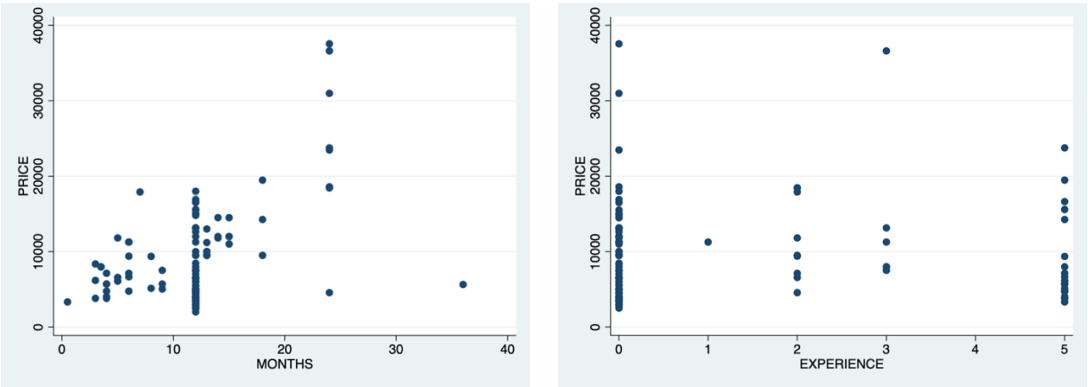


Table 59. Correlation matrix for quantitative variables PRICE, MONTHS and EXPERIENCE

| | **PRICE** | **MONTHS** | **EXPERIENCE** |
|---|---|---|---|
| **PRICE** | 1.0000 | | |
| **MONTHS** | 0.4569* | 1.0000 | |
| **EXPERIENCE** | -0.0068** | -0.3307* | 1.0000 |

*correlation significant at the 0,01 level (2-tailed)

** non-significant

Categorical variables have been evaluated through Bonferroni tests. Concerning FORMAT, the Bonferroni test (Figure 27) does not indicate significative differences between the means of the pairs of groups, even if the low p-value (0,056) connected to the difference between residential and blended masters suggests an almost significative difference among their means (Table 60).

Table 60. Bonferroni test for the categorical variable FORMAT

| Row Mean - Col Mean | **BLENDED** | **ONLINE** |
|---|---|---|
| **ONLINE** | -2436.47 | |
| | 1.000 | |
| **RESIDENTIAL** | 3055.23 | 5491.69 |
| | 0.056 | 0.201 |

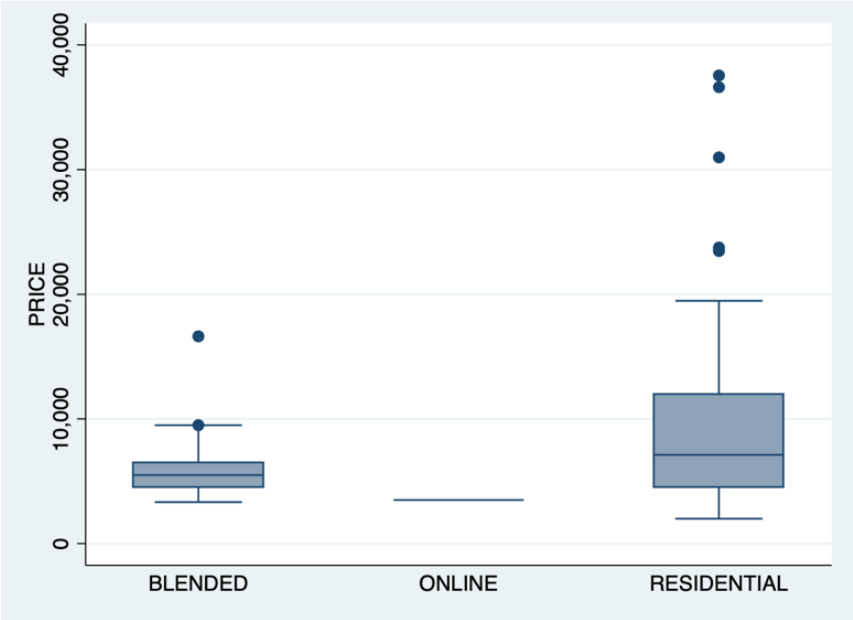
Table 61. Analysis of Variance for the categorical variable FORMAT

| | Summary of PRICE | | |
|---|---|---|---|
| FORMAT | Mean | Std. Dev. | Freq. |
| BLENDED | **5936.4664** | **2725.1423** | **25** |
| ONLINE | **3500** | **0** | **4** |
| RESIDENTIAL | **8991.6942** | **6357.1771** | **125** |
| Total | **8353.0742** | **5985.1238** | **154** |

Moreover, the ANOVA table (Table 61) displays a null standard deviation for the group ONLINE, meaning that all the four online masters collected have the same price, i.e. €3500, and, as it can be demonstrated by looking at the dataset, they are provided by the same university, i.e. Politecnico di Milano.

This output, then, suggests that any further comment about results involving any influence by online masters should be carefully read.

Figure 27. Boxplot for the categorical variable FORMAT

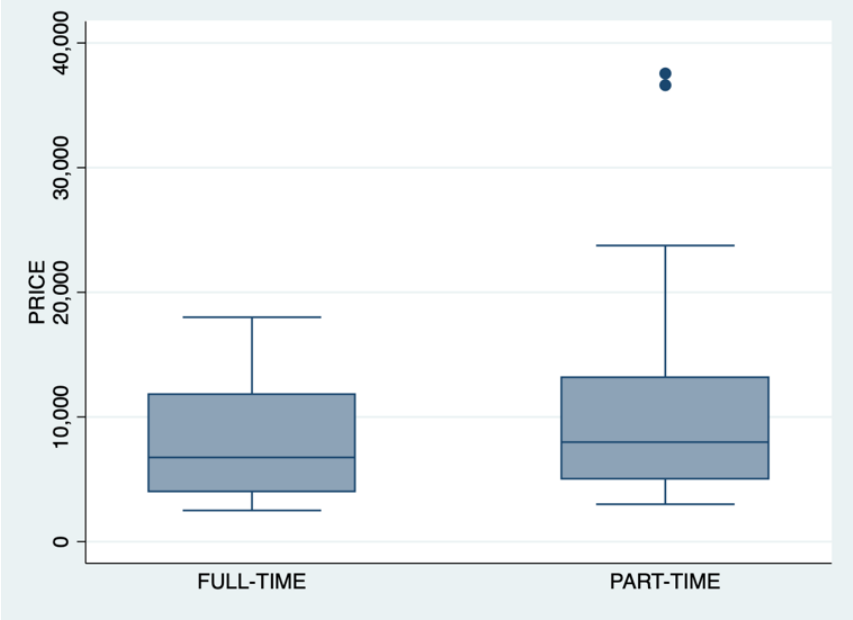



The equivalent analysis for the categorical variable STRUCTURE (Figure 28), instead, depicts a significant difference between the means of full-time and part-time courses, with the latter being offered, on average, at a price around €2500 higher with respect to the former (Table 62).

Table 62. Bonferroni test for the categorical variable STRUCTURE

| Row Mean - Col Mean | **FULL-TIME** |
|---|---|
| **PART-TIME** | 2682.84 |
| | 0.023 |

Figure 28. Boxplot for the categorical variable STRUCTURE




As usual, in the end, t-tests have been performed for binary variables. Table shows that variables SWI, ENG and PROJECT have a positive significant influence on price, in line with expectations, while MODULAR and STAGE do not bring any significant contribution (Table 63).

Table 63. t-Tests for dichotomous variables

| Dichotomous variable | t-Ratio | p-Value | Standard Error | 95% Confidence Interval |
|---|---|---|---|---|
| **ENG** | -2,4153 | 0.0169 | 949,785 | (-4170.47; -417.50) |
| **SWI** | -4,6521 | 0.0000 | 925,646 | (-6135.04; -2477.45) |
| **MODULAR** | -0,4489 | 0.6543 | 1798,103 | (-4367.37; 2752.87) |
| **STAGE** | 1,1400 | 0.2561 | 1117,604 | (-934.02; 3482.07) |
| **PROJECT** | -2,9402 | 0.0038 | 1123,151 | (-5521.31; -1083.31) |

### *3.3.2. Hedonic pricing regression*

The first regression model has been developed by following a stepwise backward procedure. The model brought to the progressive deletion of variables concerning experience, stage and format, that did not suggest any

significant influence on the price variation. The resulting output is displayed below (Table 64).

It should be noted that this first analysis does not take into consideration the distinction between different levels of masters for a given country, but it only considers the country in which universities are located, i.e. Switzerland or Italy, indicated by the dichotomous variable SWI. Other predictors applied in the model are the binary variables ENG and PROJECT, the numerical variable MONTHS and the categorical variable FORMAT, which takes the group RESIDENTIAL as baseline.

Table 64. Regression model for masters held by technical universities

| Source | SS | df | MS | Number of obs | = | 154 |
|---|---|---|---|---|---|---|
| | | | | F(6, 147) | = | 22.05 |
| Model | 2.5962e+09 | 6 | 432705737 | Prob > F | = | 0.0000 |
| Residual | 2.8845e+09 | 147 | 19622358.2 | R-squared | = | 0.4737 |
| | | | | Adj R-squared | = | 0.4522 |
| Total | 5.4807e+09 | 153 | 35821706.4 | Root MSE | = | 4429.7 |

| PRICE | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| MONTHS | 606.4501 | 75.3803 | 8.05 | 0.000 | 457.4811 | 755.4192 |
| SWI | 4965.784 | 751.8677 | 6.60 | 0.000 | 3479.918 | 6451.65 |
| ENG | 1292.975 | 741.6504 | 1.74 | 0.083 | -172.699 | 2758.649 |
| PROJECT | 2587.56 | 885.1568 | 2.92 | 0.004 | 838.2837 | 4336.836 |
| FORMAT_CODES | | | | | | |
| BLENDED | -2999.832 | 992.3187 | -3.02 | 0.003 | -4960.886 | -1038.779 |
| ONLINE | -3296.14 | 2273.364 | -1.45 | 0.149 | -7788.838 | 1196.559 |
| _cons | -1451.396 | 1089.359 | -1.33 | 0.185 | -3604.223 | 701.4321 |

First of all, the R-squared equal to 0,47 indicates a good, though not excellent, explanation of the variance of the dependent variable. This can be considered a satisfying result due to the small number of observations and to the lower number of predictors compared to the previous models. The output also shows that:

- the number of months which constitute the duration of a master significatively influences the price in a positive way and, more precisely, each additional month brings a €606,45 contribution;
- at a confidence interval of 95%, it can be stated that masters held by Swiss universities are charged, on average, a higher cost equal to nearly €5000 with respect to masters offered by Italian universities;
- the language factor does not significantly affect the final price, even if values for variable ENG suggest a positive influence on the price, with a p-value equal to 0,083;
- masters which involve project works cost, on average, more than other masters;
- the format of the master significantly affects the dependent variable price; more precisely, residential masters charge a higher price (around €3000) with respect to blended masters;
- the negative value of the constant has only a mathematical, and not economic, meaning: it is caused, among the other reasons, by the fact that all the masters included in the dataset have duration greater than four months, so that the model adapts itself in order to avoid too high expected prices.

As illustrated by the related standardized betas (Table 65), the variables that mostly influence the regression model are the ones connected to the duration of the master program (0,49) and to the country in which the program takes place (0,41).

Table 65. Regression model with standardized beta coefficients

| Source | SS | df | MS | Number of obs | = | 154 |
|---|---|---|---|---|---|---|
| | | | | F(6, 147) | = | 22.05 |
| Model | 2.5962e+09 | 6 | 432705737 | Prob > F | = | 0.0000 |
| Residual | 2.8845e+09 | 147 | 19622358.2 | R-squared | = | 0.4737 |
| | | | | Adj R-squared | = | 0.4522 |
| Total | 5.4807e+09 | 153 | 35821706.4 | Root MSE | = | 4429.7 |

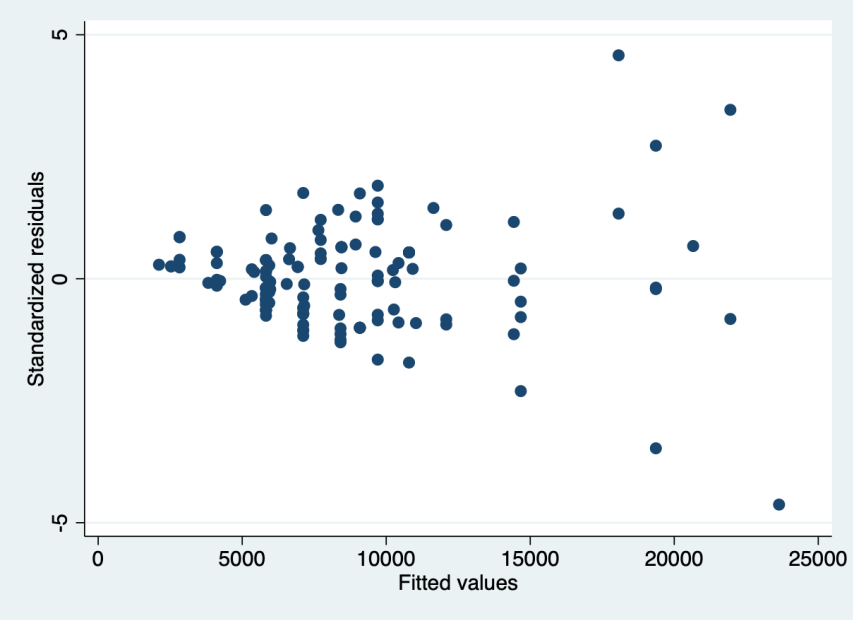
| PRICE | Coef. | Std. Err. | t | P>\|t\| | Beta |
|---|---|---|---|---|---|
| MONTHS | 606.4501 | 75.3803 | 8.05 | 0.000 | .4863514 |
| SWI | 4965.784 | 751.8677 | 6.60 | 0.000 | .407113 |
| ENG | 1292.975 | 741.6504 | 1.74 | 0.083 | .108359 |
| PROJECT | 2587.56 | 885.1568 | 2.92 | 0.004 | .1817685 |
| FORMAT_CODES | | | | | |
| BLENDED | -2999.832 | 992.3187 | -3.02 | 0.003 | -.1854311 |
| ONLINE | -3296.14 | 2273.364 | -1.45 | 0.149 | -.0878824 |
| _cons | -1451.396 | 1089.359 | -1.33 | 0.185 | . |

Furthermore, variance inflation factors explain that multicollinearity among predictors is considerably low (Table 66), while, as it has been observed also in previous regression models, this linear model presents an evident existence of collinearity, with residuals characterized by a higher dispersion for higher expected prices (Figure 29).

Table 66. Variance Inflation Factors for independent variables

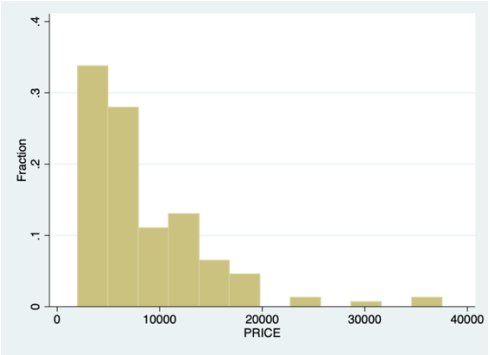
| Variable | VIF | 1/VIF |
|---|---|---|
| MONTHS | 1.02 | 0.979687 |
| SWI | 1.06 | 0.942272 |
| ENG | 1.08 | 0.926756 |
| PROJECT | 1.08 | 0.926012 |
| STRUCTURE_~S | | |
| 2 | 1.05 | 0.951568 |
| 3 | 1.03 | 0.974502 |
| Mean VIF | 1.05 | |

Figure 29. Plot of standardized residuals according to the regression model of Table 64




In order to correct this violation to the hypothesis of a normal distribution of residuals, quantitative variables should be transformed following the procedure described in previous chapters. Looking at histograms for PRICE, MONTHS and EXPERIENCE, however, only the former suggests a logarithmic transformation (Figure 30), while MONTHS and EXPERIENCE do not follow a particular pattern (Figure 31).

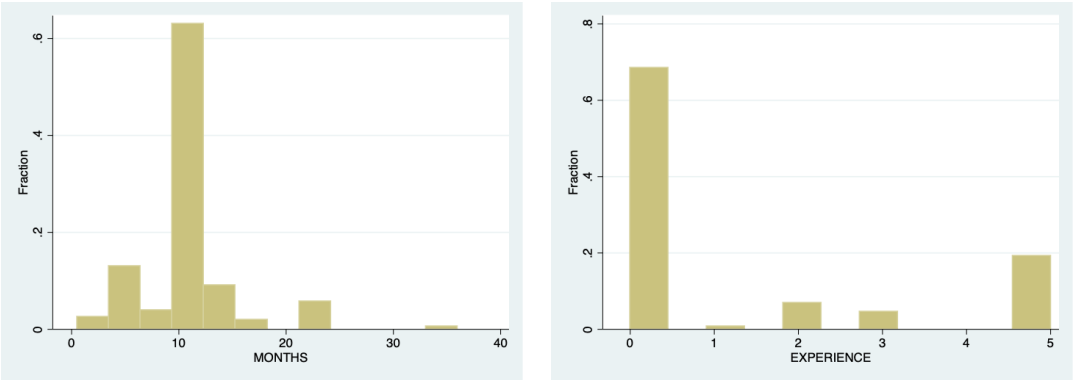
Figure 30. Frequency distribution and percentiles values for PRICE




PRICE

| | Percentiles | Smallest | | |
|---|---|---|---|---|
| 1% | 2500 | 2000 | | |
| 5% | 3000 | 2500 | | |
| 10% | 3500 | 2500 | Obs | 154 |
| 25% | 4037.5 | 2500 | Sum of Wgt. | 154 |
| 50% | 6500 | | Mean | 8353.074 |
| | | Largest | Std. Dev. | 5985.124 |
| 75% | 11265.32 | 23750 | | |
| 90% | 15500 | 30979.63 | Variance | 3.58e+07 |
| 95% | 18456.35 | 36612.29 | Skewness | 2.18606 |
| 99% | 36612.29 | 37551.07 | Kurtosis | 9.548494 |

Figure 31. Histograms for MONTHS (left) and EXPERIENCE (right)




A new regression model has then been developed (Table 67), with the only change being represented by the logarithmic transformation of the variable PRICE into logPRICE, which will now act as dependent variable. The log-model, apart from a slight decrease in the R-squared, presents some improvements, mainly due to the fact that all variables applied offer a significant contribution to the price change.

Table 67. Logarithmic regression model for masters held by technical schools

| Source | SS | df | MS | Number of obs | = | 154 |
|---|---|---|---|---|---|---|
| | | | | F(6, 147) | = | 16.07 |
| Model | 22.1493388 | 6 | 3.69155647 | Prob > F | = | 0.0000 |
| Residual | 33.7719636 | 147 | .229741249 | R-squared | = | 0.3961 |
| | | | | Adj R-squared | = | 0.3714 |
| Total | 55.9213025 | 153 | .365498709 | Root MSE | = | .47931 |

| logPRICE | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| MONTHS | .0447408 | .0081565 | 5.49 | 0.000 | .0286217 | .0608598 |
| SWI | .4912952 | .0813552 | 6.04 | 0.000 | .3305184 | .6520721 |
| ENG | .1645272 | .0802496 | 2.05 | 0.042 | .0059352 | .3231192 |
| PROJECT | .2935587 | .0957776 | 3.07 | 0.003 | .1042798 | .4828377 |
| FORMAT_CODES | | | | | | |
| BLENDED | -.2749775 | .107373 | -2.56 | 0.011 | -.4871716 | -.0627834 |
| ONLINE | -.5110198 | .2459874 | -2.08 | 0.040 | -.9971484 | -.0248912 |
| _cons | 8.020128 | .1178732 | 68.04 | 0.000 | 7.787183 | 8.253073 |

In particular, the price is greater for longer durations, for masters held by Swiss universities, for masters held in English and for masters that involve project

works, while blended and online masters cost, on average, less than residential ones. As before, variables MONTHS and SWI are the ones with a greater influence on the percentage variation of the price (Table 68).

Table 68. Logarithmic regression model with standardized beta coefficients

| Source | SS | df | MS | Number of obs | = | 154 |
|---|---|---|---|---|---|---|
| | | | | F(6, 147) | = | 16.07 |
| Model | 22.1493388 | 6 | 3.69155647 | Prob > F | = | 0.0000 |
| Residual | 33.7719636 | 147 | .229741249 | R-squared | = | 0.3961 |
| | | | | Adj R-squared | = | 0.3714 |
| Total | 55.9213025 | 153 | .365498709 | Root MSE | = | .47931 |

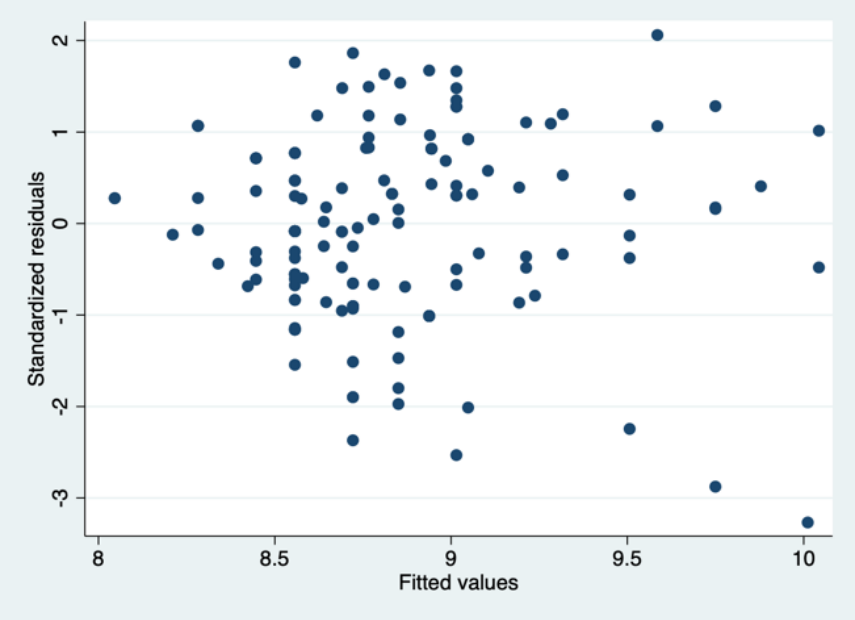
| logPRICE | Coef. | Std. Err. | t | P>\|t\| | Beta |
|---|---|---|---|---|---|
| MONTHS | .0447408 | .0081565 | 5.49 | 0.000 | .355213 |
| SWI | .4912952 | .0813552 | 6.04 | 0.000 | .3987493 |
| ENG | .1645272 | .0802496 | 2.05 | 0.042 | .1365032 |
| PROJECT | .2935587 | .0957776 | 3.07 | 0.003 | .2041519 |
| FORMAT_CODES | | | | | |
| BLENDED | -.2749775 | .107373 | -2.56 | 0.011 | -.1682724 |
| ONLINE | -.5110198 | .2459874 | -2.08 | 0.040 | -.1348852 |
| _cons | 8.020128 | .1178732 | 68.04 | 0.000 | . |

Despite the logarithmic transformation of the variable PRICE, however, the heteroskedasticity affecting the model still remains, even if its effects have been reduced by the new model (Figure 32 and 33).

Figure 32. Cameron & Trivedi's decomposition of IM-test

| Source | chi2 | df | p |
|---|---|---|---|
| Heteroskedasticity | 50.33 | 19 | 0.0001 |
| Skewness | 33.20 | 6 | 0.0000 |
| Kurtosis | 0.03 | 1 | 0.8549 |
| Total | 83.56 | 26 | 0.0000 |

Figure 33. Plot of standardized residuals according to the regression model of Table 67




It has already been said a lot about the specific nature of Italian technical masters and their differences from masters offered in other countries. As said when describing the dataset, the most similar typology of masters is represented by Swiss programs. However, notwithstanding this similarity, Italian and Swiss master programs still present some noteworthy differences, above all the one related to the classification of programs, i.e. MAS, DAS and CAS for Swiss masters and first-level and second-level for Italian ones.

This is the reason why a specific regression model will be built, in the following paragraph, only for Italian programs, in order to find out which are the main price drivers for Italian masters.

Then, the binary variable SWI has been deleted, and Swiss masters have been dropped from the dataset. The remaining 93 masters will be the object of the following analysis.

Running a new regression model (Table 69), it can be observed that almost half of the variance (0,49) of the price of Italian masters is explained by the variables applied. Moreover, all the predictors exhibit significant influences on the price and, more specifically, the output exhibits that:

- each month increases the price of almost €2000;
- master programs in English are charged prices around €1300 higher than masters held in Italian;
- programs involving project works cost nearly €2700 more than other masters;
- first-level masters, quite surprisingly, are more expensive than second-level ones, by a value amounting to almost €2000;
- residential masters are around €3000 more expensive than online masters, while there are not significant indications concerning the expected difference between residential and blended programs.

Regarding the constant, finally, it should be recalled that such a high negative value must be interpreted carefully, since it is strongly influenced by the variable MONTHS. More precisely, the majority of masters have a duration amounting to twelve months, and the duration itself gives a significantly positive contribution to the price. This translates in an automatic adjustment by the constant, in order to fit the price of each master as precisely as possible. Moreover, the analysis of standardized betas (Table 70) shows that the duration is the most influencing driver, followed respectively by the variable indicating the existence of project works and by the one related to the type of the master (first or second level).

Table 69. Regression model for Italian masters held by technical universities

| Source | SS | df | MS | Number of obs | = | 93 |
|---|---|---|---|---|---|---|
| | | | | F(6, 86) | = | 13.62 |
| Model | 658408472 | 6 | 109734745 | Prob > F | = | 0.0000 |
| Residual | 693068885 | 86 | 8058940.52 | R-squared | = | 0.4872 |
| | | | | Adj R-squared | = | 0.4514 |
| Total | 1.3515e+09 | 92 | 14689971.3 | Root MSE | = | 2838.8 |

| PRICE | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| MONTHS | 1923.121 | 442.8231 | 4.34 | 0.000 | 1042.818 | 2803.425 |
| ENG | 1292.328 | 630.9356 | 2.05 | 0.044 | 38.06977 | 2546.587 |
| PROJECT | 2673.211 | 683.9074 | 3.91 | 0.000 | 1313.648 | 4032.774 |
| MASTER_2 | -1920.912 | 679.4562 | -2.83 | 0.006 | -3271.626 | -570.1979 |
| FORMAT_CODES | | | | | | |
| BLENDED | 70.9721 | 859.207 | 0.08 | 0.934 | -1637.075 | 1779.019 |
| ONLINE | -2976.841 | 1485.815 | -2.00 | 0.048 | -5930.543 | -23.13937 |
| _cons | -17111.77 | 5574.147 | -3.07 | 0.003 | -28192.81 | -6030.736 |

Table 70. Regression model with standardized beta coefficients

| Source | SS | df | MS | Number of obs | = | 93 |
|---|---|---|---|---|---|---|
| | | | | F(6, 86) | = | 13.62 |
| Model | 658408472 | 6 | 109734745 | Prob > F | = | 0.0000 |
| Residual | 693068885 | 86 | 8058940.52 | R-squared | = | 0.4872 |
| | | | | Adj R-squared | = | 0.4514 |
| Total | 1.3515e+09 | 92 | 14689971.3 | Root MSE | = | 2838.8 |

| PRICE | Coef. | Std. Err. | t | P>\|t\| | Beta |
|---|---|---|---|---|---|
| MONTHS | 1923.121 | 442.8231 | 4.34 | 0.000 | .3634829 |
| ENG | 1292.328 | 630.9356 | 2.05 | 0.044 | .1687084 |
| PROJECT | 2673.211 | 683.9074 | 3.91 | 0.000 | .3068439 |
| MASTER_2 | -1920.912 | 679.4562 | -2.83 | 0.006 | -.251819 |
| FORMAT_CODES | | | | | |
| BLENDED | 70.9721 | 859.207 | 0.08 | 0.934 | .0066576 |
| ONLINE | -2976.841 | 1485.815 | -2.00 | 0.048 | -.158429 |
| _cons | -17111.77 | 5574.147 | -3.07 | 0.003 | . |

Additionally, due to the limited number of universities whose masters have been collected in the dataset, data about universities have been tabulated,

with the aim of finding eventual significantly different prices charged by individual universities.

Results show that one university, Politecnico di Milano, seems to depart from average results. Actually, Politecnico di Milano, among the universities for which at least four masters have been collected, is the one with the highest frequency (a sample of 38 programs has been collected) and the one which charges remarkably higher prices compared to others.

Table 71. List of masters collected for each Italian university

| University | Mean | Standard Deviation | Frequency |
|---|---|---|---|
| Politecnico di Milano | 8.816 | 3.590,0 | 38 |
| Politecnico di Torino | 6.857 | 5.137,4 | 7 |
| Sapienza Università di Roma | 4.221 | 1.443,8 | 24 |
| Università Ca' Foscari Venezia | 5.088 | 681,1 | 4 |
| Università degli studi di Milano | 4.600 | 1.193,7 | 5 |
| Università degli studi di Padova | 3.700 | 389,0 | 5 |
| Università di Bologna | 8.900 | 8.343,9 | 2 |
| Università di Genova | 2.766 | 0,0 | 1 |
| Università di Modena e Reggio Emilia | 4.750 | 288,7 | 4 |
| Università di Pavia | 15.000 | 0,0 | 2 |
| Università di Trento | 2.500 | 0,0 | 1 |

This result is confirmed by the t-test performed with the objective of finding out eventual significant influence on the price played by masters held by Politecnico di Milano. The t-ratio equal to -5,12 indeed validates this hypothesis.

Table 72. t-Test for the dichotomous variable POLIMI

| Dichotomous variable | t-Ratio | p-Value | Standard Error | 95% Confidence Interval |
|---|---|---|---|---|
| **POLIMI** | -5,1179 | 0.0000 | 716,345 | (-5089.11; -2243.25) |

This said, in order to make explicit this strong influence played by Politecnico di Milano, a binary variable called POLIMI has been created and added to the previous regression model.

As expected, this has brought an increase in the R-squared due to the additional information added by POLIMI. The newly created variable, according to the output, also contributes to the price change with a significant positive variation and, more precisely, prices increase by more than €2000 for masters held by Politecnico di Milano. As concerns the other variables, instead, nothing noteworthy has changed with respect to the previous model. Detailed results are displayed in Table 73.

Table 73. Regression model for Italian masters held by technical universities

| Source | SS | df | MS | Number of obs | = | 93 |
|---|---|---|---|---|---|---|
| | | | | F(7, 85) | = | 13.84 |
| Model | 719958882 | 7 | 102851269 | Prob > F | = | 0.0000 |
| Residual | 631518474 | 85 | 7429629.11 | R-squared | = | 0.5327 |
| | | | | Adj R-squared | = | 0.4942 |
| Total | 1.3515e+09 | 92 | 14689971.3 | Root MSE | = | 2725.7 |

| PRICE | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| MONTHS | 1333.593 | 471.9439 | 2.83 | 0.006 | 395.242 | 2271.944 |
| ENG | 1297.262 | 605.803 | 2.14 | 0.035 | 92.76322 | 2501.76 |
| PROJECT | 2079.101 | 688.3392 | 3.02 | 0.003 | 710.4981 | 3447.704 |
| MASTER_2 | -1489.844 | 669.3581 | -2.23 | 0.029 | -2820.707 | -158.9805 |
| POLIMI | 2142.17 | 744.2556 | 2.88 | 0.005 | 662.3909 | 3621.95 |
| FORMAT_CODES | | | | | | |
| BLENDED | -588.9636 | 856.247 | -0.69 | 0.493 | -2291.412 | 1113.485 |
| ONLINE | -4454.154 | 1516.144 | -2.94 | 0.004 | -7468.654 | -1439.653 |
| _cons | -10662.76 | 5802.157 | -1.84 | 0.070 | -22199 | 873.4816 |

Furthermore, looking at standardized beta coefficients, it can also be noted that POLIMI is the most influencing variable, closely followed by MONTHS and PROJECT (Figure 74).

Table 74. Regression model with standardized beta coefficients

| Source | SS | df | MS | Number of obs | = | 93 |
|---|---|---|---|---|---|---|
| | | | | F(7, 85) | = | 13.84 |
| Model | 719958882 | 7 | 102851269 | Prob > F | = | 0.0000 |
| Residual | 631518474 | 85 | 7429629.11 | R-squared | = | 0.5327 |
| | | | | Adj R-squared | = | 0.4942 |
| Total | 1.3515e+09 | 92 | 14689971.3 | Root MSE | = | 2725.7 |

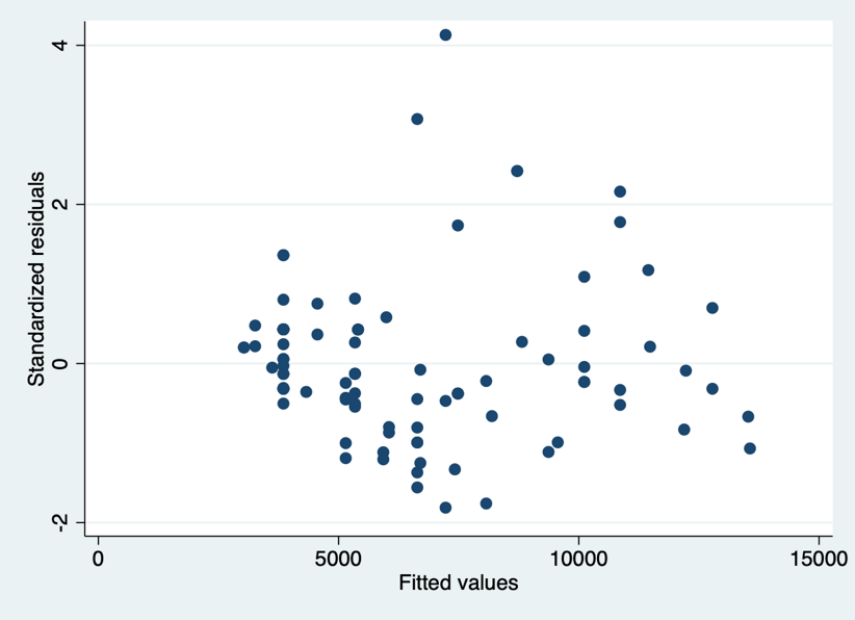
| PRICE | Coef. | Std. Err. | t | P>\|t\| | Beta |
|---|---|---|---|---|---|
| MONTHS | 1333.593 | 471.9439 | 2.83 | 0.006 | .2520581 |
| ENG | 1297.262 | 605.803 | 2.14 | 0.035 | .1693525 |
| PROJECT | 2079.101 | 688.3392 | 3.02 | 0.003 | .2386491 |
| MASTER_2 | -1489.844 | 669.3581 | -2.23 | 0.029 | -.1953088 |
| POLIMI | 2142.17 | 744.2556 | 2.88 | 0.005 | .2762366 |
| FORMAT_CODES | | | | | |
| BLENDED | -588.9636 | 856.247 | -0.69 | 0.493 | -.0552485 |
| ONLINE | -4454.154 | 1516.144 | -2.94 | 0.004 | -.2370524 |
| _cons | -10662.76 | 5802.157 | -1.84 | 0.070 | . |

Finally, differently from what observed in the cases of other courses, this model also gives a satisfying residual plot, without the need for a logarithmic transformation. From Figure 34, indeed, neither heteroskedasticity nor skewness nor kurtosis seems to arise. However, Cameron & Trivedi's test (Table 75) demonstrates the existence of low heteroskedasticity and skewness, thus suggesting a logarithmic transformation of the variable PRICE.

Table 75. Cameron & Trivedi's decomposition of IM-test

| Source | chi2 | df | p |
|---|---|---|---|
| Heteroskedasticity | 35.98 | 23 | 0.0415 |
| Skewness | 17.01 | 7 | 0.0173 |
| Kurtosis | 2.02 | 1 | 0.1554 |
| Total | 55.01 | 31 | 0.0050 |

Figure 34. Plot of residuals according to the regression model of Table 73




The model obtained after the customary transformation of PRICE into logPRICE does not demonstrate major changes, except the loss of significativity regarding the contribution of the English language on the price of the master program (Table 76).

Table 76. Logarithmic regression model for Italian masters held by technical universities

| Source | SS | df | MS | Number of obs | = | 93 |
|---|---|---|---|---|---|---|
| | | | | F(7, 85) | = | 14.02 |
| Model | 14.0313514 | 7 | 2.00447877 | Prob > F | = | 0.0000 |
| Residual | 12.1494266 | 85 | .142934431 | R-squared | = | 0.5359 |
| | | | | Adj R-squared | = | 0.4977 |
| Total | 26.180778 | 92 | .284573674 | Root MSE | = | .37807 |

| logPRICE | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| MONTHS | .154418 | .0654599 | 2.36 | 0.021 | .0242662 | .2845698 |
| ENG | .0953266 | .0840265 | 1.13 | 0.260 | -.0717406 | .2623938 |
| PROJECT | .2323091 | .0954745 | 2.43 | 0.017 | .0424802 | .4221379 |
| MASTER_2 | -.2293945 | .0928418 | -2.47 | 0.015 | -.4139888 | -.0448002 |
| POLIMI | .4033752 | .1032302 | 3.91 | 0.000 | .1981258 | .6086245 |
| FORMAT_CODES | | | | | | |
| BLENDED | -.0024189 | .1187638 | -0.02 | 0.984 | -.2385531 | .2337153 |
| ONLINE | -.7655012 | .2102932 | -3.64 | 0.000 | -1.183621 | -.3473819 |
| _cons | 6.645069 | .8047748 | 8.26 | 0.000 | 5.044961 | 8.245177 |

From the analysis of residuals (Figure 35), it is not easy to graphically detect any difference with respect to the one of Figure 34, while Cameron & Trivedi's test exhibit a small improvement in the skewness and in the heteroskedasticity of the distribution, even if the latter still remains (weakly) significantly present (Table 77).

Figure 35. Plot of residuals according to the regression model of Table 76

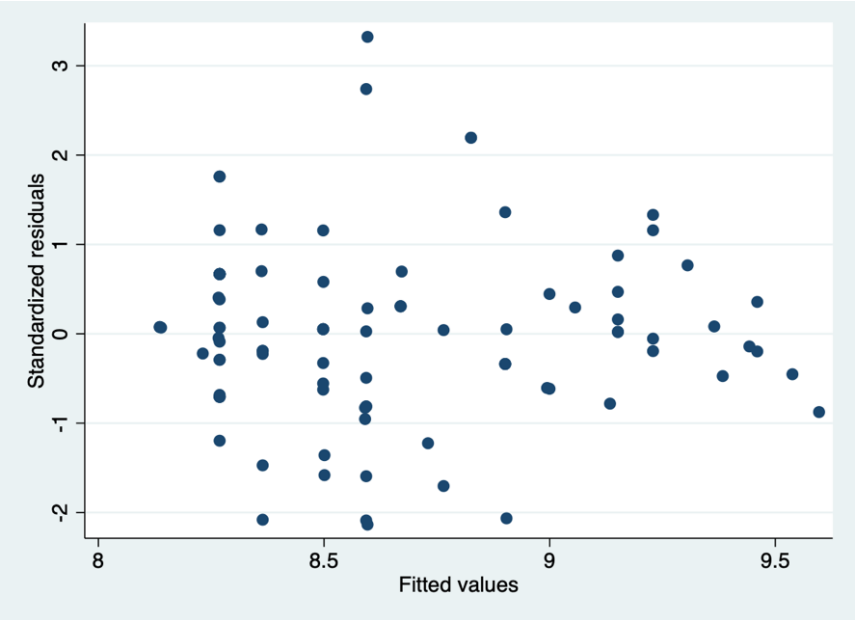



Table 77. Cameron & Trivedi's decomposition of IM-test

| Source | chi2 | df | p |
|---|---|---|---|
| Heteroskedasticity | 37.26 | 23 | 0.0305 |
| Skewness | 11.28 | 7 | 0.1267 |
| Kurtosis | 2.51 | 1 | 0.1132 |
| Total | 51.06 | 31 | 0.0131 |

Finally, effects of topics have been tested too, as done for open courses provided by technical universities. To this aim, the original dataset has been considered, including both Swiss and Italian masters. Influence played by

topics has been evaluated by means of t-tests, as done for other typologies of programs. Related results are exhibited in Table 78.

Table 78. t-Tests for topics of masters held by technical universities

| Dichotomous variable | t-Ratio | p-Value | Standard Error | 95% Confidence Interval |
|---|---|---|---|---|
| **Environment** | **3,0675** | **0.0026** | **1538,92** | **(1680.16; 7761.02)** |
| **Technology** | **-2,3681** | **0.0191** | **1602,44** | **(-6961.61; -628.95)** |
| **Design** | **-2,2263** | **0.0275** | **1387,56** | **(-5830.53; -347.71)** |
| Electrical & Energy | 1,5657 | 0.1195 | 2304,49 | (-944.85; 8161.10) |
| Agriculture | 1,3242 | 0.1874 | 3481,11 | (-2268.07; 11487.15) |
| Transportation | -1,0973 | 0.2742 | 3030,18 | (-9311.85; 2661.56) |
| Chemistry | 1,0356 | 0.3020 | 4258,87 | (-4003.86; 12824.57) |
| Healthcare & Biomedicine | 0,9798 | 0.3287 | 3490,13 | (-3475.73; 10315.11) |
| Astronautics & Space | 0,8819 | 0.3792 | 3492,21 | (-3819.80; 9979.27) |
| Safety | -0,8175 | 0.4149 | 4264,50 | (-11911.44; 4939.26) |
| Construction | 0,7859 | 0.4331 | 1007,81 | (-1199.08; 2783.16) |
| Cars & Vehicles | -0,7237 | 0.4703 | 3495,11 | (-9434.81; 4375.74) |
| IT & Computer Science | 0,4758 | 0.6349 | 2061,24 | (-3091.72; 5053.04) |
| IoT | 0,4653 | 0.6424 | 2728,16 | (-4120.73; 6659.30) |
| Data Science | 0,4548 | 0.6499 | 2498,94 | (-3800.67; 6073.60) |
| Cybersecurity | 0,1722 | 0.8635 | 1878,67 | (-3388.16; 4035.20) |
| Materials | -0,1088 | 0.9135 | 3500,99 | (-7297.78; 6536.00) |
| Industrial & Manufacturing | -0,0205 | 0.9837 | 2323,00 | (-4637.18; 4541.90) |

It can be inferred that most of the examined topics do not show any significant influence on the price. The only exceptions are represented by master programs about Environment, Technology or Design.

However, this output must be taken with a pinch of salt because of the low number of programs collected for each topic and because of some dependence from other variables, especially concerning universities.

More precisely, only 3% of masters provided by Swiss universities and Politecnico di Milano are about environment, against a 31% of masters held by other universities (Table 79).

Table 79. Summarized data on masters about environment

| University | Environment | Other topics | Total |
|---|---|---|---|
| ETH Zurich | 0 | 36 | 36 |
| Politecnico di Milano | 0 | 38 | 38 |
| Politecnico di Torino | 3 | 4 | 7 |
| Sapienza Università di Roma | 5 | 19 | 24 |
| Università Ca' Foscari Venezia | 3 | 1 | 4 |
| Università degli studi di Milano | 0 | 5 | 5 |
| Università degli studi di Padova | 2 | 3 | 5 |
| Università di Bologna | 0 | 2 | 2 |
| Università di Genova | 0 | 1 | 1 |
| Università di Modena e Reggio Emilia | 0 | 4 | 4 |
| Università di Pavia | 0 | 2 | 2 |
| Università di Trento | 0 | 1 | 1 |
| Université de Geneve | 3 | 22 | 25 |
| Total | 16 | 138 | 154 |

Merging this data with what demonstrated by the previously shown regression models, i.e. that Swiss universities and Politecnico di Milano give a significantly positive contribution to the price, it could be stated that the negative contribution suggested by Table 78 for masters about environment must be carefully analyzed.

Furthermore, 10 out of 15 masters about technology are held by Swiss universities, accounting for the 20% of Swiss masters, while only around 5% of Italian masters are about technology (Table 80). Thus, also in this case, reminding the significantly positive contribution given by Swiss masters to the price, this data should not suggest a significant influence.

Table 80. Summarized data on masters about technology

| University | Technology | Other topics | Total |
|---|---|---|---|
| ETH Zurich | 6 | 30 | 36 |
| Politecnico di Milano | 0 | 38 | 38 |
| Politecnico di Torino | 1 | 6 | 7 |
| Sapienza Università di Roma | 1 | 23 | 24 |
| Università Ca' Foscari Venezia | 0 | 4 | 4 |

| | | | |
|---|---|---|---|
| Università degli studi di Milano | 1 | 4 | 5 |
| Università degli studi di Padova | 1 | 4 | 5 |
| Università di Bologna | 0 | 2 | 2 |
| Università di Genova | 0 | 1 | 1 |
| Università di Modena e Reggio Emilia | 0 | 4 | 4 |
| Università di Pavia | 0 | 2 | 2 |
| Università di Trento | 1 | 0 | 1 |
| Université de Geneve | 4 | 21 | 25 |
| Total | 15 | 139 | 154 |

Finally, 17 of the total 21 masters about design are held by Politecnico di Milano (Table 81). Hence, considering that, as demonstrated by previous examinations, Politecnico di Milano charges significantly higher prices with respect to other Italian universities, and that it provides the vast majority of masters on design, also this t-test does not give a reliable information.

Table 81. Summarized data on masters about design

| University | Design | Other topics | Total |
|---|---|---|---|
| ETH Zurich | 0 | 36 | 36 |
| Politecnico di Milano | 17 | 21 | 38 |
| Politecnico di Torino | 1 | 6 | 7 |
| Sapienza Università di Roma | 2 | 22 | 24 |
| Università Ca' Foscari Venezia | 0 | 4 | 4 |
| Università degli studi di Milano | 0 | 5 | 5 |
| Università degli studi di Padova | 0 | 5 | 5 |
| Università di Bologna | 0 | 2 | 2 |
| Università di Genova | 0 | 1 | 1 |
| Università di Modena e Reggio Emilia | 0 | 4 | 4 |
| Università di Pavia | 1 | 1 | 2 |
| Università di Trento | 0 | 1 | 1 |
| Université de Geneve | 0 | 25 | 25 |
| Total | 21 | 133 | 154 |

### *3.4.3. Discussion*

The analysis carried out on technical masters introduced the influencing role played by universities in setting prices for their master programs.

Firstly, it has been seen that only Swiss and Italian universities provide such a typology of programs, with the former charging significantly higher prices compared to the latter, as demonstrated by the first regression model.

Then, the examination has been moved into the Italian ground, and it has been shown that, among Italian universities, technical masters offered by Politecnico di Milano are characterized by significantly higher prices compared to masters offered by other Italian universities.

This relatively high bias caused by universities, not seen in previous chapters, might be explained by the relatively small sample of masters collected in this dataset and by the fact that very few programs have been collected for several universities, while others contributed in greater manner to the population of the dataset and, consequently, to results found in the examination of masters.

As in previous analyses, linear and logarithmic regression models have been built for representing the price variation for masters provided by technical universities. Differently from other cases, however, the log-transformed model did not add great improvements to the fit of the model.

# 4. Limitations of the study

Despite the successful results demonstrated in previous chapters, it is important to underline that this study presents some limitations.

First of all, data have been collected from a limited number of universities and business schools, thus sometimes giving rise to biased results. This has been seen especially in the case of technical masters, where, due to an exiguous number of universities offering such category of programs, influences played by individual universities have been demonstrated to be quite heavy.

Moreover, datasets have been built between March and May 2020, when the COVID-19 pandemic had already spread. Hence, it is possible to hypothesize that some programs' features could have been changed. For instance, residential programs might have been turned online, duration might have been reduced and entire modules or even programs might have been delayed or cancelled.

Furthermore, it would be unrealistic to assume that prices of programs are influenced only by variables that have been collected and analyzed in this study. Actually, instead, a plurality of implicit and non-quantitative variables surely plays a key role in determining the price of masters and open courses. The following ones can be cited in this sense:

- Reputation of business schools and universities: even if this information is partially related to the Triple Crown Accreditation, whose influence on prices has been largely discussed in this study, distinctions between groups of accredited and non-accredited schools in terms of perceived reputation cannot be measured. Furthermore, as repeatedly reminded during the analysis of programs held by technical universities, no accreditation exists for such universities, so that data about reputation of technical universities have not been captured in any way.

- Information about professors: generally, open courses and masters are taught by a large number of professors, together with consultants and field experts. It is expectable that factors such as career, job positions and achievements of professors have an influence on the price too.
- Characteristics of companies collaborating with universities: it has been seen that many programs, especially masters, give attendees the opportunity to undertake stages, participate in company visits and work in projects in collaboration with companies. It is likely that the reputation of companies and the career opportunities perceived by attendees play a major role in determining the price of a master program.

Finally, it is unwise to think that prices are set basing on programs' features. Different universities could indeed select different pricing methods, for example basing on cost-plus criteria, customers' willingness to pay or prices set by competitors. Also, as observed while collecting data from universities and business schools' websites, many of them set equal prices for entire categories of programs (for instance, equal prices for all the one-year specializing masters, without distinctions on the bases of language, topics, format or structure).

# 5. Conclusion

The study has identified several price drivers common to all categories of lifelong learning programs analyzed.

First of all, as expected, higher prices have been found for longer programs. On one hand, a possible explanation to this finding is connected to the higher costs incurred by universities and business schools for setting up longer programs (professors compensations, cost of making teaching material, cost of HVAC for residential programs, compensation of IT technicians and cost of IT equipment for online programs, et cetera). On the other hand, consumers' willingness to pay is likely to increase with the duration of programs and, consequently, with the quantity of teaching hours. This has been revealed to be particularly true for open courses, whose shorter length makes it easier to detect small price variations for slight increases in the duration. Prices of master programs, conversely, showed a lower dependency on the duration, meaning that, after a certain threshold in terms of duration, the quality of the program plausibly takes over its quantity.

Another noteworthy result is related to the language in which programs are held. In most cases, masters and open courses held in English have shown a higher predicted price with respect to programs held in other languages. This factor may be explained by several reasons. Firstly, programs held in English are able to attract a wider consumer base due to the increasing fraction of learners from non-English-speaking countries who are able to easily attend specialization courses in English. Secondly, universities and business schools have the possibility to involve a wider range of professors with various backgrounds and specialized skills from all over the world, thus giving rise to top-quality programs and making possible to offer such programs at higher prices. Moreover, programs in English are easily replicable and allow universities and business schools to reach unexplored markets. This is the case

of some European business schools, above all INSEAD, which have launched new venues in Asia and Middle East.

Another element of major relevance in determining the price of masters and courses is connected to the format that characterizes each program. Significantly lower prices have indeed been predicted for online programs with respect to residential ones. From a university's perspective, the reason is undoubtedly connected to the replicability of courses and to the capability of online programs to reach a greater number of attendees, especially as concerns open courses, thus allowing to charge lower prices to a greater number of consumers. However, it is important to highlight the higher investment necessary for setting up an online program. Such programs, in fact, require some expenses in resources such as servers, software, ad-hoc learning materials and IT technicians that are more negligible for residential courses.

From a consumer perspective, instead, the finding according to which online programs are cheaper might be explained by the fact that consumers do not perceive the quality of online programs at the same level of face-to-face ones. Hence, their willingness to pay appears to be lower for online courses with respect to residential ones.

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Data on lifelong learning programs have been collected from the following websites.

Business schools:

www.som.polimi.it

www.hec.edu

www.london.ac.uk

www.insead.edu

www.essec.edu

www.ie.edu

www.esmt.berlin

www.escp.eu

www.businessschool.luiss.it

www.cuoa.it

http://www.liucbs.it

www.bbs.unibo.it

www.24orebs.com

www.sdabocconi.it

www.es.unisg.ch

www.iese.edu

www.mib.edu

Universities:

www.polimi.it

www.ethz.ch

www.tudelft.nl

www.epfl.ch

www.unibo.it

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Data have been elaborated through:

Stata 15 (StataCorp. 2017. Stata Statistical Software: Release 15. College Station, TX. ©StataCorp LLC)

Microsoft Excel (Microsoft. 2020. Version 16.43. Redmond, WA. © Microsoft)