A RECURSIVE MODEL FOR DECOMPOSITION OF DIRECT AND INDIRECT COSTS IN HEI IN ROMANIA

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Abstract. *This paper represents an original work as regards the analysis of the costs structure in a higher education institution in Romania, aiming at identifying a model for calculating the minimum tuition fee and the marginal student so as for the principle of managerial and financial efficiency stipulated in the new law of education to be complied with. In the calculation process, all the costs within a university are decomposed and a cost-per-subject is developed consisting of all the costs involved in the entire teaching process of a school subject, irrespective of its type. The need for analysis was triggered by the evidence that each university establishes the level of tuition fees in an arbitrary manner, "in accordance with the market", but without having a model for direct and indirect cost distribution at the level of the programs of study.*

Keywords: higher education, cost decomposition, resource allocation, efficiency.

1. Introduction

The issue of cost calculation in universities worldwide has represented the focus of researchers in the field of economics since the 1980s. However, although the importance of the topic has consistently grown, one cannot talk about an exponential increase in the number of studies. A study of the specialized literature reveals that studies have focused on distinct aspects of the issue, the only connection being represented by the very broad topic of cost analysis. Most of the studies rely on statistical and econometrical analyses devised at the level of education cycles on the optimal tuition fee or cost efficiency in Higher Education Institutions (HEI). Thus, back in 2003, Mensah and Werner theorized that greater financial restrictions appeared to lead to more cost efficiency. According to these authors, prior research on the relative efficiency of HEI can be divided into two types: those using econometric approaches and those using data envelopment analysis (DEA) approaches. The econometric studies have focused principally on examining the degree to which economies of scale and scope exist in HEI, and the relative costs of educating undergraduates versus graduate students. In their opinion, the principal findings in the DEA studies concern the substantial differences in cost efficiency among HEI.

The same year saw the publication of Mensah and Werner's study which evaluates the degree to which the common perception that the lack of financial flexibility inhibits institutional efficiency is empirically valid in the context of institutions of higher education.

In 2004, McMeeking underlined that universities are not-for-profit public sector organizations and therefore do not seek to maximize their financial surplus. However, universities are expected to balance their revenues with expenditure and a positive return on investment is sought by most business entities. Therefore, his study used break-even analysis as a minimum justification cut-off point.

Laband and Lentz (2005) estimate a multiproduct cost function for public universities with expenditures on extension added to the traditional product mix of undergraduate teaching, graduate teaching and research. They use detailed data on costs and "outputs" (typically the number of full-time equivalent undergraduate or graduate students taught, number of degree programs or academic departments, amount of externally funded research and the like) for a large number of academic institutions, the researcher using multivariate regression to estimate the relationship between the level and type of output produced and the institution's cost.

Adams and Shannon (2006) make an analysis of the HEI costs, also developing a series of strategies on cost control. They categorize these strategies within the context of administration, instruction and athletics, and for each one they propose some measures for cost cutting.

According to Gary-Bobo and Trannoy (2008), the optimal tuition follows a classic marginal social-cost pricing rule. In the same paper the authors also analyse tuition fees and student application for admission for "philanthropic" and rent-maximizing universities with a view to finding out the optimal number of students and the optimal value of the tuition fee.

Lenton (2008) draws a comparison between institutions in US/UK/other states regarding the structure of costs in HE, estimating „cost functions" and specifying that higher education vocational courses are the most cost-efficient. The estimations of the quadratic specification for both US and UK are presented in the paper with evidence of ray economies of scale, indicating that cost efficiencies can be gained by proportionally increasing the numbers of all students. Also, Johnes and Johnes (2009) find that the higher than expected costs of those institutions are partly due to an unusual cost technology, and partly to efficiency issues. They use methods to estimate frontier cost functions for higher education institutions within the context of a random parameter model, this bringing their analysis closer to the spirit of non-parametric techniques and allowing questions to be answered about the distinction between inefficiency and idiosyncratic cost technologies.

In what concerns Romanian education, we would like to mention the analysis conducted by Ilie (2009). In her article, descriptive methods are used in order to present the main characteristics of the financing process in higher education. A comparative study for HEI is proposed in the paper, which considers the differences between the private and public institutions with the purpose of creating a model of cost distribution in HEI for calculating the efficiency of the teaching process.

In actual fact, the evaluation of costs in higher education has long been of significant interest for the managers of these institutions in Romania, where the financing of HEI is made according to their real activities, while the responsibilities for using funds and implicitly the liberty for developing strategies for cost optimization goes to the institutions' management.

Nowadays the Romanian HE system has two categories of institutions: public institutions, with partial state funding and private institutions, which are entirely privately financed, all these leading to a management for each institution that is based on demand and supply in the market economy model. At present, competition can be encountered at several levels: between private institutions and public ones, between the faculties within the same university and between the study programs within a faculty.

In this article we consider the HEI activity to be an economic activity whose quantification we start from the calculations of incomes and expenditure. If the problem is very simple regarding incomes, as they consist of public grants and tuition fees for public universities, and tuition fees only for private universities, the issue of quantifying, distributing and decomposing expenditures between different consumers is a very complex one, requiring different criteria and methods for obtaining equitable results.

The articles concerned with the analysis of costs in HEI do not reveal any cost distribution methodology for setting the marginal student cost and the costs involved by each study program starting from the real measured costs so that the study program could be economically efficient.

Hereinafter a direct and indirect cost distribution model is proposed in which costs are decomposed to subject level. This model is based on the principles of the National Education Law: university autonomy, quality assurance, equity, managerial and financial efficiency and transparency. The model proposed aims at distributing costs transparently and clearly, in accordance with the cost repartition regulations, and, at the same time, at determining the "marginal student" at study program level. This model can be applied not only in Romania but also in other countries/universities. Also, we consider this model as our contribution to knowledge, as there are no other models that decompose all costs in HEI.

Following the use of the proposed model, top and middle university management may take decisions for rendering the activity more economically efficient, making it possible for forecasting and simulations for the next periods by means of indicators and variables such as: number of students and level of education, choosing "profitable" study programs instead of the less efficient ones, choosing rooms and equipment from classes, calculating the minimum tuition fee for defrayal according to all the costs of a study program. The model covers all the costs/expenditures within a HEI organization, aiming at finding the most equitable distribution base for each expenditure type as regards the calculation of the total cost on expenditure bearers.

In the following section, we are going to discuss aspects related to the Romanian fund allocation for universities. The next part deals with the concepts of equivalent student, equivalence coefficients, cost coefficient, income distribution on study domains, while the third part actually develops the model proposed for distributing direct and indirect costs.

2. Fund allocation for HEI in Romania

According to the Romanian system, public HEI work as institutions financed with funds from the state budget, with the possibility to have extra-budgetary income. The income of these institutions consists of funds allotted from the budget of the Ministry of National Education (MNE) on a contractual basis for core financing, complementary financing and supplemental financing, and the institution's own income (e.g. tuition fees, interest rates, donations, sponsorship and other fees).

The Ministry of National Education guarantees the core financing for public universities by means of study grants calculated on the base of average cost per equivalent student, per domain, per study cycle and teaching language. The cost is a historical one and not a real one. The use of our model may also lead to updating the value of the above average cost by recalculating it based on real costs in universities.

The algorithm for calculating the base financing starts from guaranteeing the objectivity and transparency of the annual distribution process for the budgetary allocations using the fundamental principle "*resources follow students*" the takes into account that the student training for different programs involves different (financial) efforts brought together by grouping these programs in *equivalence classes*, corresponding to the domain and type of education (full time education, distance learning, part-time education).

The number of equivalent students is calculated for each study domain inside a university as a sum of *physical students* enrolled in all forms of education within a university for the given field balanced with a score associated with different types of education. The scores, which represent *equivalence coefficients*, express the ratio between the required financial effort for training a student in the type of education *f* and the effort required for training a student in full time education, the *first cycle of study (bachelor's degree)*, having Romanian as the teaching language, in the same major field of study:

$$SE_d^U = \sum_{f=1}^{F} e_f \times S_{fd}^U ,$$

where:

SE_d^U = number of equivalent students in the domain d, university U;

S_{fd}^U = number of physical students in the domain d, type of education f, university U;

e_f = equivalence coefficient for the type of education f;

F = total number of the types of education financed from the public budget in Romanian universities (F = 19 this year).

Table 1

Equivalence coefficient in Romanian HEI

Type of education	Equivalence coefficient
UNDERGRADUATE STUDIES	
Studies taught in Romanian	1.00
Studies taught in Magyar as mother tongue	2
Studies taught in German as mother tongue	2.5
Studies taught entirely in major world languages	1.5
Studies taught partially in both world languages and Romanian	1.25
POSTGRADUATE/MASTER STUDIES	
Postgraduate studies taught in Romanian	2-3
Postgraduate studies taught in both world languages and Romanian	3
DOCTORAL STUDIES	
Full time doctoral studies	3
Full time doctoral studies for technical and agronomic domains and also for science and medicine	4

The term of *equivalent student* implies that student training requires different costs, according to the *study domain*. These differences are considered to be homogenous for all types of education except for the special ones mentioned above. For the latter we consider that the finance requirements involved in the training are the same irrespective of the study domain. Formally we include all the students of the special types of education in the parameters of the economic domain. The number of equivalent students is calculated for each university as a multiplication between the number of equivalent students in different domains for a certain university and the number of students associated to the study domains. These numbers or *domain cost coefficients* express the report between the financial effort required for training a student in full time education, first cycle of study (Bachelor's degree), taught in Romanian, in the study domain *d,* and the effort required by training a student in the same type of education in the economic or socio-humanistic field. Taking the economic or socio-humanistic as a benchmark triggers that the necessary expenditure for training a student in other fields of study is greater, being brought about by the necessary material basis and additional applicative requirements. We calculate the number of equivalent students at university level by means of the formula:

$$SEU^U = \sum_{d=1}^{D} C_d \times SE_d^U ,$$

where:

SEU^U = number of equivalent students for university U;

SE_d^U = number of equivalent students for domain d, university U;

C_d = cost coefficient for study domain d;

D = number of domains financed from the public budget in university U.

The number of equivalent students represents a fundamental parameter of the financing methodology, its value being an indicator of a university's dimension financially speaking.

Table 2

Domain-level cost coefficients in Romanian HEI

Study domain	Cost coefficient
Technical	1.75
Architecture	2.5
Agronomic	1.75
Science	1.65
Mathematics	1.65
Socio-human sciences	1
Psychology	1
Medicine	2.25
Economics	1
Theatre	5.37
Film	7.5
Music performance	5.37
Music	3
Arts	3
Sports	1.86

Complementary financing is approved by the Ministry of National Education by means of: a) subsidies for meal and accommodation; funds allotted based on priorities and specific normative for equipment and other investment expenditures and major renovations.

Calculation of the total income for a university provided by the ME:

- Total allocation (*St*) intended for core financing at national level (In Romania, 70% of the total core financing is distributed according to the *number of equivalent students* while the rest of 30% considers *quality indicators*):

$$Ss = 70\% \times St \text{ and } Sc = 30\% \times St,$$

where:
Ss = allocation calculated on the base of equivalent students for university U;
Sc = quality indicator;
K = number of quality indicators;
N = number of universities financed from the public budget.

$$St^U = Ss^U + \sum_k Sc_k^U \text{, where } Ss^U = \frac{SEU^U}{\sum_n SEU^{U_n}}$$

- Total income for university U:

$$VT^U = St^U + OwnIncome + IncomeFromComplementaryFin. + otherIncomes.$$

3. Preliminary data

In this article we would not follow the classic analysis of fixed and variable costs, but introduce methods for cost repartition based on the number of students, number of subjects and other parameters so that we could obtain, at the end, the real cost of a subject / study program / domain based on their real expenditures.

We will categorize the following groups of costs:

- Personnel costs (direct costs – teaching staff and indirect costs – non-teaching and auxiliary staff);
- Goods and services (e.g. office furniture, cleaning materials, heating, lighting and power, water, sanitation, fuels and lubricants, post, telecom, radio, TV, internet);
- Regular repairs;
- Drugs, sanitary materials, reactants;
- Laboratory materials;
- Rents.

We will classify the capital expenditures (constructions, equipment and transportation, furniture, office equipment and other tangible assets belonging to the Investments category. The data we used for analysis were obtained from the budgetary execution of some representative public universities in Romania.

Table 3

Groups of expenditures calculated in proportion to the total expenditures

Indicator	Total	% level 1	% level 2	% of total
Total expenditures	100%			100%
Current	88%	100%		
• Personnel		81%		71,5%
• All goods and services		19%	100%	16,5%
o goods and services (natural gas, electricity, water, internet, office stationary)			81%	13%
o Current repairs			2%	0,4%
o Food			4%	0,6%
o Transportation, detachments, transfers			10%	2%
o Lab materials			1%	0,2%
o Other expenditures			2%	0,3%
Capital/Investments	12%			12%

In the process of cost repartition we will also discuss the repartition principle taking into account the following preconditions:

- Some of the costs (e.g. costs related to staff which we associate to "direct production") can be measured directly. The budgetary execution does not reveal which the sums allotted directly to production are, but they can be measured by means of various tools (applications or measurement tools);
- For public services a university receives generic bills, devised per building, not per room. Also, not all the study programs/domains/faculties carry out their activities in their own building (so that all the costs in a building belong to a certain study programs/domains/faculties), and consequently a common base for the distribution of these expenditures needs to be found;
- There are other costs that are not quantifiable and distributable in a direct manner, but they must be distributed at student/subject level.

4. Model and discussion

The subject is considered to be the converging point between the demand, represented by the student, and the offer represented by the education system. Hereinafter we will detail the components of the subject cost and we will try to identify the most appropriate distribution bases for the costs mentioned above.

Table 4

Notations used in the model

Parameter	Description
CT_{Subj}	Subject Cost
C_T	Teaching staff cost
$CSalLab$	Non-teaching staff cost
$CMatCons$	Consumable Cost
C_{Room}	Room cost
$CIndir$	Indirect costs
$CSal_{Pos}$	Salary for a teaching position
$CTotalDel$	Total, university-level delegation costs
$CDel$	Delegation for one subject
$C\Pr oj$	Project costs
$CBir_T$	Teacher’s office cost
NoH_{Subj}	Number of conventional hours for a subject
NoH_{Pos}	Number of conventional hours for a teaching position
Sup_{Room}	Room area in square meters
$TotalSup_{Building}$	Total building area (including common spaces and teaching/research rooms)
$NoSt_{Subj}$	Number of students registered at subject level
$NoSt_{Building}$	Number of students inside a building, calculated based on the building schedule
$TotalNoSt$	Total number of students
$CHeat_{Room}$	Heating costs at room level
$CElec_{Room}$	Electricity costs at room level
$CElecEquip_{Room}$	Electricity costs for the equipment within a room, except lightning
$CDepr_{Room}$	Depreciation costs at room level
$CMntn_{Building}$	Building maintenance cost
$C\mathrm{Re}act_{Subj}$	Reactants costs for the subject
$CMat_{Subj}$	Other material costs for the subject
$CT_{Building}$	Total cost at the building level
$C\mathrm{Re}nt_{Building}$	Rent paid for a building
$CAdmn$	Administrative cost
$CHeat_{ComSp}$	Heating costs for common spaces inside a building
$CElc_{ComSp}$	Electricity costs for common spaces inside a building

Parameter	Description
$CDepr_{ComSp}$	Cost depreciation for common equipment and installations inside a building
$CAdmn_{UHQ}$	Administrative cost at the university headquarters level (for the whole university)
$Indem_{Mgmt}$	Management salaries for the lower/middle/top management at department/faculty/university level
$C_{Secretar}$	Secretariat cost
C_{Cons}	Consumable costs
$CBir$	Total costs for a room
$Investments$	Investments at university level, carried out by the university for a faculty/teaching department/research department
$CAdmn_{FHQ}$	Administrative cost associated with the faculty headquarters
$Cost_{Spec}$	Study program cost
$CSal_{Building}$	Salaries for the maintenance personnel associated with a building
$CMat_{Building}$	Costs associated with maintenance materials for a building
c	Number of staff for a subject
l	Number of laboratory technicians for a subject
s	Number of rooms in which the subject is taught

We start from:

$$CT_{Subj} = \sum_{c} C_T + \sum_{l} CSalLab + CMatCons + \sum_{s} C_{Room} + CIndir. \quad (1)$$

Then we detail the costs for C_T:

$$C_T = CSal_{Pos} + CDel + C\,Proj + CBir_T. \quad (2)$$

The teaching position salary represents the salary for one teaching position according to the staffing schedule, where we can identify all the subjects one teacher has to teach during a university year expressed in conventional hours. Given that a teacher's annual salary is known, the salary for each combination of teaching position-subject can then be identified. Furthermore, since hours are expressed in conventional hours in the staffing schedule, we consider as distribution base the ratio between the hours allocated for a subject and the total hours in that position.

We introduce the following variables:

- NoH_{TPos}^{Subj} represents the percentage of hours for one subject of the total hours for that position, for a teacher: $NoH_{TPos}^{Subj} = \frac{NoH_{Subj}}{NoH_{Pos}} \times 100;$

- $Sup_{Building}^{Room}$ represents the report between the surface of a room and the total surface of the building $Sup_{Building}^{Room} = \frac{Sup_{Room}}{TotalSup_{Building}} \times 100;$

- $NoSt_{Building}^{Subj}$ ratio between the students registered for a subject and the total number of students who have classes in a building, according to the yearly schedule $NoSt_{Building}^{Subj} = \frac{NoSt_{Subj}}{NoSt_{Building}} \times 100;$

- $NoSt_{Total}^{Subj}$ ratio between the students registered for a subject and the total number of students in the university $NoSt_{Total}^{Subj} = \frac{NoSt_{Subj}}{TotalNoSt} \times 100;$

We may calculate:

$$CSal_{Pos} = CSal_T \times NoH_{TPos}^{Subj}. \quad (3)$$

Because each teacher may benefit of various delegations during a year (e.g. teaching staff in Erasmus) and the university may contribute financially, we consider these costs have the same distribution base as above.

$$CDel = CTotalDel \times NoH_{TPos}^{Subj}. \quad (4)$$

Research is considered as a compulsory and complementary part for each teacher's activity. Thus we consider that the costs concerned with the research projects in which teachers participate and which are partly financed by the university can be found in the quality of the teaching process and implicitly in the costs associated with the subjects.

$$CProj = CTotalProj \times NoH_{TPos}^{Subj}. \quad (5)$$

Preparing the materials for the subject and also the research activity involve a series of rooms for teachers' offices and also research laboratories.

$$CBir_T = \left(CCHeat_{Room} + CElec_{Room} + CDepr_{Room}\right) \times NoH_{TPos}^{Subj} + CMntn_{Building} \times Sup_{Building}^{Room}. \quad (6)$$

Being given that the surface of these rooms is different and that the costs associated with heating/electricity/depreciation/maintenance cannot be measured in distinctly for each room, we will use a different the distribution base, in proportion with all the corresponding costs for the overheads.

We can distribute the heating costs taking into consideration an "equivalent thermal surface - SET" for heating bodies calculated according to STAS 11984/1983: one square meter of SET releases heat 525 W (revised to 453 W) and these rooms are heated using a centralized system. We may calculate SET according to INCER2001 for all the heating bodies (heaters, columns and distribution pipes) and for all the rooms, so that, provided the SET is calculated correctly, we should not have loses and non-distributed costs.

$$Q_{Room} = \frac{SET_{Room}}{TotalSet} \times Q_{heating}. \quad (7)$$

For common spaces we may use:

$$Q_{ComSp} = \frac{SET_{common}}{TotalSET} \times K \times Q_{heating}, \quad (8)$$

where:
- K represents part of the common property;
- $Q_{heating}$ represents the total thermal energy for heating;
- SET_{common} represents the SET for equipment in common space;
- $TotalSET$ represents the total SET;
- SET_{Room} – represents the SET for a room.

If the rooms have heating cost distributors, the number of consumed units for each room may be calculated using:

$$n_{Room} = \sum_{j} n_j \times K_j^{CHB} \times K^a \times K_j^{QHB}, \quad (9)$$

where:
n_{Room} – the number of consumed units allocated using heating cost distributors for space “i”;
n_j – number of consumed units showed by the heating cost distributor for the heating body “j”;
K_j^{CHB} – evaluation factor for the thermal coupling which differentiates the cost distribution unit and the heater "j" on which the former is attached (where HB – heating body);
K^a – situation factor for the heating body;
K_j^{QHB} – evaluation factor of the thermal power for the heating body the "j" room, on which the distribution unit is placed.

In mixed cases, the distribution of the consumption units is accomplished relative to the indications of the heating cost distribution unit and the SET, also taking into account the situation factor of the heating bodies. The situation factor takes into account the position of the room inside the building and the correction factors according to the cardinal directions.

The quantity of electrical energy used in the technological process may be established using the current-meters installed where the energy is used. In default of these or other measuring equipment, the energy consumption is commensurate to the number of equipment working hours and other electric mechanisms. Taking into account that current-meters are not installed in every location, the cost of electrical energy may be distributed using one of the following methods:

- Cataloguing the equipment consumers in each room and applying a variable calculated in proportion to the yearly schedule room holding time;
- Using an average value (e.g. according to IEA, 2006, 10% of the energy consumption is intended for lighting and for the equipment, while the consumption for equipment is calculated using the hourly consumption rate). Also, according to Fontoynont, M., Escaffre, L., Marty, Ch. (2002), in business offices the consumption may vary between 20% and 30% of the total energy;
- Using an average value on the room/building area: the annual lighting electricity consumption per square meter in buildings varies between 20 to 50 kWh/m^2, a (SEA 2007, STIL 2007), while in the education sector it reaches 25 kWh/m^2 (IEA, 2006).

We consider that the optimal electrical energy cost distribution may be accomplished by cataloguing the equipment in each room, simultaneously using a variable (K) for the up-time hours for all equipment.

$$CElec = K \times \sum_i RatedPower_i . \quad (10)$$

The *water* costs should be distributed according to the total number of the students who have classes in a building, according to the yearly schedule. Also, water usage for special purposes (e.g. research and labs) should be metered separately.

At the previous costs for using a room we also add the room maintenance costs, calculated starting from the room area. Since a laboratory technician is needed for more than one subject, all the costs concerned with their salaries will be distributed in proportion to the subjects serviced.

$$CSalLab = CSalLab \times NoH_{TPos}^{Subj} . \quad (11)$$

The material costs involve all the consumables involved in the teaching process. These costs may be calculated directly according to the number and the value of the consumed objects.

$$CMatCons_{Subj} = CReact_{Subj} + CMat_{Subj} . \quad (12)$$

The *room cost* comprises the costs involved in the teaching process without using the equipment in that room, as well as the costs incurred by the use of this equipment. Thus when using a room without equipment, (7) and (10) can be found in the costs in proportion with the number of hours associated to a subject. When using the equipment in a room, the previous calculation is completed with the costs for the electrical energy (10) measured according to the consumption and also its depreciation. To these costs we also add the maintenance costs calculated in accordance with the occupied area.

$$C_{Room} = \left(CHeat_{Room} + CElecEquip_{Room}\right) \times NrH_{PosT}^{Subj} + \left(CElec_{Room} + CDepr_{Room}\right) \times NoH_{TPos}^{Subj} + CMntn_{Building} \times Sup_{Building}^{Room} . \quad (13)$$

Indirect costs comprise common costs associated to the maintenance of the building and administrative costs.

$$CIndir = CT_{Building} + CAdmn, \quad (14)$$

where

$$CT_{Building} = C\,Rent_{Building} \times Sup_{Building}^{Room} + \left(CHeat_{ComSp} + CElec_{ComSp} + CDepr_{ComSp}\right) \times NoSt_{Building}^{Subj} + CMntn_{Building} \times Sup_{Building}^{Room}; \quad (15)$$

$$CMntn_{Building} = CMat_{Building} + CSal_{Building}. \quad (16)$$

Administrative costs are also drilled down into those belonging to the university, respectively the faculty headquarters:

$$CAdmn = CAdmn_{UHQ} + CAdmn_{FHQ}, \quad (17)$$

where

$$CAdmn_{UHQ} = \left(CIndem_{Mgmt} + C_{Secretar} + C_{Cons} + CElec + CBir + Investments\right) \times NoSt_{Total}^{Subj}; \quad (18)$$

$$CAdmn_{FHQt} = \left(CIndem_{Mgmt} + C_{Secretar} + C_{Cons} + CElec + CBir\right) \times NoSt_{Total}^{Subj}; \quad (19)$$

$$CBir = (CHeat + CElec + CDepr) \times NoSt_{Total}^{Subj} + CMntn_{Building} \times Sup_{Building}^{Room}. \quad (20)$$

The common costs associated to a building comprise rent, heating costs, energy costs, depreciation and maintenance. We distribute these costs based on the $NrSt_{Building}^{Subj}$ variable.

Also, administrative costs are composed of the administrative costs for the whole university and the administrative costs of each faculty. We also included here the investments carried out by the university for different faculties/programs of study.

We may calculate the value of the minimum tuition fee and the marginal student using the above costs:

$$Cost_{Spec} = \sum CT_{Subj} \quad (21)$$

$$UnitCost_{Stud} = \frac{Cost_{Spec}}{NoStud_{Spec}} \quad (22)$$

$$StudMarginal = \frac{Cost_{Spec}}{V_{Stud}}, \quad (23)$$

where V_{Stud} represents the income obtained for training a student.

According to the Romanian legislation, education institutions are not-for-profit organizations, so that the income for the teaching process is equal to the costs of the programs of study. We can calculate the minimum tuition fee for the maximum number of students as approved by the Romanian Agency for Quality Assurance in Higher Education (ARACIS):

$$Taxa_{Min}^{Stud} = \frac{Cost_{Spec}}{NoMax_{Stud}} - VBuget_{Spec}. \tag{24}$$

Following the calculation of this indicator, top and middle management may take decisions for obtaining economic efficiency at the level of the programs of study. In real life/practice, the indicator must be correlated with teaching quality parameters with a view to attracting the optimal number of students.

5. Conclusions

In this article we analysed and decomposed the costs within a HEI to the subject level, which we consider the convergence point between the demand coming from the students and the supply of the programs of study coming from the universities. This decomposition is accomplished by means of a model having several steps so that we can distribute all the direct and indirect costs that occur in the education process, whether these costs could be measured directly or not. We have also identified distribution bases for each type of cost so that the distribution is not accomplished only in accordance with the number for students. In the end, based on the real costs of a program of study, we have calculated the minimum tuition fee and the marginal student starting from which the program of study becomes financially efficient.

It needs to be mentioned that the present model only focuses on the economic side of the HEI system, as it does not consider any data related to specific features of certain programmes of study (for instance, in the case of programmes of study such as medicine or music, it is necessary for groups to have a small number of students, so as for the teacher to be able to interact with them all during the practical courses or laboratories), or aspects related to the quality of the teaching process. If the issue be regarded strictly from a financial position, there should be no difference between a course taught by a professor, Ph.D., with 20 years of experience and the same course taught by a beginner. Obviously, in reality, this triggers significant differences, the course taught by the beginner teacher being financially optimal.

Nevertheless, we consider that the model can be implemented in establishments where the teaching staff is homogenous, where there is a balance between experienced and beginner teachers, the system being worth considering from the point of view of the economic efficiency.

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