Mária Vojtasová, Rastislav Solej
Factors affecting Academic Performance in Econometrics: interests, abilities and attitudes

Abstract

The presented study was conducted with the objective of identifying the factors that influence the outcomes of grades in the Introduction to Econometrics, particularly using the Gretl program. A total of 163 students enrolled in the undergraduate program participated in the study, during which data was gathered via two questionnaires, resulting in the collection of over 50 variables. This article aims to provide a follow-up of the previous research conducted by Vojtasová and Solej (2023) and evaluate the impact of broader variables on academic performance. The article's primary objective was to evaluate the degree to which individual factors contribute to the academic performance of students in the field of econometrics. The results of the research confirmed statistical significance of previously used variables such as tutorial attendance and row, time preparation. Moreover, it reaffirms the importance of regular engagement with course materials and active participation in tutorial sessions. Results highlight the importance of previous knowledge of statistics and attitudes towards learning econometrics.

Key words

Econometrics, GRETL, study results, quantitative methods

JEL Classification

A22, C01, C21

DOI

http://dx.doi.org/10.37355/KD-2023-14

Introduction

Econometrics requires a unique set of skills and perspectives from students. Many elements impact student's academic performance as they work through the complex concepts of econometric analysis. This includes student's personal interests, innate skills, and attitudes

toward the topic. The presented study aimed to find the factors influencing students' marks in the Introduction to Econometrics course. The primary motivation for our research originates from finding a way to improve teaching, understanding how to motivate students to obtain better results, and finding out what to focus on when it comes to preparation for teaching. Moreover, the following study, together with primary anonymized data, can be used as a case study in the future for participants of econometric courses within the University of Economics.

In the earlier research conducted by Vojtasová and Solej (2023), the primary objective was to investigate the fundamental factors that influence the study outcomes pertaining to the course titled "Introduction to quantitative methods". In the winter semester of 2022/2023, 163 students specializing in Finance, Banking, and Insurance were at the University of Economics in Bratislava. Approximately 50 variables were collected, which had been subjected to partial evaluation in the initial study. The variables mostly related to the quantitative measurement of activity in seminars that were mandatory for students and participation on lectures that were voluntary. In addition, the models also incorporated characteristics such as the proximity to the blackboard. This variable was quantified as the count of rows starting from the teacher's desk. Our primary focus was on the ongoing preparation of students for seminars and their preparation prior to the midterm test. The model also incorporated the variable gender. A comprehensive examination of the gender differences was addressed in a different article.

Given the previous article's emphasis on the significance of econometrics (Vojtasová, Solej, 2023; Conaway et al., 2018; Mahjabeen, Mahmud, 2016), we now aim to integrate and assess the outcomes of extended variables within the models. Students undertook two mid-term examinations to evaluate their comprehension of econometrics and proficiency in the statistical program GRETL (Gnu Regression, Econometrics, and Time-series Library). The program was selected based on its ease of instructing the introductory econometrics course (Mixon, Smith, 2006).

1 Literature review

Many academics and studies have examined the elements that affect academic achievement in universities and other educational settings. Tintner (1954) conducted an initial investigation on the teaching of econometrics, primarily emphasizing the examination of teaching methods across various countries worldwide. According to him, econometrics is the field that utilizes mathematical economic theory and quantitative statistical methods to solve various economic issues.

The primary objective of the original studies was to examine the correlation between academic achievement in the fields of economic theory, mathematics, and statistics. Cohn (1972) designed a questionnaire to evaluate the possibility of reorganizing the "Introduction to Quantitative Methods" course. The findings confirmed a possible link between skills in mathematics and performance in quantitative methods. In contrast, the study revealed no substantial correlation between academic performance in economics and proficiency in econometrics. Anderson et al. (1994) provided more evidence that a solid foundation in mathematics is a powerful indicator of success in this subject.

MacDowell et al. (1977), conducted a study to investigate the differences in learning economics among men and women. The collected data revealed that academic performance in the field of economics failed to have a substantial influence. Following that, Dancer (2003) extended the research of gender disparities in the identical field. The study encompassed a group of 696 students from the University of Sydney, with a fairly balanced distribution between males and females. It was assumed that female students would surpass male students in academic performance. This hypothesis was validated when reviewing the data in econometrics, since it became evident that women attained better results. Nevertheless, within the field of economics, women had poorer results in comparison to their male counterparts.

Incorporating a variable related to part-time employment, Paul (1982) and Greenberger and Steinberg (1986) observed a statistically significant association. These findings indicate the existence of possible prejudice, as students who held part-time jobs had restricted preparation time because they come from financially less secure families. Romer (1993) identified class attendance as a significant determinant. The research was conducted at the University of California and involved a total of 195 students. The study's main aim was to assess the impact of absences and verify the feasibility of implementing mandatory lectures.

Cladera (2021) conducted a study that intended to assess the methodology of econometrics among undergraduate students in Spain. The author claims that there has been an increasing importance and need for econometric knowledge and skills in the labor market. Nevertheless, students frequently dislike and have unfavorable attitudes towards this subject (Cladera, 2021, p. 8). The study used a sample of 87 students registered in the econometrics course throughout 2018. Cladera (2021, p. 4) employed 36 factors in the study to evaluate several aspects, such as Affect, Self-confidence, Value, Difficulty, Interest, and Effort. The results indicated a direct relationship between students' self-perception of their talents in econometrics and their passion for the subject, consequently leading to improved academic achievement. The observed pattern

of findings is consistent with prior studies that explored analogous associations in different disciplines, such as Statistics (Mills, 2004; Emmioğlu, Capa-Aydin, 2012).

Vojtasová and Solej (2023) conducted a recent study that specifically examined a group of students from Slovakia. The research findings have shown that incorporating econometrics and quantitative methods can improve the quality of research. As a result, modern institutions deliberately provide their students with the necessary information and abilities right from the beginning of their academic journey. The main aim of this study was to investigate the factors that impact students' grades, general academic achievement, and comprehension of the subject matter at universities. One hundred sixty-three students participated in the study as part of the research sample. A questionnaire was given to the students at the end of two mid-term assessments. A designed econometric model indicated that active participation in seminars and involvement in tutorials had a statistically significant effect. Furthermore, in the initial examination, students' distance to the teacher's desk was identified as a noteworthy variable; the greater the distance between the student and the teacher's location, the more unfavorable their outcomes were likely to be. Moreover, attending lectures was essential in deciding one's score on the initial mid-term test. Comprehensive preparation before the test was also recognized as a significant predictor of academic success.

2 Data and methodology

The chapter explores the related data collection processes and describes our selected sample. The primary objective of this paper, building upon the prior research conducted by Vojtasová and Solej (2023), is to investigate additional explanatory factors that affect the outcomes of the econometrics course. Data was collected between November 2022 and January 2023, involving 163 second-year bachelor's students at the University of Economics in Bratislava. As part of their final evaluation in the course "Introduction to Quantitative Methods," students were required to complete two mid-term assessments.

Data obtained through methods other than questionnaires relate to diverse factors, including the distribution of students by gender, their involvement in study groups, scores attained in the first and second midterms, participation in seminars, and the accumulation of activity points during these seminar sessions. The original questionnaire conducted after the first midterm included fundamental questions on the classification based on study groups. This survey also included factors related to the accessibility of computer equipment. Significantly, the classroom design consisted of four rows containing four computers. As a result, some students had to either work on their own laptops or work with their

classmates. To address this circumstance, the variable "school computer" was created. There was a simultaneous interest in determining whether the distance from the blackboard impacted students' academic performance.

The primary focus of the initial questionnaire centered predominantly on students' preparedness for seminars and their engagement in pre-seminar lectures, typically held two days before the actual seminars, and served to provide students with a theoretical foundation pertinent to the topics of the seminar. This questionnaire gathered information about the specific actions performed by students before seminars and evaluated the average time spent preparing, excluding lecture and seminar hours. Furthermore, it explored the importance of the preparation that takes place before the midterm examination, measured in minutes. In addition, the questionnaire investigated the amount of time students spent preparing before submitting their credit reports. It is crucial to emphasize that this variable measured only days prior to the midterm exam.

In contrast, the following questionnaire addressed to the second midterm test and included a wider range of questions and factors aligned with the existing scientific literature. Significantly, it replicated the factors associated with seminar preparation and lecture attendance from the first questionnaire. After open discussion with students, additional questions were incorporated to evaluate the effectiveness of collaborative and individual exam preparation approaches. The survey also included questions regarding students' utilization of office hours. In addition, a personality type variable was included, allowing students to select whether they identify as introverted or extroverted. Most full-time students also participated in internships or other paid activities while studying to support themselves financially. Considering this, the survey incorporated inquiries about the students' employment status and the number of hours they dedicate to their jobs on weekly basis. Furthermore, it aimed to assess students' length of sleep before midterm test and whether they participated in physical activities such as sports during their free time.

Since the econometrics lesson utilized the Gretl program, we investigated whether there were any connections between technical proficiency demonstrated by proficiency in Microsoft Office applications like Word and Excel. In addition, our analysis included characteristics related to students' academic achievement, specifically focusing on their grades in statistics and their overall cumulative academic averages in all disciplines. In addition, during the data collection phase, we prioritized the variables specified in the study conducted by Kara et al. (2009), where the authors analyzed the factors that influence student performance in introductory courses on microeconomics and macroeconomics. The study's findings indicate

that various factors significantly impacted students' final grades. These factors included demographic variables such as gender and variables like work hours, SAT scores, class absences, and the number of economics courses taken. Moreover, factors such as students' inherent motivation, grade point average, age, living in university housing, enrollment in mathematics courses, and the instructor teaching the course were recognized as significant factors influencing student achievement.

In her study, Cladera (2021) assessed the attitudes of undergraduate Economics students towards econometrics by conducting a questionnaire after they finished the introductory Econometrics course. This investigation emphasized the significance of evaluating students' viewpoints after completing the course. Examining students' self-perceptions of their achievements is crucial for identifying methods to increase motivation and, consequently, improve their academic performance.

2.1 Empirical model

We constructed an Ordinary Least Squares (OLS) model to analyse empirical data, integrating particular data obtained from questionnaire responses. The model includes statistically significant variables from the previous paper of Vojtasová, Solej (2023). These variables are points for the activity where a positive relationship has been demonstrated. Likewise, the number of seminars that the student participated in was significant. Attendance at lectures (Romer, 1994), the ROW variable with the expected final effect, and preparation before the credit report were also significant in Test I. Our research involved the construction of two initial empirical models using the following equation:

$$POINTS\text{-}total = a0 + a1.TUTORIAL\text{-}activity + a2.TUTORIAL\text{-}attendance + a3.ROW + a4.LECTURES\text{-}attendance + a5.PREP\text{-}beforetest + a6.CONSULTATION + a7.EXTROVERT + a8.SLEEP + a9.JOB + a10.WORK\_HOURS + a11.EXERCISE\_HOURS + a12.EXERCISE + a13.GRADE\_AVERAGE + a14.DORMITORY + a15.SELFEVALUATION + a16.INTEREST + a17.TECHNICAL\_SKILLS + a18.STATISTICS + \varepsilon \quad (1)$$

$$POINTS\text{-}total = a0 + a1.COGNITIVE\_COMPETENCE + a2.INTEREST + a3.AFFECT + a4.EFFORT + a5.DIFFICULTY + a6.VALUE + \varepsilon \quad (2)$$

, where

a0	Initial value (constant)
POINTS-total	Total number of points from Test I. / Test II.
TUTORIAL-activity	number of points for the activity (max. 6 points)
TUTORIAL-attendance	the number of seminars attended by a student
ROW	row from the blackboard in which the student sat during the seminars
LECTURES-attendance	the number of the lectures attended
PREP-beforetest	the number of minutes the student spent preparing before for the test. (during the week before the test held)
CONSULTATION	dummy variable (1 = if student attended consultation, 0 = if not)
EXTROVERT	dummy variable (1 = if student considers himself to be an extrovert, 0 = if not)
SLEEP	the number of hours of sleep before test
JOB	dummy variable (1 = if student had part-time job, 0 = if not)
WORK_HOURS	number of work hours as part-timer per week
EXERCISE_HOURS	number of hours exercised per week
EXERCISE	dummy variable (1 = if student exercised regularly, 0 = if not)
GRADE_AVERAGE	average of student's grade from the academic system (AIS2)
DORMITORY	dummy variable (1 = if student lived in dormitory, 0 = if not)
SELFEVALUATION	student's self-evaluation of his work during seminar on a following scale: (1 = not enough, 2 = enough, 3 = good, 4 = very good, 5 = excellent)
INTERESTING	dummy variable (1 = if student the class interesting, 0 = if not)
TECHNICAL_SKILLS	dummy variable (1 = if student considers himself/herself to be a technical type, 0 = if not)
STATISTICS	students grade of obtained from Statistics
COGNITIVE_COMPETENCE	average of student's self-evaluation of cognitive competencies connected with econometrics on a scale 1-5, where five is the highest
INTEREST	average of student's self-evaluation of interest towards econometrics on a scale of 1-5, where five is the highest
AFFECT	average of student's perception of the class on the scale of 1-5, where five is the highest
EFFORT	average of student's self-evaluated performance during the semester on a scale of 1-5, where 5 is the highest
DIFFICULTY	average of student's self-evaluated difficulty of the class on a scale of 1-5, where five is the highest
VALUE	average of student's self-perceived value of econometrics on a scale of 1-5, where five is the highest
εi	error term

This research searches through new variables, notably focusing on designated consultation sessions that students had access to before their exercises. We anticipate a positive influence

stemming from this factor. Furthermore, we have included the personality trait variable "Extrovert" in our analysis, although we do not anticipate statistically significant differences in outcomes between extroverted and introverted students, drawing from the findings of Paul (1982). Moreover, we have incorporated the variable "job" (part-time employment) into our model, with the expectation that students juggling additional employment commitments may allocate less time to their studies, potentially resulting in lower academic performance. To quantify this difference, we introduce the variable "Work hours." Similarly, we consider the presence of adequate physical activity, with the expectation that it will positively impact academic performance.

Furthermore, the overall study results (grades) hold considerable significance in our analysis. In this context, we anticipate a robust and favorable impact. The same principle applies to the conversion of the statistics grade, a methodology previously employed by Cohn (1972). In addition, we have introduced variables such as "dormitory" or "self-evaluation" into our model. Moreover, we consider the assessment of students' interest in the subject matter and whether the students perceive themselves as technically skilled.

2.2 Summary statistics

Table 1 shows the most important descriptive statistics for all used variables as part of analysis. Its aim is to better comprehend the data. Total number of observations was 163 students, who filled the first questionnaire. The second questionnaire was not filled by 4 of them.

The maximum attainable score for both tests was 17 points. Upon comparing summary statistics, Test 2 yielded slightly superior results for parameters such as mean, median, 5th percentile, and 95th percentile.

Additional variables considered included activity, attendance at tutorials and lectures. These variables were further stratified based on the semester stage. Tutorials, obligatory with a 25% permissible absence rate, naturally exhibited higher participation. In contrast, lectures, which were non-mandatory, witnessed increased attendance in the initial segment. Data related to preparation were denoted in minutes, with noticeably shorter preparation times for the second mid-term test due to prior student experience. The Row variable lacked substantial significance in terms of summary statistics, as students were freely distributed across four rows.

Consultations, a binary variable, indicated that only 20% availed themselves of consultation hours. Extrovert was another binary variable. Sleep hours ranged from 1.5 to 10, while the Job variable, also binary, reflected whether students were employed. Work Hours, closely correlated, represented the hours worked by full-time employees. Similarly, Exercise

and exercise hours exhibited a comparable correlation. Grade average variables captured the study's average results, determined by the weighted study average in the AIS academic system (A – 1.0, B – 1.5, C – 2.0, D – 2.5, E – 3.0, Fx – 4.0). Dormitory, another binary variable, pertained to accommodation. Self-evaluation gauged students' self-assessment, with higher values indicating a more favorable evaluation of their class performance. The Interest variable, a dummy variable, reflected students' interest or lack thereof in the subject. This statistic denoted the average grade from the subject of the same name completed by the student in the preceding semester before the course. Other variables were derived from a study by Cladera (2021), and a questionnaire completed separately by students, with individual variable values averaged.

Table No. 1: Descriptive statistics of selected variables

Variable	Mean	St. Dev.	Median	Min	Max	5-perc	95-perc	IQ range	Observations
Mid-term Test_1 points	*10,9*	*4,7*	*12,0*	*0,0*	*17,0*	*2,1*	*16,5*	*7,3*	*163*
Mid-term Test_2 points	*11,9*	*3,9*	*12,5*	*0,0*	*17,0*	*2,7*	*17,0*	*4,8*	*163*
T1_TUTORIAL-activity	*2,4*	*2,4*	*2,0*	*0,0*	*6,0*	*0,0*	*6,0*	*4,0*	*163*
T1_TUTORIAL-attendance	*5,6*	*0,8*	*6,0*	*2,0*	*6,0*	*4,0*	*6,0*	*1,0*	*163*
T1_LECTURES-attendance	*2,8*	*2,0*	*3,0*	*0,0*	*6,0*	*0,0*	*6,0*	*3,0*	*162*
T1_PREP-beforetest	*277,0*	*214,0*	*240,0*	*0,0*	*1700,0*	*30,0*	*600,0*	*240,0*	*162*
Total_TUTORIAL-activity	*5,8*	*2,4*	*6,0*	*0,0*	*12,0*	*1,0*	*9,8*	*2,0*	*163*
Total_TUTORIAL-attendance	*10,2*	*1,1*	*10,0*	*4,0*	*11,0*	*8,0*	*11,0*	*1,0*	*163*
Total_LECTURES-attendance	*4,2*	*3,4*	*3,0*	*0,0*	*11,0*	*0,0*	*11,0*	*5,0*	*159*
T2_PREP-beforetest	*185,9*	*132,0*	*150,0*	*0,0*	*600,0*	*30,0*	*480,0*	*150,0*	*159*
ROW	*2,5*	*1,1*	*3,0*	*1,0*	*4,0*	*1,0*	*4,0*	*1,0*	*162*
CONSULTATION	*0,2*	*0,4*	*0,0*	*0,0*	*1,0*	*0,0*	*1,0*	*0,0*	*159*
EXTROVERT	*0,5*	*0,5*	*1,0*	*0,0*	*1,0*	*0,0*	*1,0*	*1,0*	*159*
SLEEP	*6,9*	*1,5*	*7,0*	*1,5*	*10,0*	*4,0*	*9,0*	*2,0*	*159*
JOB	*0,7*	*0,5*	*1,0*	*0,0*	*1,0*	*0,0*	*1,0*	*1,0*	*159*
WORK_HOURS	*13,6*	*12,7*	*15,0*	*0,0*	*52,0*	*0,0*	*35,0*	*20,0*	*159*
EXERCISE_HOURS	*153,0*	*204,0*	*70,0*	*0,0*	*1200,0*	*0,0*	*540,0*	*240,0*	*159*
EXERCISE	*0,7*	*0,4*	*1,0*	*0,0*	*1,0*	*0,0*	*1,0*	*1,0*	*159*
GRADE_AVERAGE	*2,2*	*0,6*	*2,1*	*1,0*	*4,0*	*1,5*	*3,5*	*0,6*	*159*
DORMITORY	*0,6*	*0,5*	*1,0*	*0,0*	*1,0*	*0,0*	*1,0*	*1,0*	*159*
SELFEVALUATION	*3,5*	*0,9*	*3,0*	*1,0*	*5,0*	*2,0*	*5,0*	*1,0*	*159*
INTERESTING	*0,7*	*0,5*	*1,0*	*0,0*	*1,0*	*0,0*	*1,0*	*1,0*	*159*
TECHNICAL	*0,6*	*0,5*	*1,0*	*0,0*	*1,0*	*0,0*	*1,0*	*1,0*	*159*
STATISTICS	*2,0*	*0,6*	*2,0*	*1,0*	*4,0*	*1,0*	*3,0*	*1,0*	*159*
COGNITIVE_COMPETENCE	*2,8*	*0,7*	*2,8*	*1,0*	*4,3*	*1,5*	*4,0*	*1,0*	*159*
INTEREST	*3,0*	*0,8*	*3,0*	*1,0*	*5,0*	*1,5*	*4,5*	*1,3*	*159*
AFFECT	*2,8*	*0,6*	*2,8*	*1,2*	*3,8*	*1,7*	*3,8*	*1,0*	*159*
EFFORT	*3,6*	*0,8*	*3,5*	*1,3*	*5,0*	*2,0*	*4,8*	*1,0*	*159*
DIFFICULTY	*2,0*	*0,6*	*2,0*	*0,5*	*3,5*	*0,8*	*3,0*	*0,8*	*159*
VALUE	*2,6*	*0,9*	*2,5*	*0,5*	*4,5*	*1,3*	*4,3*	*1,3*	*159*

Source: own calculation

3 Results

The purpose of this chapter is to show the key findings of our research. Building upon prior investigations, our emphasis is on the expansion of data that was not incorporated in previous studies. Our primary focus is on understanding the influence of interests, capabilities, and attitudes on academic performance in the field of econometrics.

3.1 Empirical model

The results of the empirical model can be seen in Table 2, which includes the unrestricted and restricted models. An unrestricted model shows us that the model is statistically significant as whole. The value of the F-statistic is relatively high (12,42) and is in the area of rejecting the null hypothesis ($p<0.05$). Among the previously considered variables, several emerged as statistically significant, notably tutorial attendance, class rank, and preparation efforts. Conversely, activity levels during seminars and participation in lectures did not exhibit statistical significance in this context.

Focusing on the recently added factors, the variable consultation, which had a negative coefficient, was determined to be statistically insignificant. Moreover, there was no statistically significant differentiation observed between introverted students and those who were extroverted. The impact of sleep before mid-term test remains unsubstantiated despite a positive coefficient. Similarly, there was no proven effect on the students' job status or the amount of time they dedicated to work in relation to their academic achievements during the semester.

Remarkably, a statistically significant relationship was found with the variable "hours of exercise," despite the fact that the binary variable "exercise" itself did not reach statistical significance. Furthermore, additional factors such as students' use of school-provided accommodation, their level of interest in the subject, and their self-perceived technical proficiency were not identified as statistically significant factors influencing the outcomes.

In line with existing literature, our analysis confirmed the significance of certain variables correlating with the number of points obtained. These factors include self-evaluation, grade average, and the grade received in statistics. Worth noting is that these grades exhibited negative coefficients, with the best grade 'A' assigned a value of 1 and the poorest grade 'Fx' (fail) assigned a value of 4, as per the grading scale.

Table No. 2: Dependence of the result from mid-term test 1 on the explanatory variables

Dependent variable: Mid-term Test_1 points	***Unrestricted Model*** Coefficient (p-value)			***Restricted model*** Coefficient (p-value)		
const	7,07131	**	(0,0243)	8,23257	***	(0,0035)
T1TUTORIALactivity	0,07596		(0,5102)			
T1TUTORIALattendance	1,07595	***	(0,005)	1,18381	***	(0,0009)
ROW	−0,441990	*	(0,0688)	−0,465888	**	(0,0382)
T1LECTURESattendance	0,021		(0,8857)			
T1PREPbefore	0,00380	***	(0,0012)	0,00363	***	(0,0012)
CONSULTATION	−0,220314		(0,7056)			
EXTROVERT	0,00488		(0,9923)			
SLEEP	0,16472		(0,344)			
JOB	0,52987		(0,5047)			
WORK_HOURS	−0,0256915		(0,4156)			
EXERCISE_HOURS	−0,00284651	**	(0,0387)	−0,00265724	**	(0,0249)
EXERCISE	−0,379851		(0,5561)			
GRADE_AVERAGE	−1,80656	***	(0,0005)	−2,11705	***	(<0,0001)
DORMITORY	−0,235485		(0,6452)			
SELFEVALUATION	1,30284	***	(0,0002)	1,45560	***	(<0,0001)
INTERESTING	0,26142		(0,6533)			
TECHNICAL	0,77393		(0,1597)			
STATISTICS	−1,74763	***	(0,0001)	−1,74273	***	(<0,0001)
Observations	159			162		
Adjusted R square	0,5653			0,5771		
F-Statistic	12,4155			31,7954		
P-value (F)	$5{,}09\ e^{-21}$			$8{,}80\ e^{-27}$		

Note: Statistical significance is indicated by (*), (**) and (***) at the 10%, 5% and 1% significance level, respectively. **Source:** own calculation

Statistical tests showed that the specification of the unrestricted model is inadequate. The Ramsay reset test came out with a p-value is less than 0.05 (p = 0.00669984). Based on White's test for heteroskedasticity, heteroskedasticity also seems to be a problem (p = 0.013454), but the Breusch-Pagan test came out the opposite way (p = 0.0602513). The random errors in this model are randomly distributed (p = 0.615343).

In the case of the restricted model, a problem with heteroskedasticity is obvious. White's test and Breusch pagan's test are gaining value in the area of rejecting the null hypothesis (p-value<0.05). Test for normality of residual indicates that errors are normally distributed. The Ramsay reset test acquired a higher value than the previous one, but it is still in the area of rejecting the null hypothesis (p = 0.043). Possible multicollinearity problems were not detected based on the analysis. Variance Inflation Factors was very close to the number 1 and condition index based on Belsley-Kuh-Welsch collinearity diagnostics does not indicate problems with collinearity for restricted and unrestricted model.

Table No. 3: Dependence of the result from mid-term test 2 on the explanatory variables

Dependent variable: Mid-term Test_2 points	***Unrestricted Model*** Coefficient (p-value)			***Restricted model*** Coefficient (p-value)		
const	1,70073		(0,6194)	1,93602		(0,5212)
TotalTUTORIALactivity	0,14584		(0,2134)			
TotalTUTORIALattendance	1,18272	***	(<0,0001)	1,35253	***	(<0,0001)
ROW	0,02648		(0,9048)			
TotalLECTURESattendance	−0,0447044		(0,5654)			
T2PREPbefore	−0,000171685		(0,9219)			
CONSULTATION	0,55572		(0,3051)			
EXTROVERT	0,06897		(0,8778)			
SLEEP	0,27318	*	(0,0855)	0,30859	**	(0,0365)
JOB	0,52352		(0,4669)			
WORK_HOURS	−0,0149360		(0,6019)			
EXERCISE_HOURS	−0,000382052		(0,757)			
EXERCISE	−1,66332	***	(0,005)	−1,49203	***	(0,0025)
GRADE_AVERAGE	−1,09857	**	(0,0159)	−1,14336	***	(0,0067)
DORMITORY	−0,0237635		(0,9588)			
SELFEVALUATION	0,30436		(0,3285)			
INTERESTING	0,03708		(0,9439)			
TECHNICAL	0,98031	*	(0,0522)	1,00241	**	(0,0238)
STATISTICS	−1,18755	***	(0,0038)	−1,29210	***	(0,0007)
Observations	159			159		
Adjusted R square	0,4215			0,4397		
F-Statistic	7,3947			21,6619		
P-value (F)	$4{,}10\ e^{-13}$			$2{,}65\ e^{-18}$		

Note: Statistical significance is indicated by (*), (**) and (***) at the 10%, 5% and 1% significance level, respectively. **Source:** own calculation

Table 3 provides an overview of the outcomes from the Mid-term Test II. Considering the R-squared value, it is apparent that the initial model accounts for approximately 42% of the overall variance in the dependent variable, signifying a relatively robust explanatory capability. Both the restricted and unrestricted models exhibit statistical significance as complete entities.

Regarding the original variables, a notable and statistically significant influence is observed in the context of overall seminar participation throughout the entire semester. However, among the newly introduced variables, consultation, extroversion, part-time employment, dormitory residency, self-evaluation, and interest did not demonstrate statistical significance.

Conversely, a noteworthy finding emerged, highlighting the positive impact of the number of hours of sleep prior to the credit report submission. Each additional hour of sleep is associated with an increase of 0.31 test points. Contrarily, engagement in regular physical exercise displayed a negative effect, revealing that students who maintained consistent physical

activity scored, on average, 1.49 points lower compared to those who did not engage in such activities.

Comparatively, similar to the preceding results, the technical skills of students were deemed statistically significant. More proficient students exhibited an average score that was 1 point higher. Moreover, the cumulative academic performance across all subjects and the grade in statistics once again demonstrated significance, indicating that a stronger academic performance in these domains corresponded to better results in the introductory econometrics course. Statistical tests for the unrestricted model showed that heteroskedasticity is not present in the model. White's test has a p-value of 0.4628. A test of normality of the residuals indicates that the errors are not normally distributed. The specification of the model based on the Ramsay reset test is adequate. With the restricted model, there is a strong indication of a problem with heteroskedasticity. White's test and Breusch-Pagan test yielded p-value<0.05. Also, errors are not normally distributed. Moreover, the specification of the model is adequate based on the Ramsay reset test. Model indicates no problem with multicollinearity.

Table No. 4: Dependence of the result from mid-term test 1 on the explanatory variables

Dependent variable: Mid-term Test_1 points	***Unrestricted Model*** Coefficient (p-value)	***Restricted model*** Coefficient (p-value)
const	−1,87659 ** (0,3478)	−1,02118 (0,5959)
COGNITIVE_COMPETENCE	0,53363 (0,3811)	
INTEREST	0,99021 *** (0,0879)	1,17694 *** (0,0074)
AFFECT	0,75283 * (0,2786)	1,54352 *** (0,0007)
EFFORT	1,398 (0,0026)	
DIFFICULTY	1,26484 *** (0,04)	1,59471 *** (0,0067)
VALUE	−0,384624 (0,4147)	
Observations	159	159
Adjusted R square	0,2404	0,2200
F-Statistic	8,0166	14,5756
P-value (F)	1,59 e^{-07}	2,07 e^{-08}

Note: Statistical significance is indicated by (*), (**) and (***) at the 10%, 5% and 1% significance level, respectively. **Source:** own calculation

Table 4 and Table 5 show the variables we included based on Cladera's (2021) study. These are proxy variables that subjectively measure the influence of cognitive competence, interest, affect, effort, difficulty, value. In both cases, interest and also difficulty proved to be a key variables. In the first mid-term test, the variable affect was also significant, and in the second, effort during tutorials. The analysis did not identify potential multicollinearity issues. The Variance Inflation Factors were closely approximating 1, and the condition index, as per

Belsley-Kuh-Welsch collinearity diagnostics, did not signal any collinearity problems for both the restricted and unrestricted models.

Table No. 5: Dependence of the result from mid-term test 1 on the explanatory variables

Dependent variable: Mid-term Test_2 points	***Unrestricted Model*** Coefficient (p-value)	***Restricted model*** Coefficient (p-value)
const	3,62530 ** (0,0255)	3,56932 ** (0,0222)
COGNITIVE_COMPETENCE	0,54056 (0,2718)	
INTEREST	0,95902 ** (0,0409)	0,713469 ** (0,0427)
AFFECT	−0,251815 (0,6528)	
EFFORT	1,290 *** (0,0006)	1,2948 *** (0,0004)
DIFFICULTY	0,85473 * (0,0848)	0,968774 ** (0,0395)
VALUE	−0,508043 (0,1825)	
Observations	159	159
Adjusted R square	0,2404	0,1763
F-Statistic	6,0620	11,0580
P-value (F)	0,00001	1,28 e^{-06}

Note: Statistical significance is indicated by (*), (**) and (***) at the 10%, 5% and 1% significance level, respectively. **Source:** own calculation

Conclusion

The presented paper provides valuable insights into the determinants of academic performance in the context of econometrics. Our research aimed to integrate and assess the outcomes of expanded variables to identify the fundamental factors that influence the study outcomes. Through a comprehensive analysis of various variables, we have identified factors that significantly influence students' outcomes in this discipline.

Among the variables we considered, tutorial attendance, row, and preparation time emerged as statistically significant contributors to academic success. These findings reaffirm the importance of regular engagement with course materials and active participation in tutorial sessions. Furthermore, when examining the average grade, we have also found previous knowledge of statistics and performance in econometrics are strongly corelated.

Conversely, several other variables, such as consultation, extroversion, and certain demographic factors, job, or hours worked did not exhibit statistically significant associations with academic performance. While these factors may still play roles in students' overall experiences, their direct impact on econometrics performance appears to be limited.

Notably, our study unveiled some unexpected insights. The positive effect of sleep duration on academic performance suggests the importance of rest and alert students. On the other hand, the negative impact of regular exercise on performance highlights the potential challenges faced by students who engage in intensive physical activities alongside their studies.

In conclusion, this research enriches our understanding of the multifaceted nature of academic success in econometrics, shedding light on the complex interplay of various factors that influence students' outcomes. These findings can inform educators and institutions in devising strategies to support students in their pursuit of excellence in this field.

For future research, exploring the relationships among additional potential indicators that impact teaching would be suitable. Specifically, investigating the influence of specific study materials and determining whether early semester absences have a significant effect would be valuable avenues of inquiry. Additionally, examining the correlation between the academic outcomes of students and those of their classmates who sat next to them in class could provide further insights into the dynamics of the learning environment.

Acknowledgements

We would like to express our gratitude to all of students who participated in this research. Moreover, we would like to appreciate their work at the seminars as well as the valuable feedback that has been a great contribution. Our thanks also belong to associate professor Martin Alexy, PhD. for allowing us to conduct this research.

Literature

[1] ANDERSON, G.A., BENJAMIN, D. and M.A. FUSS (1994) The determinants of success in university introductory economics courses. Journal of Economic Education. Vol. 25, No. 2, pp. 99–119

[2] BECKER, W. E. and W. H. GREENE (2001) Teaching statistics and econometrics to undergraduates. Journal of Economic Perspectives. Vol. 15, No. 4, pp. 169–182.

[3] CLADERA, M. (2021) Assessing the attitudes of economics students towards econometrics. International Review of Economics Education. Vol. 37, 100216.

[4] COHN, E. (1972) Students' characteristics and performance in economic statistics. The Journal of Economic Education. Vol. 3, No. 2, pp. 106–111.

[5] CONAWAY, B., CLARK, C., ARIAS, J. J. and J. FOLK (2018) Integrating econometrics: A modern undergraduate economics capstone experience. The Journal of Economic Education. Vol. 49, No. 3, pp. 260–270.

[6] DANCER, D. M. (2003) The gender issue revisited: a case study of student performance in Economics and Econometrics. Economic Analysis and Policy. Vol. 33, No. 1, pp. 73–89.

[7] EMMIOĞLU, E. and Y. CAPA-AYDIN (2012) Attitudes and achievement in statistics: A meta-analysis study. Statistics education research journal. Vol. 11, No. 2, pp. 95–102.

[8] GREENBERGER, E. and L. STEINBERG (1986) When teenagers work: The psychological and social costs of adolescent employment. New York: Basic Books.

[9] KARA, O. D., BAGHERI, F. and T. TOLIN (2009) Factors Affecting Students Grades in Principles of Economics. American Journal of Business Education. Vol. 2, No. 7, pp. 25–34.

[10] MACDOWELL, M.A., SENN, P.R. and J. C. SOPER (1977) Does sex really matter? The Journal of Economic Education. Vol. 9, No. 1, pp. 28–33.

[11] MILLS, J. D. (2004) Students' attitudes toward statistics: Implications for the future. College Student Journal. Vol. 38, No. 3, pp. 349–362.

[12] WILSON MIXON, J., JR, and. R. J. SMITH (2006) Teaching undergraduate econometrics with GRETL. Journal of applied econometrics. Vol. 21, No. 7, pp. 1103–1107.

[13] PAUL, H. (1982) The impact of outside employment on student achievement in macroeconomic principles. The Journal of Economic Education. Vol. 13, No. 2, pp. 51–56.

[14] ROMER, D. (1993) Do students go to class? Should they? Journal of economic perspectives. Vol. 7, No. 3, pp. 167–174.

[15] SIMKINS, Z., MAHJABEEN, R. and S. MAHMUD (2016) Integrating undergraduate research into economics general education. Council on Undergraduate Research Quarterly. Vol. 37, No. 2, pp. 11–19.

[16] VOJTASOVÁ, M. and R. SOLEJ (2023) Determinants of econometrics grades: A case study from Slovakia. QUAERE 2023, roč. XIII. Recenzovaný sborník příspěvků interdisciplinární mezinárodní vědecké konference doktorandů a odborných asistentů. Hradec Králové: MAGNANIMITAS, pp. 920–929.

[17] TINTNER, G. (1954) The teaching of econometrics. Econometrica: Journal of the Econometric Society. Vol. 22, No. 1, pp. 77–100.

Contact

Ing. Mária Vojtasová, MSc.
University of Economics in Bratislava
Faculty of National Economy, Department of Finance
Dolnozemská cesta 1
85235 Bratislava
Slovak Republic
maria.vojtasova@euba.sk
ORCID: 0009-0008-8475-3451

Ing. Rastislav Solej, MSc.
University of Economics in Bratislava
Faculty of National Economy, Department of Finance
Dolnozemská cesta 1
85235 Bratislava
Slovak Republic
rastislav.solej@euba.sk
ORCID: 0000-0002-2886-5191