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oksana.marets@lnu.edu.ua, nazar.demchyshak@lnu.edu.ua, popadynets.n@gmail.com**SIMULATION OF TUITION FEES IN COMPETITIVENESS
MANAGEMENT OF HIGHER EDUCATION INSTITUTIONS
(CASE OF UKRAINE'S UNIVERSITIES)**

Abstract. The purpose of study is to simulate the tuition fees in Ukrainian higher education institutions (HEIs), taking into account the internal and external factors of their activity. The choice of variable models is based on the theoretical study and classification of pricing factors in higher education. The empirical part of the research is performed according to online data of 35 Ukrainian universities. Using correlation analysis, we found that the main factors that impact variability the tuition fees variation are: 1) academic reputation of HEI, 2) popularity of the study program among entrants, 3) population income in the region of HEIs activity. To simulate the tuition fees, taking into account the essential factors, the programming language R was used. The modeling found that there is an issue with the overpricing and underpricing of education in Ukrainian HEIs in comparison with its theoretically justifiable value. Competition in the market of educational services forces Ukrainian universities to pursue a pricing policy that is accompanied by both too high and low tuition fees, which do not cover training costs and do not provide long-term development. The results of modeling could be used to improve the quality of decision making process in HEIs management.

Key words: Tuition Fees, Higher Education Institutions, Analysis of Pricing Policy, Regression Model, Ukraine.

Introduction. The price and quality of a product are the main criteria for its competitiveness in a market economy. A similar statement applies to educational products. With the increasing number of educational providers and the expansion of opportunities for non-formal education, competition in global and national educational services markets is increasing. Accordingly, the relevance of applied pricing problems is increasing as well.

According to the classical theories of a market economy, the competitive advantages of a product depend on its price and quality. In this regard, the analysis of causal relationships and justification of the tuition fees factors, as well as its modeling, are important tasks in managing competitiveness of HEIs.

The pricing policy in higher education, as a special sector of Ukrainian economy, is based on general principles and pricing methods, but has its own distinctive features.

First, the majority (81.1% in 2018) of HEIs in Ukraine [1] are non-profit organizations and set the tuition fees adhering to the regulatory documents of the Cabinet of Ministers [2; 3].

Second, HEIs that set tuition fees based on state and communal forms of property receive financial support from the central and local budgets, and thus have competitive advantages in pricing compared to private HEIs.

Third, the lack of relevant information for analyzing the quality of educational services of HEIs means that entrants may perceive the high tuition fees as the criteria for its quality and prestige. In this regard, the demand for HEIs study programs is mostly inelastic.

An analysis of the pricing policy of educational providers in Ukraine indicates that there is a lack of reasonable foundation for prices for educational products. It can be argued that the prices of certain educational products are overestimated due to their prestige on the market, while others are underestimated (the case of lowering prices) in order to attract more students in a competitive market. As a result, some HEIs in Ukraine face problems with covering actual costs of training. On the other hand, customers face a significant difference of the education quality at the same levels of tuition fees.

As an additional argument in favor of the statement concerning tuition fees at Ukrainian universities, table 1 shows the ratio of average (2019) tuition fees for undergraduate management programs to the average salary in Ukraine and some neighboring countries. Leading HEIs were selected based on The Times Higher Education World University Rankings 2018.

Table 1 – Comparative analysis of tuition fees at leading universities in Ukraine, Belarus and Russian Federation

	Taras Shevchenko National University of Kyiv	Belarusian State University	Lomonosov Moscow State University
Country of University main activity	Ukraine	Belarus	Russian Federation
University Rank in The Times Higher Education World University Rankings 2018	801-1000	801-1000	194
Tuition fees for Bachelor’s degree study program «Management» in 2019 (for citizens of the country)	33900 UAH	4022 BYN	490000 RUB
Average Monthly Salary in Country of University Activity, 2018	8865 UAH	971,4 BYN	43724 RUB
Source: [4-8]			

Underestimated tuition fees do not fully cover the costs of training and limit the financial capabilities of Ukrainian universities to improve the infrastructure and human resources development. In order to prevent the policy of lowering tuition at state universities, the Cabinet of Ministers of Ukraine has developed a draft resolution a price index for particular courses/programs (such as Economics, Marketing, Management, Medicine, Law and some others) at state HEIs [3]. The price index is defined as 60% in year 2020, (70% in 2021, 80% in 2022) of the average cost of training at expense of state (regional) order. It is expected that the introduction of such regulations, may contribute to higher university incomes. However, it may also reduce the number of entrants for majors with traditionally high demand at state HEIs.

Thus, the problems in pricing policy of Ukraine’s HEIs highlight the need for scientific and applied analysis and modeling of the tuition fees in managing of HEIs competitiveness.

The purpose of the study is to develop an economic-statistical model of the tuition fees in Ukraine’s HEIs, taking into account internal and external factors of their activity in the educational services market. To achieve the goal, the following tasks are set: 1) to identify the main groups of factors determining tuition fees in HEIs; 2) to conduct an empirical analysis of the tuition fees for certain at leading universities in all regions of Ukraine; 3) to model the tuition fees in Ukraine’s leading universities for certain programs and to estimate the deviation between actual and theoretically justified tuition fees.

These tasks defined the logic of study as well as theoretical and empirical research findings.

The paper is structured as follows. First, we analyze the factors affecting tuition fees, using their classification related to the internal and external environment of HEIs, as well as the distribution of factors of direct and indirect influence. Second, we conducted an empirical analysis of annual tuition fees at 35 Ukrainian undergraduate management programs. Using correlation analysis, we identified the most significant factors affecting tuition fees. We then used these factors to model the annual tuition fees for the undergraduate management programs in the investigated universities. Calculations of the parameters of various types of multifactor regression models were performed using the software R. The results of modeling allowed us to identify universities that set too low or too high tuition fees, taking into account such factors as the academic reputation of HEI, the popularity of the course among entrants, and average income in the region of HEIs activity.

Finally, we conclude with overview of the unusual observations in the model of annual tuition fees. Using programming language R and graphical interpretation, we identify universities that significantly affect the pricing policy in the educational services market, as well HEIs with a high deviation between actual tuition fees and theoretically justified tuition fees.

Literature Review. The problem of effective pricing in economics of higher education is relevant beyond the management of Ukraine's HEIs. Foreign researchers are also paying attention to the problem of price discrimination in universities of European Union countries. For example, D. Grundey and I. Griesiene [9], who invest the phenomenon of price discrimination in higher education, define it as a market phenomenon in which providers offer similar or identical services to different buyers at different prices for reasons that are not directly related to the cost. The factors or drivers of such discrimination include institutional prestige, international and national HEIs, quality of teaching, inefficiency of price competition, and the budget financing of HEIs.

Scholars of the problems of higher education competitiveness in the post-soviet countries, in particular Kazakhstan, Russia, Ukraine focus the attention to the issues of marketing educational services, including effective pricing policy of HEIs [10], flexible technologies of management [11,12].

Research on business behavior patterns in education [13], notes that in the USA, Australia, Japan, and EU countries, HEIs can determine tuition fees "at will," while less well-known colleges are forced to lower prices to attract students. For example, universities and colleges in the United States can adhere to various business models of pricing behavior and cost-effectiveness in general [14]: lowering tuition among middle-level HEIs to increase demand while reducing other benefits; increasing tuition fees with a flexible system of discounts; reducing the number of high-value programs; redirecting resources to high-demand programs; establishing fixed prices for educational services throughout the entire period of study; increasing operational efficiency by optimizing the costs of support and maintenance staff; increasing the hours of online learning while reducing hours of more expensive training in university lectures.

Recent technological and socio-cultural changes create the need for different business models of behavior for different types of HEIs, as well as gradual transformation of the institutional structure of educational providers and their pricing policy. In their special report "Universities of the Future [15], Ernst & Young's international experts predict the development of three major types of educational providers: 1) Streamlined Status Quo providers that continue to function as powerful educational and research institutions; 2) Niche Dominators that will focus on specific segments of clients with individual learning, research, and related services; 3) Transformers who are new entrants involved in providing new products in the traditional sector, as well as creating new market spaces, combining the higher education sector with other sectors, such as media, technology, innovation, and venture capital.

Ukrainian researchers argue that tuition fees are not a significant criterion for entrants when choosing a university for study. According to a special student survey conducted by Lysytsia, N., Prytychenko, T., & Gron, O. [16] the possibility of studying at the expense of state and tuition fees rank 12th and 14th out of 21 criteria consumers use to select a university. Some of the most significant criteria include «university brand», «my friends' opinion about the university», «university status (national)» and «friends studying at this university».

The similar conclusions regarding tuitions fees influence on entrants demand make Havranek et al [17]. Based on meta-analysis of relationship between tuitions fees and demand for higher education researchers argue that available empirical research do not confirm significant effect of tuition on enrollment. At the same time, the researchers often consider tuition fees as an independent variable, exploring the relationship in the form of the price elasticity of demand for higher education. Other independent variables affecting the demand include the university ranking, percentage of full professors employed, family income of a student [18], average wages after graduation [19].

Given the above research results, we can argue that customers are willing to pay higher tuition fees, depending on the reputation of the university and the quality of education. Consequently, HEIs competitiveness should take into consideration their current academic position, the scope of activities, development goals, and the development of an appropriate pricing policy.

Methodology. The empirical part of this study is based on multifactor regression modeling. Dependent variable is annual tuition fees for undergraduate management programs at Ukraine's leading universities (data sources: universities official websites). Independent variables are (data sources in brackets): 1) the average wage in the region of the HEI's activity [1], 2) the university's rank in the National Rating TOP-200 Ukraine [20], as well as 3) popularity of the undergraduate management degree program in HEI (measured by the number of applications filed in the HEI for studying on the program per one licensed place). The sample size is 35 observations.

For the model fit we used statistical software R [21]. We estimated correlation coefficients significance with the *hmisc* package [22]. For model quality estimation we used R-Square and Root Mean Square Error, which are built in modern *dive* package [23].

Next step was to check whether linear regression assumptions are satisfied. These are: Global Stat, Skewness, Kurtosis, Link Function, Heteroscedasticity. We checked regression assumption with the *gvlma* package [24]. For the multicollinearity evaluation we used Variance Inflation Factor (VIF), provided within *car* package [25]. We used cutoff of 4 as a value if VIF which indicates multicollinearity.

We used tools from *ggplot2* package [26] to present annual tuition fees in 2017 and theoretically justified annual tuition fees on one plot (figure 1).

Our study also included identification of unusual observations. These are: 1) Outliers, 2) Points of high leverage, 3) Influential points. An outlier is an observation, which is poorly predicted by a model; it is characterized by large residuals. Points of high leverage are characterized by unusual combination of independent variables. Influential observations have a significant impact on the results of regression analysis.

We visualized unusual observations with the Influence plot, provided within *car* package (figure 2). It is a “bubble” plot of Studentized residuals versus hat values, with the areas of the circles representing the observations proportional to the value Cook's distance. Vertical reference lines are drawn at twice and three times the average hat value, horizontal reference lines at -2, 0, and 2 on the Studentized-residual scale [25].

Results and discussion. To form an effective pricing policy for educational products, it is important to analyze the variety of factors that determine the level and dynamics of prices. The classification of factors provides an opportunity to better understand the causes of price fluctuations and to determine the role of each of the factors in pricing policy of a particular HEI and its competitors, as well as in the behavior of consumers in the educational services market. Table 2 shows the typology of factors in HEIs' pricing policy based on the typical classification of factors in the analysis of complex socio-economic phenomena.

Table 2 – Classification of factors in pricing policy of HEIs

	Level 1: Direct Influence	Level 2: Indirect Influence
Internal factors: directly related to the HEIs activity	<ul style="list-style-type: none"> – Costs of resources that determine the cost and tuition fees for particular educational product (course/program). – The volume of the state order for the training in HEIs. 	<ul style="list-style-type: none"> – Academic reputation, prestige of HEIs (positions in international and national rankings, integrity ratings). – Academic reputation, prestige of the faculty, department of HEIs responsible for a particular educational product.
External factors: related to the HEIs activity environment	<ul style="list-style-type: none"> – Household income level in the country; region of HEIs activity. – Demand for particular professions/jobs in the labor market. – Income of HEIs graduates for programs/courses in the labor market. 	<ul style="list-style-type: none"> – The prestige of a certain program, course among entrants, their parents, other external stakeholders. – Pricing policy of competitors in the educational services market.
Source: authors' results.		

The status and academic rank of HEIs, qualifications of staff, and additional professional development opportunities (studying abroad, obtaining two diplomas) can be attributed to the main criteria for choosing HEI by applicants who are willing to pay a higher price for educational products.

In pricing policy, the educational services market combines a set of pricing methods. Of these methods, the following are most common: 1) cost-oriented methods (product cost, fixed and variable costs); 2) methods focused on the value and prestige of the product in the market of educational services; 3) methods focused on competitors' prices.

HEIs do not use any of the above methods in the "pure form", but mostly combine different pricing techniques, taking into account the scale and academic rank of the HEI as well as its competitive environment and region of activity.

Thus, it can be argued that the setting of tuition fees is a complex task in which the tuition fees is a function of a variable set, including cost of personnel and other resources, the HEI academic reputation among entrants and other reference groups, popularity and prestige of the program/course in the educational services market, and demand of the population in the region of the HEI activity.

Given the differentiation of the tuition fees depending on the course, educational program, and types and levels of education, we selected undergraduate management tuition fees in the 2017/2018 academic year for our empirical analysis and modeling.

There are more than 250 HEIs that provide undergraduate management degree programs in the Ukraine. Preliminary diagnostics and qualitative analysis indicate that the factor analysis of the tuition fees within certain types of HEIs is correct. In this regard, an empirical database that includes the tuition fees and factors influencing its variation in the 35 leading state universities in each Ukraine's regions has been collected for analysis.

The correlation analysis of pricing factors in Ukrainian universities suggests that in addition to the cost of an educational product, the following factors are important in determining the market value of training:

- the level of demand in the region of HEI activity (measured by average wages in the region, Av.mon.wage; correlation coefficient with the tuition fees – 0.770, p-value < 0.05);
- academic reputation of HEI (measured by the HEI index in the National Ranking TOP-200 Ukraine, Int.ind; correlation coefficient with the tuition fees – 0.757, p-value < 0.05);
- popularity of the program in HEI (measured by the number of applications filed in the HEI for undergraduate management program per one licensed place, Comp; correlation coefficient with the tuition fees – 0.578, p-value < 0.05);

To select the optimal model of tuition fees according to a set of criteria (coefficient of determination, R^2 ; mean-square residual model, RMSE, etc.) the programming language R was used. The table 3 shows the statistical characteristics of the regression models of annual tuition fees for the Bachelor's degree study program «Management» in the 2017/18 academic year in the 35 leading HEIs in the regions of Ukraine.

Table 3 – Statistical characteristics of the regression models of annual tuition fees for the bachelor's program "management" in the 2017/18 academic year

Formula	R^2	RMSE	Assumptions (Global Stat, Skewness, Kurtosis, Link Function, Heteroscedasticity)	Multi- collinearity	Unusual observations* (HEIs)		
					Outliers	Points of high leverage	Influential points
1) Tuition.Fees ~ Av.mon.wage, Int.ind + Comp)	0.767	1944	Link Function	No problems	35 14 17	1 2	2 17
2) ln(log(Tuition.Fees) ~ Av.mon.wage + Int.ind + Comp	0.624	1842	No problems	No problems	14 17	1 2	1 17
* 1-National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute", 2-Taras Shevchenko National University of Kyiv, 14-Lesya Ukrainka East European National University, 17-Mykolaiv V.O.Sukhomlynskyi National University, 35- Chernihiv National University.							
Source: authors' results.							

Based on the data in Table 3, it can be argued that it is correct to model tuition fees using a regression model of the second type, since this model fulfills all of the requirements of the least squares and the smallest value of the root mean square value of the model (RSME) is achieved.

The modeling results yield a multifactor regression model for estimating undergraduate management tuition fees at the largest classical and technical universities of Ukraine in the 2017/18 academic year:

$$\log(\text{Tuition.Fees}) = 3,82202 + 0,00002 \text{ Av.mon.wage} + 0,00217 \text{ Integr.ind} + 0,01049 \text{ Comp} \\ (0,00) (0,10) (0,13) (0,00)$$

Proposed model showed a significant overall effect ($F = 17,15, p < 0,05$). The three predictor variables explained 62,4 % of the variance in the outcome of predicted variable, and no multicollinearity was observed. Further diagnostics with Fox's car package [25] revealed five unusual observations, which were divided into 3 groups: outliers, leverage points, influential observations.

In 16 out of the 35 largest Ukrainian universities providing undergraduate management programs there was a reduction in the tuition fees compared to the position of HEI in National academic ranking, the demand for program as well population income in the region of HEI activity (figure 1).

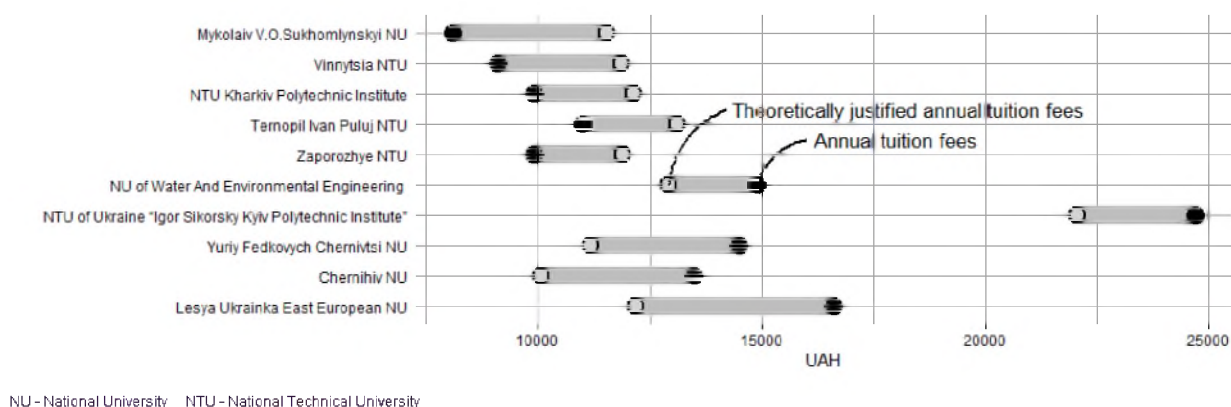


Figure 1 – Top-10 Ukraine’s HEIs with the largest difference between actual and theoretically justified annual tuition fees on the bachelor’s program «Management», 2017/18 academic year
Source: Authors' calculations. The database is available on the universities' sites

Based on the results of modeling, there were the five universities with the lowest tuition fees for the Bachelor’s degree study program «Management» in 2017/18 academic year. These universities are characterized by the highest estimates of lost financial opportunities to receive higher revenues from tuition fees, given the academic rank of the HEI, the demand for particular education program and average wage in the regions of HEIs activities. At the same time, 11 out of the 35 largest Ukrainian universities are setting excessively high tuition fees for their undergraduate management program, assuming the risk of additional losses due to a possible reduction in the number of potential students.

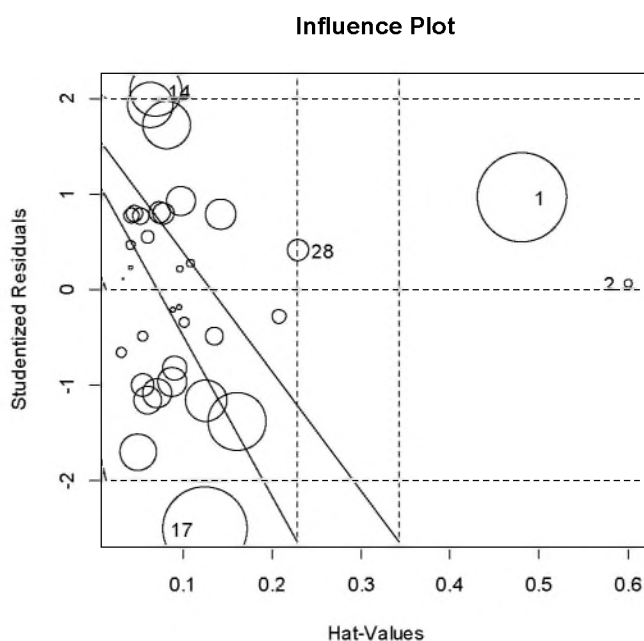


Figure 2 – The graphical interpretation of unusual observations (HEIs) in the regression models of annual tuition fees for the bachelor’s program “Management”, 2017/18 academic year.
Source: authors' results

Despite the satisfactory conditions for using the model 2, there are five unusual units (HEIs with numbers 1; 2; 14; 17) in this set. Such units in the software R include: 1) Outliers, 2) Points of high leverage, 3) Influential points. Figure 2 serves as a graphical interpretation of unusual HEIs in the regression model 2 of tuition fees.

For the regression model 2, outliers are the Lesya Ukrainka East European National University (14) and Mykolaiv V.O. Sukhomlynskyi National University (17). The first one has a substantial excess of the actual value over the theoretically justified tuition fees, based on the model. On the contrary, for Mykolaiv V.O. Sukhomlynskyi National University, actual tuition fees are much lower than its theoretically justified value.

Among the HEIs with high tuition of fees, there are two large Ukrainian universities characterized by an unusual combination of independent values: Taras Shevchenko NU of Kyiv (2) and the NTU of Ukraine “Igor Sikorsky Kyiv Polytechnic Institute” (1). These universities are defined in the process of modelling as high leverage points.

According to the software R, influential observations have a significant impact on the results of regression analysis. In the regression model 2, this is the NTU of Ukraine “Igor Sikorsky Kyiv Polytechnic Institute” (1) and Mykolaiv V.O. Sukhomlynskyi National University (17).

Conclusion. The processes of pricing in the Ukrainian higher education system are influenced by the set of factors associated with the market and non-market institutions of governance. The determinants of non-market institutions are the demographic factors affecting the number of actual and potential entrants, and accordingly - the demand for higher education. Demographic factors are closely interwoven with economic and market factors, in particular with consumers' demand, inflation rates, the number of competitors, the level of monopolization of the educational services market, the prestige of particular occupations in the labour market, and future revenues of graduates. These factors are related to the external environment of the HEI activity; that is, they are exogenous. The determinants of endogenous pricing are the academic reputation of HEI as well as its lecturers and researchers, along with the quality and popularity of HEIs educational products.

Using the classification of pricing factors in the higher education system, we offer a multi-factorial regression model of tuition fees for undergraduate management programs at 35 leading universities in all regions of Ukraine. The model allows us to determine theoretically justified tuition fee, which takes into account the influence of the three most significant factors - the average salary in the region of HEI activity, its academic reputation and the popularity of the educational program.

The multi-factorial regression model allows to identify HEIs setting too high, or, conversely, too low tuition fees. This HEI pricing policy increases the risk of additional losses due to a possible reduction in the number of potential students, or reduction of financial resources necessary to cover all expenses associated with training.

Thus, modeling tuition fees provides information and analytical support for making decisions in the HEI competitiveness management, taking into account market and non-market factors for pricing educational products.

Future research may focus on the influence of introducing indicative training costs at state universities in Ukraine, including the analysis of risks associated with a significant increase in tuition fees at state HEIs.

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**ЖОҒАРЫ ОҚУ ОРЫНДАРЫНЫҢ БӘСЕКЕГЕ ҚАБІЛЕТТІЛІГІН
БАСҚАРУДАҒЫ ОҚУ АҚЫСЫН МОДЕЛЬДЕУ
(УКРАИНА УНИВЕРСИТЕТТЕРІН МЫСАЛҒА АЛУ НЕГІЗІНДЕ)**

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**МОДЕЛИРОВАНИЕ ПЛАТЫ ЗА ОБУЧЕНИЕ
В УПРАВЛЕНИИ КОНКУРЕНТОСПОСОБНОСТЬЮ ВУЗОВ
(НА ПРИМЕРЕ УНИВЕРСИТЕТОВ УКРАИНЫ)**

Аннотация. Ценовая политика в высшем образовании как особом секторе экономики основана на общих принципах и методах ценообразования, но имеет отличительные особенности в каждой стране. Например, большинство вузов в Украине и многих других постсоветских странах являются некоммерческими организациями и устанавливают плату за обучение в соответствии с рекомендациями центрального органа исполнительной власти в сфере образования. Во-вторых, государственные и коммунальные вузы получают финансовую поддержку из центрального и местных бюджета и, таким образом, имеют дополнительные конкурентные преимущества. В-третьих, абитуриенты часто воспринимают высокую плату за обучение в качестве индикатора его качества и престижа. В связи с этим спрос на образовательные продукты вузов в основном неэластичен.

Анализ ценовой политики в системе высшего образования показывает, что плата за обучение может быть как завышенная, с учетом престижности вуза/специальности, так и заниженная, с целью привлечь большее количество студентов. Недооценка платы за обучение не покрывает расходы на образовательные услуги вузов, ограничивает финансовые возможности их развития. В то же время завышенные цены ограничивают образовательные возможности абитуриентов. Таким образом, проблемы ценовой политики обуславливают актуальность задач анализа и моделирования платы за обучение в управлении конкурентоспособностью вузов.

Целью исследования является моделирование платы за обучение с учетом внутренних и внешних факторов деятельности вузов. Выбор переменных моделей основан на теоретическом исследовании и классификации факторов ценообразования в высшем образовании. Эмпирическая часть исследования выполнена по данным официальных сайтов 35 вузов Украины. Результаты корреляционного анализа показывают, что факторами существенной вариации платы за обучение на рынке образовательных услуг в Украине являются: 1) академическая репутация вуза, 2) популярность образовательной программы/специальности среди абитуриентов, 3) доходы населения в регионе деятельности вузов. Моделирование платы за обучение с учетом указанных факторов и использованием языка программирования R позволяет выявить вузы, которые слишком занижают, или наоборот, завышают плату за обучение, а также определить ее теоретически обоснованный уровень. Результаты моделирования могут быть использованы для улучшения качества процессов принятия решений в ценовой политике вузов и повышения их конкурентоспособности.

Ключевые слова: высшие учебные заведения, конкурентоспособность, плата за обучение, анализ ценовой политики, регрессионная модель, Украина.

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