Article

From Policy to Outcome: How Economic Conditions and National Funding Affect Graduation Rates: Case of Lithuanian Universities

Gintarė Židonė * and Rytis Krušinskas

School of Economics and Business, Kaunas University of Technology, LT-44249 Kaunas, Lithuania; rytis.krusinskas@ktu.lt

* Correspondence: gintare.zidone@ktu.lt

Abstract: This study examines how national public funding and macroeconomic conditions affect higher education performance, measured by graduation rates. A panel dataset covering 2013–2022 and ten Lithuanian public universities integrates economic, financial, and institutional variables. Lithuania applies a mixed higher education funding model that combines institutional support with elements of student-based financing, where part of the public resources follow individual enrollment patterns. Both immediate and lagged effects are analyzed using multiple regression models with time-lag factors. A review of academic literature indicates that increased funding does not necessarily lead to better outcomes; instead, the strategic allocation of resources to priority areas is particularly important. The results confirm that macroeconomic factors are statistically significant and that overall public funding does not have a positive impact unless it is allocated efficiently. On the contrary, funding directed toward research and infrastructure consistently shows a positive effect. These findings underscore the importance of evaluating the effectiveness of education policy through lagged impact analysis.

1. Introduction

Globally, higher education systems are under increasing pressure to expand access and improve graduation rates, now widely recognized as a central metric of education policy effectiveness (Ashwin, 2022). Graduation rates reflect student achievement and institutional capacity to guide learners toward successful degree completion in alignment with evolving labor market demands.

Recent research has moved beyond the focus on total public investment, highlighting the importance of how resources are allocated, particularly whether they support core academic functions such as instruction, research, and infrastructure (Kelchen et al., 2023; Rosinger et al., 2022). However, funding design alone does not fully explain variation in student outcomes. Macroeconomic conditions, including gross domestic product (GDP) per capita, unemployment, and inflation, shape both institutional strategies and student behavior by influencing the opportunity cost of education and the perceived returns on higher education (Behera & Mallick, 2022; Shobande & Asongu, 2022).

Crucially, the effects of both funding and macroeconomic shifts are not always immediate. Institutions often require time to adapt to financial changes, and students may respond to external conditions only in subsequent academic cycles. As recent studies emphasize,

incorporating time-lagged dynamics is essential to understanding when and how such variables affect graduation outcomes (Dobrovolska et al., 2023; E. Jackson & Hotte, 2022).

This study makes a novel contribution at both contextual and methodological levels. Lithuania, a small member of the European Union, employs a unique higher education funding model that combines institutional-based funding with a student-choice "voucher" system. This design generates a distinctive interplay between public policy, institutional adaptation, and individual decision-making—yet it remains insufficiently studied in the empirical literature.

To address this gap, the study applies a multi-year time-lag model (t, t−1, t−2, t−3) and disaggregates public funding into instruction, research, and infrastructure. This allows for a more granular analysis of how both funding structure and macroeconomic conditions relate to graduation rates over time.

By integrating structural and temporal perspectives, the study seeks to determine whether macroeconomic variables and public funding, both in volume and allocation, are significantly associated with graduation outcomes, and whether these effects materialize with a delay.

2. Literature Review

2.1. Graduation Rate as a Policy Outcome

In contemporary higher education policy discourse, the graduation rate has emerged as both a measurable performance indicator and a proxy for the cumulative effectiveness of institutional structures, student support systems, and policy design. While it traditionally served as the final checkpoint in the academic progression, its function has expanded, now representing a broader evaluative lens through which the alignment between educational objectives and systemic capacities is assessed (O'Hagan & Stiefel, 2025; Ashwin, 2022). Despite increasing interest in metrics such as admission and retention rates, a growing body of research positions graduation as the most consequential outcome of tertiary education.

To understand the graduation rate conceptually, it must be embedded within a multidimensional framework of related indicators. Admission rates signal system accessibility and social inclusion, while retention reflects institutional ability to support continuous engagement. However, as Spilioti and Anastasiou (2024) argue, these indicators are only meaningful as they culminate in successful degree completion. In this framework, graduation does not merely close the student lifecycle—it confirms whether prior stages functioned effectively and equitably.

However, graduation cannot be treated as an isolated metric. The institutional processes that facilitate or hinder it are susceptible to policy pressures and internal practices. Abdullah et al. (2022) caution that retention, often mistaken for progress, may be artificially inflated when not anchored in pedagogical quality or curricular coherence. Similarly, Chi and Bustillo (2024) emphasize that short-term targets—driven by internal reporting or external audits—can distort institutional priorities, leading to policies prioritizing student continuation over authentic academic growth.

This dynamic is further complicated by the spread of performance-based funding (PBF) mechanisms. By tying financial resources to graduation outcomes, PBF policies reinforce the visibility of graduation rates as strategic performance goals. On the one hand, this model can motivate investment in academic advising, remediation services, and student engagement initiatives (Rahaman & Abdul-Rahman, 2022). On the other hand, it introduces unintended incentives: Kuijpers et al. (2024) highlight the risks of lowering academic thresholds, relaxing admission criteria, or reshaping curricula to optimize completion statistics rather than learning outcomes. Within a conceptual framework, these practices

represent feedback loops where policy shapes institutional behavior, which alters student trajectories.

Graduation outcomes do not just matter to universities; they play a critical role in shaping broader economic and social trends. Ogawa (2025) and Mallillin (2022) both show that students who complete higher education are better positioned in the labor market. They are likely to find steady work, earn more overtime, and contribute to national productivity. These outcomes turn graduation into something more than a personal milestone—it becomes a way to understand how education connects to social mobility and national development.

Fuchs et al. (2022) emphasize how graduation data can support practical decision-making at the system level. Because it is relatively easy to compare across countries or institutions, it gives policymakers a clear view of what works. When this kind of data is considered alongside other indicators—like how satisfied students are, how many find jobs, or how well their skills match workforce needs—it can guide more innovative reforms focusing on actual student outcomes, not just numbers.

In short, this literature suggests that graduation rate should be viewed as the final result of multiple interacting elements. These include how accessible and supportive the system is for students (through admissions and retention), what incentives or pressures institutions face (like funding schemes), and the broader economic or policy context. Graduation is both the endpoint and the outcome that reveals whether all parts of the system work together as they should.

2.2. Macroeconomic Factors and Graduation Rate

Macroeconomic conditions—such as national income, employment trends, and price stability—significantly shape educational outcomes, including graduation rates. These forces are often external to the education system, yet they influence what institutions and students can do. For example, public budgets are closely tied to gross domestic product (GDP) levels, while students' decisions are shaped by perceived job security and affordability. In this context, graduation can result from choices made within specific economic constraints and opportunities.

Take GDP per capita, for instance. Growing a country's economy typically results in increased public investment in services, including education. Filippova et al. (2021) and Dawud (2020) show that rising GDP levels often translate into more financial support for higher education institutions, enabling them to enhance infrastructure, academic services, and teaching quality. During economic downturns, however, this relationship shifts. Jia (2023) notes that when the job market becomes uncertain, people are more likely to pursue further education to improve their long-term prospects, even without increased institutional capacity. This behavior positions graduation as an educational outcome and an adaptive response to labor market risk.

Unemployment exerts influence from another angle. In high-unemployment contexts, tertiary education is often seen as a strategic tool to improve employability, driving enrollment and persistence (Shobande & Asongu, 2022; Behera & Mallick, 2022). Conversely, when the job market is strong and opportunities are more abundant, students may be less motivated to continue their studies, especially if the perceived value of a degree diminishes in the short term (Maneejuk & Yamaka, 2021). This creates a fluctuating relationship where graduation becomes sensitive to changes in opportunity costs.

Inflation adds further complexity. When inflation is high, families may struggle to afford tuition and living costs, forcing students from lower-income backgrounds to abandon or delay their studies. Sebki (2021) points out that such economic pressure reinforces educational inequality by limiting who can realistically stay on track to graduate. On the

other hand, when inflation stabilizes, universities can better plan tuition levels and support structures, encouraging consistent academic progression (Dokhkilgova et al., 2023).

These macroeconomic variables influence education systems indirectly but substantially. GDP per capita shapes the funding landscape; unemployment alters demand patterns; and inflation affects affordability and persistence. Their effects are filtered through public policy, institutional capacity, and student perception. As Maneejuk and Yamaka (2021) and Batool and Liu (2021) suggest, in countries aiming to modernize their economies, these conditions often drive reform efforts and define the effectiveness of higher education systems.

From this perspective, macroeconomic variables act as background forces that filter through institutional policies and student behavior. Whether through public funding allocation or how students evaluate the cost–benefit of staying enrolled, these conditions help determine who graduates and when. As Maneejuk and Yamaka (2021) and Batool and Liu (2021) suggest, especially in fast-developing economies, such external factors often shape the direction and success of higher education systems more than internal reforms alone.

2.3. *National Funding and Graduation Rate*

Public funding remains a key factor in shaping graduation outcomes, but its impact is shaped by more than just the amount of investment. While economic models often assume that higher levels of funding should naturally improve student completion, empirical studies suggest a more complex picture. The effectiveness of public investment depends on how well funding is aligned with institutional needs, national policy goals, and the internal governance of universities (Kelchen et al., 2023; Rosinger et al., 2022; Ortagus et al., 2020). Without such alignment, funding may have only limited or inconsistent effects.

Önder (2024) finds that institutions are better positioned to support students through graduation when public funding is used to improve infrastructure, reduce financial stress, and expand academic services. However, Motala et al. (2023) emphasize that financial input alone is insufficient. Even substantial investments may fall short without thoughtful integration into educational planning and quality improvement. Similarly, C. K. Jackson et al. (2021) highlight the importance of how funding is distributed within institutions, noting that strategic and equitable allocation plays a larger role in shaping outcomes than funding size alone.

The type of investment also matters. Mobegi and Kara (2022) report that while teaching-focused funding can support retention in the short term, its connection to completion rates is less clear. On the other hand, research-related investments often improve the overall academic environment, increasing student motivation and institutional prestige. Abelha et al. (2020) point out that such investments help students build competencies valued by employers, especially when academic programs align with labor market needs. Likewise, Ahmad et al. (2023) argue that infrastructure upgrades, such as modern learning spaces and digital tools, support inclusion and persistence.

Broader funding strategies often reflect national policy directions. Governments use funding models to shape institutional priorities, and one common approach is PBF. This links financial support to student outcomes like graduation rates. While Rahaman and Abdul-Rahman (2022) note that this can drive institutions to improve support services, it may also have unintended effects. Kuijpers et al. (2024) caution that under intense performance pressure, universities may shift focus toward easily measurable results, sometimes at the cost of academic rigor or fair access.

The literature reveals that funding works best when embedded in institutional strategies that support long-term goals. As Kelchen et al. (2023) argue, this requires not only providing resources but also ensuring that they are used to support inclusive, quality-

oriented education. Effective funding models encourage planning, responsiveness, and accountability—not just better numbers but better outcomes.

From this perspective, public funding functions as a structural mechanism that influences student completion. While it does not determine success on its own, its purposeful use, aligned with institutional priorities, can significantly shape graduation outcomes. in enabling or limiting student completion. It does not guarantee success, but it can significantly influence graduation rates when directed purposefully and matched by strong institutional practices.

2.4. Time Lags in the Analysis

Graduation outcomes in higher education are shaped by immediate inputs and delayed effects that unfold over time. Time lags have gained increasing attention in empirical research as a necessary component in understanding how economic and policy changes influence institutional performance. Rather than expecting linear or instant responses, scholars emphasize that outcomes such as graduation rates often result from cumulative and deferred processes.

Structural shifts in public funding or broader macroeconomic changes rarely result in immediate transformations. According to Dobrovolska et al. (2023), Zając et al. (2023), Papík et al. (2022), and Bal-Domańska (2022), institutional systems require adjustment periods in which new policies are implemented, resources are reallocated, and students adapt to the evolving context. This latency is critical to understanding the effectiveness of education policy reforms and fiscal interventions.

Theoretical approaches to time lag analysis highlight how educational systems absorb external pressures gradually. Tools such as panel data models and time-lagged regressions provide a way to measure these effects across multiple time periods. Iheanacho and Nwaogwugwu (2021) and Trisnaningsih et al. (2020) demonstrate that using such models reveals delayed relationships that would otherwise remain obscured in cross-sectional studies. These findings affirm that causal pathways in education are often non-linear and unfold in stages.

Empirical studies further validate these insights. A delay of one to three years between policy action and observable changes in graduation rates has been consistently documented (Dobrovolska et al., 2023; Bal-Domańska, 2022). E. Jackson and Hotte (2022) observe that in Canadian provinces, shifts in funding arrangements required two years before resulting in graduation rate variations. In a related study, Barber et al. (2023) report that graduate employment outcomes tend to reflect decisions made in earlier academic cycles. These patterns reinforce the idea that evaluation strategies must extend beyond short-term metrics.

Designing effective education policies requires awareness of these temporal patterns. Research by Cho-Baker et al. (2022) stresses that institutions respond incrementally, making time-sensitive models essential for developing realistic expectations and avoiding premature conclusions. Policymakers who rely solely on immediate outcomes risk overlooking the full effects of reform.

Incorporating time lags into educational analysis creates a more accurate and nuanced understanding of how graduation rates respond to change. As systems evolve through cycles of reform and adjustment, robust methodologies that account for temporal distance enable researchers and decision-makers to evaluate long-term impacts with greater clarity and precision.

2.5. Conceptual Framework

This section introduces a conceptual model that combines the key themes identified throughout the review. Rather than analyzing individual factors in isolation, the framework emphasizes how broader economic conditions, public investment choices, institutional practices, and student-level behaviors interact over time. These dimensions are not static or independent; they operate through layered feedback loops and are often subject to delay in effect. This time-sensitive dynamic is central to understanding graduation as more than an administrative endpoint; it reflects long-term systemic alignment between policy inputs and educational outcomes.

Figure 1 below presents a conceptual framework which serves as the foundation for the following theoretical synthesis.
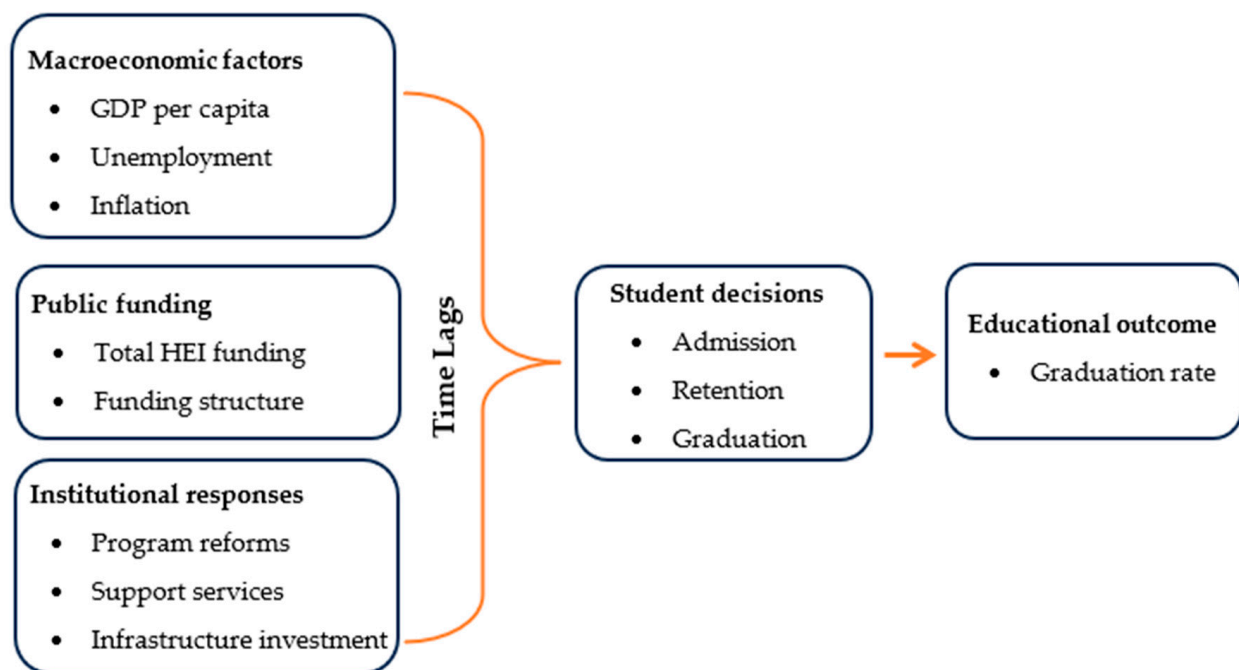

Figure 1. Conceptual framework linking macroeconomic factors, public funding, and graduation rate.

At the macro level, economic indicators such as GDP per capita, unemployment, and inflation influence the resources available for education and the strategic choices made by students. These conditions shape public investment patterns and determine whether higher education is seen as an accessible and valuable pursuit. Public funding—both in terms of volume and structural design is a key mediator, translating national policy priorities into actionable support mechanisms within institutions. As seen in the literature, the effects of funding depend on how much is allocated and how equitably and strategically it is deployed.

Institutional responses function as the operational link between structural inputs and student experiences. Program reforms, investments in infrastructure, and support services are not neutral actions; they reflect strategic efforts to align internal capacity with external demands. These responses shape the educational environment, influencing whether students can access, persist, and ultimately graduate.

Critically, these processes do not unfold instantaneously. Time lags play a central role in mediating the relationship between policy actions and observable outcomes. Structural changes often take one to three years to manifest, reflecting the inertia of educational systems and the need for adaptive learning among institutions and students alike.

At the center of this model lie student decisions: admission, retention, and graduation. These choices result from upstream structural conditions and the proximate drivers of educational outcomes. In this framework, graduation rate is a dependent variable that reflects the cumulative success of interactions across all domains.

To operationalize this model, the subsequent analysis employs a time-lagged regression design that tests the relationship between macroeconomic indicators, disaggregated public funding categories, and graduation rate over multiple years. This approach allows for an empirical assessment of the delayed and mediated effects outlined in the conceptual framework, aligning the theoretical structure with the study's methodological design.

3. Methodology

3.1. Data and Variables

The empirical part of the study analyzes annual data from ten Lithuanian public universities covering the period 2013–2022. The data sample has a panel structure that covers time and institutional dimensions. The research contains 100 observations (10 institutions × 10 years). The universities included in the analysis are Vilnius University, Kaunas University of Technology, Vytautas Magnus University, Vilnius Gediminas Technical University, Lithuanian University of Health Sciences, Mykolas Romeris University, Klaipėda University, Lithuanian University of Sport, Lithuanian Academy of Music and Theatre, and the Vilnius Academy of Arts. Data was collected from official sources: Eurostat, Educational Management Information System, and the Ministry of Education, Science, and Sport of the Republic of Lithuania.

Lithuania's higher education funding model is classified as a hybrid system: core budget funding is allocated according to a formula that includes student numbers, normative costs, targeted funding, and infrastructure needs. At the same time, PBF elements are integrated. The European Commission & Directorate General for Education, Youth, Sport and Culture (2023) reports that public budget revenues represent 65% of total higher education institution funding in Lithuania, thus requiring a thorough analysis to evaluate public policy effectiveness. The voucher-based principle functions as the main funding mechanism because institutions receive allocations based on the enrollment numbers of government-funded students. The funding system depends on institutions' success in student recruitment. The funding mechanism serves as an indirect assessment tool for evaluating how well institutions attract students and their market efficiency and responsiveness to market needs. The analysis was limited to the 2013–2022 period due to the unavailability of validated and publicly accessible institutional data for more recent years.

The analysis requires examination of public funding relationships to higher education performance outcomes. Figure 2 presents the development of public funding for bachelor's and master's degrees and the number of graduates in Lithuania from 2013 to 2022.

Despite increasing investment, graduation rates have declined over the past decade, which may signal the limited effectiveness of funding in terms of graduation rates. Although Lithuania does not have a fully implemented PBF system, the data recorded at the national level allows for an assessment of both the volume of funds allocated and the structure of their distribution by functional area. This context provides the basis for the systematic logic of the analysis: the empirical part seeks to investigate how the level and structure of different types of public funding correlate with graduation rates, one of the leading indicators of the effectiveness of modern higher education policy. At the same time, it also looks at broader macroeconomic conditions that may have an immediate or delayed impact on educational outcomes at the institutional level.
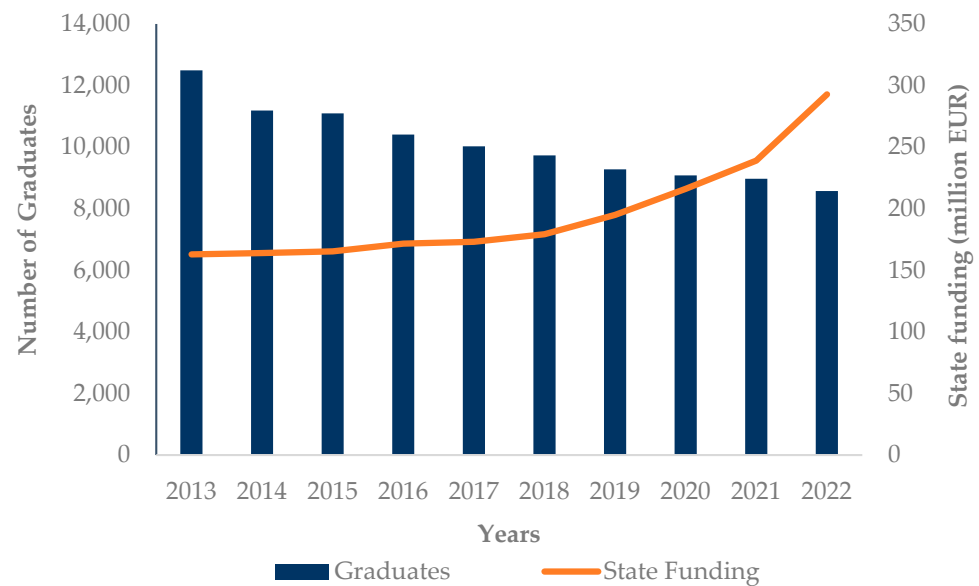
Figure 2. Number of publicly funded bachelor's and master's graduates and public university funding in Lithuania (2013–2022).

Figure 3 provides a diagram of the relationship between dependent and independent variables, including economic and financial factors, and their potential impact on graduation outcomes, to provide a visual representation of the analytical logic used in the study.
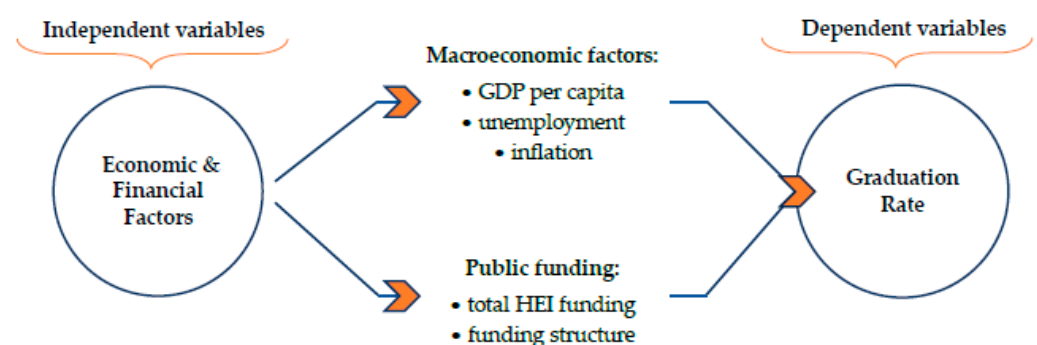

Figure 3. Empirical model: the relationship between macroeconomic and public funding variables and graduation rate.

The dependent variable is the graduation rate (Grads), defined as the share (%) of publicly funded bachelor's and master's degree students graduating from publicly funded bachelor's and master's programs out of the total number of students enrolling in publicly funded courses. This indicator reflects the effectiveness of higher education outcomes at the institutional level.

Independent variables:

- GDP per capita $\left(\frac{GDP}{Capita}\right)$ is the gross value of goods and services at market prices (EUR) divided by the average population.
- Unemployment rate (*Unemployment*)—the share (%) of unemployed individuals aged 15–74 as a proportion of the labor force of the same age group.
- Inflation (*Inflation*) is the average annual change in consumer prices (%), calculated using the Harmonized Index of Consumer Prices (HICP).
- Higher education funding as a share of GDP ($\frac{Exp\ HEI}{GDP}$)—the annual public funding allocated to a specific institution, expressed as a share of GDP (%).

- Funding breakdown by function—a breakdown of the structure of the allocations made to an institution by the State, showing the share of total funding (%) that has been allocated to undergraduate and postgraduate activities ($\frac{Studies}{Exp\ HEI}$), research ($\frac{Research}{Exp\ HEI}$), and infrastructure ($\frac{Infrastructure}{Exp\ HEI}$).

Transformation. To reduce the asymmetry in the distribution of the variables and avoid the possible dominance of large values, the variable GDP per capita has been transformed into logarithmic form. At the same time, the other indicators have been kept in percentage form. This data transformation helps bring the distribution closer to the normal distribution, thus improving compliance with the assumptions of the regression analysis: normality of the residuals and homoskedasticity. In addition, the logarithmic form facilitates economic interpretation by allowing changes in the results to be treated as proportions or percentages.

The study contributes to the theoretical and practical discourse on measuring higher education outcomes and the effectiveness of education policy by highlighting how the national economic environment and investment structure can determine graduation trends at the institutional level.

3.2. Model Specification

Given the objective of the study and the structure of the data, an econometric model is built to quantify the relationship between macroeconomic and higher education funding factors and the graduation rate. The analysis was carried out using multiple regression methods using the IBM SPSS Statistics 29.0.2.0 software package.

As all institutions are subject to the same macroeconomic indicators, there is a risk of clustering, which can affect the estimation of standard errors. This risk is not corrected within the survey and is considered a methodological limitation when interpreting the results. Qualitative indicators of institutions and students, such as admission standards or the quality of academic services, are not included in the design of this study and are considered external factors.

The model includes data with different time lags: current year (t), one (t−1), two (t−2), and three (t−3) years in order to assess the potential lagged effect of the independent variables. Such modeling allows for analyzing factors' immediate and lagged impact on the graduation rate. Macroeconomic conditions, such as unemployment rates or economic growth, can influence individuals' decisions to start, continue, or discontinue studies. In addition, the allocation of public funding affects institutions' ability to ensure the quality of their programs, develop research potential, and modernize infrastructure. Such changes are often gradual rather than immediate, and their analysis with time lags is theoretically and empirically justified.

The inclusion of time lags (t, t−1, t−2, t−3) is grounded in the structure and duration of higher education programs, as well as in the logic of enrollment decisions. In Lithuania, bachelor's studies typically last three to four years, while master's programs take approximately two years to complete. Given this timing, economic or financial conditions present three years prior may have influenced students' decisions to enter programs that are completed in the observation year. Therefore, incorporating a t−3 lag enables the analysis to capture the immediate impact of macroeconomic variables and their delayed influence, particularly as it relates to decisions made at the start of the academic path. While the current model applies discrete annual lags, future research could explore distributed lag models or alternative temporal specifications to capture more complex or non-linear policy effects over time.

Equation (1) specifies how the relationship between macroeconomic conditions, public funding, and graduation rates is modeled.

$$
\begin{aligned}
Grads_{i,\,t} = \beta_0 + \quad & \beta_1 \log\left(\tfrac{GDP}{Capita}\right)_{t-k} + \beta_2 Unemployment_{t-k} + \beta_3 \Delta Inflation_{t-k} \\
& + \beta_4 \tfrac{Exp\ HEI}{GDP}_{\,i,\,t-k} + \beta_5 \tfrac{Studies}{Exp\ HEI}_{\,i,\,t-k} + \beta_6 \tfrac{Research}{Exp\ HEI}_{\,i,\,t-k} \\
& + \beta_7 \tfrac{Infrastructure}{Exp\ HEI}_{\,i,\,t-k} + \varepsilon_{i,t}
\end{aligned}
\tag{1}
$$

where

- β_0—the intercept represents the base value of the graduation rate.
- β_1–β_7—coefficients related to macroeconomic conditions and higher education funding variables.
- i—index indicating an individual higher education institution.
- t—time period.
- k—lag length (0, 1, 2, or 3 years), indicating the number of years by which variables are lagged in the model.
- $\varepsilon_{i,t}$—the error term accounts for unobserved factors that are not explicitly modeled.

The following research hypotheses are formulated based on the literature analysis and the structure of the developed model:

- H_1: Macroeconomic factors are statistically significantly related to the graduation rate.
- H_2: The amount and structure of public funding to universities by function is statistically significantly related to graduation rates.
- H_3: The relationship between macroeconomic and financing factors and the graduation rate is time lagged (t−1, t−2, or t−3).

An overview of the hypotheses and their associated variables is provided in Table 1.

Table 1. A summary of hypotheses and their analytical components.

Hypothesis	Conceptual Focus	Variables
H_1	Macroeconomic factors influence the graduation rate	Log GDP/Capita Unemployment, % ΔInflation, %
H_2	The amount and structure of public funding by function influence the graduation rate	Exp HEI/GDP, % Studies/Exp HEI, % Research/Exp HEI, % Infrastructure/Exp HEI, %
H_3	The effect of economic and financial factors is time-lagged	Models with time lags: t, t−1, t−2, t−3

The econometric equation reflects the theoretical assumption that the graduation rate is determined not only by the current period but also by economic and financial indicators from previous periods, which may have a time lag effect. The study contributes to the theoretical and practical discourse on measuring higher education outcomes and the effectiveness of education policy by highlighting how the national economic environment and investment structure can determine graduation trends at the institutional level.

4. Results and Distinction

4.1. Descriptive Statistics

Descriptive statistical analysis was performed to provide a preliminary assessment of the characteristics of the variables and their suitability for further regression analysis. The

main statistical indicators—mean, median, standard deviation, and extreme values—allow an assessment of central tendencies, the extent of dispersion, and the symmetry of the distribution (see Table 2).

Table 2. Key descriptive statistical indicators.

Variable	N	Mean	Median	Std. Deviation	Min	Max
Grads %	100	0.2578	0.2532	0.0455	0.1799	0.5617
Log GDP/Capita	100	4.1966	4.1922	0.0948	4.0711	4.3769
ΔInflation, %	100	0.0344	0.0170	0.0540	−0.0070	0.1890
Unemployment, %	100	0.0807	0.0750	0.0188	0.0600	0.1180
Exp HEI/GDP, %	100	0.0004	0.0003	0.0004	0.0001	0.0016
Studies/Exp HEI, %	100	0.4625	0.4716	0.1049	0.2648	0.7069
Research/Exp HEI, %	100	0.1903	0.1884	0.0442	0.1017	0.3170
Infrastructure/Exp HEI, %	100	0.1589	0.1533	0.0465	0.0743	0.2576

The dependent variable, the graduation rate, has sufficient variance and close mean and median values, indicating a relatively symmetric distribution. These characteristics suggest moderate differences between institutions, whose results are not significantly affected by extreme values.

Macroeconomic indicators are spread unevenly. Inflation is characterized by a high standard deviation and a wide range of values (from −0.7% to 18.9%), reflecting significant economic fluctuations during the period under analysis. Such fluctuations can be attributed to external economic shocks that may indirectly affect the higher education sector. Meanwhile, the volatility of logarithmic GDP per capita is very low ($\sigma = 0.09$), suggesting that the country's economic situation has remained fairly stable over the period. The unemployment rate shows moderate variation and a slight positive asymmetry in its distribution.

Regarding higher education funding, the overall level of public spending as a share of GDP is low and has a relatively narrow dispersion range. These differences between institutions may be explained by their different sizes or performance. On the contrary, the indicators for the distribution of funding by function show a greater variation between institutions. For example, the average share of funding for studies is around 46%, but this ranges from 26% to 71%, suggesting different priorities or strategic choices. The shares for research and infrastructure show a smaller, but still significant, variation, which may also influence the differences in performance between institutions.

The intensity and distributional properties of the variables suggest that the data are suitable for further regression analysis to determine the relationship between macroeconomic and financial factors and the university graduation rate.

4.2. The Results of the Models

The empirical analysis employed multiple regression analysis with time lags (t, t−1, t−2, t−3) for the independent variables. The dependent variable sample consisted of 70 observations that covered the period from 2016 to 2022 to include the t−3 lag. The time periods of the independent variables were t—2016–2022, t−1—2015–2021, t−2—2014–2020, and t−3—2013–2019. The reduction in sample size became essential because it guaranteed that all independent variable values with their respective time lags existed for each observation of the dependent variable.

The models represent different assessment points for macroeconomic and financial factors' potential impact on graduation outcomes. The models demonstrate statistical significance through ANOVA F-tests, which produce *p*-values below 0.001 while their explanatory power (Adjusted R^2) ranges between 0.566 and 0.784 (see Table 3).

The inflation rate proved statistically insignificant across all models, which indicates that short-term price level changes do not affect graduation outcomes either immediately or

with delays. The result makes sense because most public university studies receive public funding, and inflation effects represent overall economic conditions instead of student graduation choices.

Table 3. Coefficients and statistical significance of multiple regression models.

Variable	Model (t)	Model (t−1)	Model (t−2)	Model (t−3)
(Constant)	0.888 (0.000)	0.836 (0.000)	0.908 (0.000)	0.084 (0.001)
Log GDP/Capita	−0.165 (0.000)	−0.162 (0.000)	−0.180 (0.000)	-
Unemployment, %	-	-	-	0.812 (0.000)
Exp HEI/GDP, %	−30.484 (0.000)	−27.679 (0.000)	−23.831 (0.004)	−15.453 (0.068)
Studies/Exp HEI, %	−0.055 (0.015)	-	-	-
Research/Exp HEI, %	0.325 (0.000)	0.405 (0.000)	0.392 (0.000)	0.359 (0.000)
Infrastructure/Exp HEI, %	0.198 (0.001)	0.177 (0.008)	0.200 (0.004)	0.298 (0.000)
Adjusted R^2	0.784	0.633	0.566	0.586
ANOVA F-test (*p*-value)	<0.001	<0.001	<0.001	<0.001
N (Observations)	63	68	68	66

The results of the models were used to assess the validity of the hypotheses.

Hypothesis H_1, which states that there is a relationship between macroeconomic factors and university graduation rates, is empirically supported. The logarithmic GDP per capita was statistically significant in the three models (t, t−1, t−2), and its effect was negative. This result can be interpreted as reflecting the impact of economic alternatives, in particular employability, on the graduation of studies: as the standard of living improves and labor demand increases, the continuation of studies may be postponed or discontinued if entering the labor market becomes a quicker and more financially attractive alternative. This result confirms the findings of previous studies that rising living standards can encourage some students to choose the labor market over an academic path (Filippova et al., 2021; Dawud, 2020).

Although this interpretation is consistent with previous literature, it remains partly speculative without additional supporting evidence. The relationship between economic prosperity and graduation outcomes may be mediated or moderated by factors such as labor market conditions, opportunity structures, or demographic trends. Future research could examine interaction effects, for example, between GDP and unemployment, or test whether the observed pattern persists when controlling for enrollment shifts, population cohorts, or regional disparities in labor market demand.

The unemployment rate was significant only in the model with a three-year lag (t−3), indicating a positive lagged effect. These dynamics suggest that at higher unemployment rates, the population is more likely to look for alternatives and choose to start or continue their studies to strengthen their position in the labor market. These results align with Behera and Mallick (2022) and Shobande and Asongu (2022), who find that at higher unemployment rates, the population is more likely to invest in its human capital through higher education.

While these findings are consistent with theoretical expectations, it is important to consider that the observed effect at "t−3" may also be influenced by structural variables not directly included in the model. Another relevant limitation concerns the interpretation of the unemployment effect, which may be affected by unobserved factors such as changes in education policy or demographic trends. In Lithuania, public funding decisions are primarily tied to the year a student enters the higher education system. Once admitted, institutions are expected to ensure continuity of funding and program delivery throughout the study period, regardless of subsequent macroeconomic changes. Study programs and funding commitments are typically fixed at the entry point, which limits the system's

responsiveness to dynamic changes in economic conditions or policy priorities during study. However, these factors are indirectly captured in the model. First, public funding levels and structure serve as a proxy for education policy dynamics, as they reflect government priorities and strategic choices in supporting institutions and students. Second, since public funding, particularly the student-based voucher component, is tied to enrollment numbers, demographic patterns are implicitly embedded in the funding indicators. Although this approach does not fully isolate policy or population effects, it helps mitigate potential bias arising from omitted variables. Future research could strengthen this aspect by including explicit demographic and policy indicators.

Hypothesis H_2, which states that the amount and distribution of public funding by function is related to university graduation rates, has some empirical support. The results of multiple regression show that total funding as a share of GDP was statistically significant in the three models and had a negative effect in all cases. Although the literature often emphasizes that more funding can theoretically improve graduation outcomes (Önder, 2024), the study's results suggest that more funding does not always lead to better outcomes. This may be related to inefficiencies in institutional strategies and allocation mechanisms, where increases in funding are not matched by improvements in quality or focus on student success (Kelchen et al., 2023).

The funding for study activities was only significant in the current year model (t), with a negative effect. While in theory, funds allocated to direct study activities could help to reduce retention rates or improve student support, in practice, their allocation may be too fragmented or unrelated to factors relevant to graduation outcomes. Moreover, current-year funds may only indirectly impact graduation rates by reducing attrition.

One of this study's most noteworthy and unexpected findings is the negative association between total public funding (as a share of GDP) and graduation rates, particularly in models with short-term lags ("t" to "t−2"). While this may seem counterintuitive, several potential explanations merit consideration. First, the observed effect may reflect a misalignment between funding allocation and quality-enhancing measures. In contexts where increased funding is not strategically targeted—e.g., directed toward short-term operational needs or fragmented initiatives—the overall effectiveness in improving student outcomes may be diminished. Second, institutional adaptation to policy or financial changes often takes time; thus, an initial surge in funding may not translate into immediate improvements in performance. Instead, it may temporarily disrupt existing institutional processes or affect student expectations and decision-making regarding study continuation or completion. Third, higher funding levels may coincide with systemic reforms or expanded enrollment, which could initially strain academic support systems and reduce institutional efficiency.

Furthermore, the negative coefficient observed for funding allocated to study activities in the t model suggests that resource allocation within institutions plays a crucial role. If funding does not align with long-term strategies for student retention and academic support, its impact may be diluted. These findings align with existing literature emphasizing that it is not the volume of funding, but its structure, timing, and strategic application that determine its effectiveness in enhancing graduation outcomes. Future research could benefit from exploring these dynamics qualitatively at the institutional level to understand how universities interpret and implement funding changes under performance-based pressures, and how these interpretations may ultimately influence the long-term effectiveness of national education policy.

In contrast, funding for research and infrastructure had a consistent, positive effect on all models. These results align with research findings showing that long-term investments in improving the academic environment, enhancing faculty competencies, and upgrading

physical facilities contribute to student motivation, quality of studies, and ultimately, to successful completion (Ahmad et al., 2023).

Hypothesis H$_3$, which states that the impact of macroeconomic and funding factors on university graduation rates may be time lagged, is empirically supported. The results of the models show that significant effects tend not to occur immediately, but after one or even three years. For example, the unemployment rate was only significant with a lag of three years, confirming that decisions to continue studying are often a long-term response to macroeconomic insecurity. In contrast, funding indicators such as research and infrastructure spending had a consistent and strong effect across all lag periods analyzed. These dynamics suggest that higher education systems respond to changes in resources gradually, through institutional adjustment mechanisms that affect the quality of studies, the availability of services, and the academic environment.

These results are consistent with theoretical models that argue that the effects of changes in education policy and funding only become apparent over time (Dobrovolska et al., 2023; Zając et al., 2023; Barber et al., 2023). The findings confirm that short-term models may not reveal the full extent of the impact. Therefore, a longer-term analysis is necessary to understand the effectiveness of education interventions. This incremental effect strengthens the argument for integrating time lags into evaluating higher education outcomes at the academic and policy levels.

The study reveals that graduation outcomes are sensitive to the current economic environment and past policy and funding decisions. This means that increasing funding alone is not enough; a targeted and efficient resource allocation is needed, focusing on long-term impact. Given the institutional autonomy in Lithuania, universities may reallocate public funding internally among categories such as study activity, research, and infrastructure. Suppose such reallocations do not correspond to the strategic objectives of the funding authority, for instance. In that case, when funds intended to support study activity are redirected toward administrative infrastructure, the effectiveness of public expenditure may be reduced. This mechanism may help explain why increases in public funding are not consistently associated with higher graduation outcomes.

4.3. Model Diagnostics

To ensure the robustness of the results and minimize potential biases, a systematic diagnostic evaluation of the multiple regression models was conducted using standard statistical tests (see Table 4).

All four regression models follow the classical assumptions of regression analysis. The Kolmogorov–Smirnov test confirmed normality of residuals in all cases since *p*-values exceeded 0.05. The assessment of homoskedasticity through visual examination of residual dispersion revealed no signs of heteroskedasticity.

Table 4. Diagnostic results for multiple regression models.

Assumption	Test	Model (t)	Model (t−1)	Model (t−2)	Model (t−3)
Normality of standardized residuals	Kolmogorov–Smirnov	$p = 0.200$	$p = 0.192$	$p = 0.200$	$p = 0.200$
Zero mean of standardized residuals		0.000	0.001	0.001	0.005
Homoscedasticity	Residuals are evenly dispersed, indicating no evidence of heteroskedasticity.				
Independence of remainders	Durbin–Watson	1.865	1.683	1.670	1.614
Outliers/ influential observations	Cook's Distance Centered Leverage Max Residuals	0.130 0.224 −2.327; 2.212	0.063 0.173 −2.790; 2.097	0.116 0.160 −2.516; 2.036	0.195 0.149 −2.324; 2.550
Multicollinearity	VIF Tolerance	<2.0 >0.5	<2.0 >0.5	<2.0 >0.5	<2.0 >0.5

The risk of autocorrelation was rejected, and all models fell within the acceptable range (1.5–2.0) for the Durbin–Watson tests, indicating that residuals are not serially correlated. The influence of outlying observations was assessed using Cook's distance, leverage, and standardized residuals, all of which fell within acceptable thresholds, suggesting no distortion from influential points.

Multicollinearity was also tested through variance inflation factors (VIFs), which remained below the conservative threshold of 2.0, and tolerance values above 0.5, confirming that predictors were not linearly dependent and that coefficient estimates are stable. These diagnostics support the validity of the model specification and the reliability of estimated effects under classical assumptions.

The specification of lagged models (t to t−3) reflects the temporal logic of policy impact and program duration. However, no additional robustness checks—such as testing alternative lag structures or computing marginal effects—were conducted in this study. Future research could expand on this by applying distributed lag models, calculating marginal effects, or testing the sensitivity of results to alternative model forms.

5. Conclusions

The study's results revealed that graduation rates in Lithuania are statistically significantly related to macroeconomic conditions, the amount of state funding, and its distribution structure. The analysis showed that higher GDP per capita is correlated with lower graduation rates, with the effect being statistically significant in models with t, t−1, and t−2 lags. This result can be explained by the fact that living standards and labor supply have increased, so some students choose to enter the labor market by postponing or discontinuing their studies. This aligns with previous studies noting the impact of economic alternatives on academic persistence (Filippova et al., 2021; Dawud, 2020).

In contrast, the unemployment rate was significant only in the model with a t−3 lag, suggesting that the decision to pursue or continue higher education may be a delayed response to long-term economic insecurity. This reinforces the role of the education system as a protective mechanism. Similar findings are presented by Behera and Mallick (2022) and Shobande and Asongu (2022), who argue that high unemployment encourages the population to invest in human capital.

Public funding as a share of GDP was still significant in the t-to-t−2 models, but its effect is negative. This result suggests that a higher funding volume does not necessarily lead to better graduation outcomes, especially if the allocation is not in line with targeted quality improvement measures. This effect gradually weakened with increasing lag, which may reflect a shorter-term sensitivity to the overall level of funding.

The expenditure on study activities was only significant in Model t with a negative effect, indicating the potential limited effectiveness of this funding component. This result may be related to the fragmentation of short-term measures or their incompatibility with long-term strategies for student success.

On the contrary, research funding had a stable positive effect in all models from t to t−3, suggesting that this type of investment has a consistent long-term impact on student outcomes. This confirms previous studies highlighting the importance of research quality, academic staff excellence, and an innovative environment for student motivation and achievement.

A positive and consistent effect was also found for infrastructure financing, which was significant in all models with different lags. It is particularly pronounced in Model t−3, suggesting that the impact of infrastructure improvements is delayed, consistent with the logic that upgrading the physical environment works gradually through the quality of learning conditions.

The time-lag analysis confirmed the hypothesis that the relationship between financial and macroeconomic factors and graduation outcomes is often not immediate but has delayed dynamics. This is empirically supported by the regression models: the unemployment effect only became apparent after 3 years, while infrastructure and research funding remained significant in the long run, indicating a more gradual response of the system to investment and economic signals.

These dynamics are consistent with theoretical models that argue that the effects of changes in education policy and funding only become apparent over time (Dobrovolska et al., 2023; Zając et al., 2023; Barber et al., 2023). The findings confirm that short-term models may not reveal the full extent of the impact, and therefore, longer-term analyses are necessary to assess the effectiveness of education interventions. This gradual effect strengthens the argument for integrating time lags into assessing higher education outcomes, both at the academic and policy levels.

The study reveals that the graduation outcomes are sensitive to the current economic environment and past policy and funding decisions. This means that increasing funding alone is insufficient—a targeted and efficient allocation of resources focusing on long-term impact is needed. In evaluating these results, it is also necessary to consider the context of institutional decisions and strategies, which can lead to different intensities of investment impact. Therefore, it is recommended that further research deepen the analysis at the institutional level, including qualitative aspects and contextual factors that may explain differences in graduation rates between HEIs.

Although this study focuses exclusively on Lithuania, some of the observed patterns—such as delayed effects of funding and the importance of strategic allocation—may be relevant to other higher education systems operating under similar funding principles, especially those using performance-based or voucher-based financing. However, the generalizability of findings remains limited, given the national context and institutional structures, and should be tested in cross-country settings.

Based on this study's findings, several targeted policy measures are proposed to improve the effectiveness of public funding in higher education. First, the positive and consistent effect of research and infrastructure funding suggests that a more balanced allocation strategy should be adopted—one that ensures long-term institutional development is supported through sustained investment in physical and intellectual capacity, rather than being overshadowed by short-term operational expenditures such as administrative overhead or fragmented initiatives. Second, since the effect of study-related funding was either negative or statistically insignificant, it is recommended to reallocate these funds toward academic support systems that have demonstrated impact on student retention, such as tutoring programs, counseling services, early alert systems, and evidence-based teaching development for faculty. Third, as macroeconomic conditions affect student decisions with a time lag, funding frameworks should be made more adaptive, considering lessons from the COVID-19 period, during which Lithuanian universities did not experience reductions in state funding but had to absorb rising inflation-related costs, such as utilities, from within existing budgets. The state allocations did not fully offset these pressures, requiring institutions to reallocate internal resources or delay investment in quality-enhancing activities. Finally, linking a portion of public funding to medium-term graduation outcomes may encourage institutions to focus more on student progression rather than only enrollment numbers.

This study has several methodological and contextual limitations that may affect the interpretation of results and inform future research.

First, the analysis does not account for potential clustering effects. Since all universities in the dataset operate within the same national context, they are subject to identical

macroeconomic conditions, potentially resulting in correlated errors across institutions. Although standard model diagnostics—such as tests for heteroskedasticity, autocorrelation, and multicollinearity—revealed no major violations, using IBM SPSS constrained the possibility of estimating cluster-robust standard errors. Future studies are encouraged to apply statistical tools that support clustering techniques, especially in country-specific or nested data structures.

Second, formal panel unit root tests were not applied to assess the stationarity of macroeconomic variables. All macro-level indicators were expressed in percentages (inflation, unemployment) or log-transformed (GDP per capita) to mitigate the risks associated with non-stationary data, reducing long-term trend effects and stabilizing variance. Model robustness was further supported through normality checks (Kolmogorov–Smirnov), autocorrelation diagnostics (Durbin–Watson), and multicollinearity tests (VIF, Tolerance), all of which confirmed internal consistency. While these steps do not replace unit root testing, they strengthen confidence in the model's reliability. Future work could enhance this approach by incorporating formal stationarity procedures.

Third, the scope of model specifications was limited. Although the study adopts a time-lagged panel design to examine delayed effects, it does not employ alternative estimation techniques such as fixed effects, random effects, or generalized method of moments (GMM), which are widely used to address unobserved heterogeneity and endogenous dynamic. One key limitation is the lack of control for institution-level heterogeneity—differences in university size, academic orientation, demographic composition, or strategic responses to funding, which may influence how resources affect graduation outcomes. This limitation arose primarily due to technical constraints in the analytical environment and data structure. Nevertheless, the temporal specification and diagnostic validation offer a robust empirical foundation. Future research could apply fixed effects models, Hausman tests, or GMM estimators to explicitly address these institutional differences and assess the stability of observed relationships under alternative assumptions.

Another important limitation concerns the assumption of exogeneity for public funding. In practice, performance indicators—such as graduation rates—may influence future budget allocations, particularly under performance-based funding frameworks. Although the use of lagged independent variables helps mitigate concerns of reverse causality, it does not eliminate them entirely. Future research could strengthen causal inference by employing instrumental variable approaches, including lagged dependent variables, or conducting placebo tests to test the robustness and directionality of the identified effects.

Although the study period includes the years of the COVID-19 pandemic (2020–2022), there is no indication that this period fundamentally altered either public funding flows or graduation outcomes in Lithuania. Unlike in some countries, core public funding for universities was not reduced—in fact, financial allocations continued to grow, particularly in 2021 and 2022. Graduation rates, while slightly declining in earlier years due to demographic trends, remained relatively stable throughout the pandemic period. Institutions successfully adapted to remote learning and managed to maintain academic continuity. Nonetheless, it is possible that increased operational costs during the pandemic, such as rising utility and information technology expenditures, required internal reallocations that may have temporarily constrained resources otherwise directed toward student success initiatives. To further verify that the pandemic did not bias the results, an additional robustness check was performed by excluding the pandemic years from the regression models. The findings remained consistent, suggesting that pandemic-related anomalies do not drive the observed relationships but reflect structural patterns in funding and higher education performance. Similarly, while the Russia–Ukraine war began in the final year of

the study period, its potential effects were not yet reflected in the data and therefore remain outside the empirical scope of this analysis.

Abbreviations

The following abbreviations are used in this manuscript:

ANOVA	Analysis of variance
GDP	Gross domestic product
HEI	Higher education institution
PBF	Performance-based funding
VIF	Variance inflation factor

References

Abdullah, D., Azman, N., Wan, C. D., & Abdullah, N. S. (2022). Snapshots of Malaysian academics in international engagement. *Yuksekogretim Dergisi*, *12*, S45–S61. [CrossRef]

Abelha, M., Fernandes, S., Mesquita, D., Seabra, F., & Ferreira-Oliveira, A. T. (2020). Graduate employability and competence development in higher education—A systematic literature review using PRISMA. *Sustainability*, *12*(15), 5900. [CrossRef]

Ahmad, U. S., Safdar, S., & Azam, M. (2023). Debt swap funding nexus education attainment in the presence of per capita income in debt burdened economies: An empirical analysis using two step SYS-GMM. *Journal of Education and Social Studies*, *4*(3), 534–546. [CrossRef]

Ashwin, P. (2022). The educational purposes of higher education: Changing discussions of the societal outcomes of educating students. *Higher Education*, *84*, 1227–1244. [CrossRef]

Bal-Domańska, B. (2022). The impact of macroeconomic and structural factors on the unemployment of young women and men. *Economic Change and Restructuring*, *55*, 1141–1172. [CrossRef]

Barber, C., Blair, M., McCaffrey, T. A., & Palermo, C. (2023). Employability and employment outcomes of nutrition science graduates: A qualitative exploration. *Nutrition & Dietetics*, *80*(3), 253–261. [CrossRef]

Batool, S. M., & Liu, Z. (2021). Exploring the relationships between socio-economic indicators and student enrollment in higher education institutions of Pakistan. *PLoS ONE*, *16*(12), e0261577. [CrossRef]

Behera, B. K., & Mallick, H. (2022). Does fiscal deficit matter for economic growth performance of Indian states? *Indian Public Policy Review*, *3*(6), 16–44. [CrossRef]

Chi, J., & Bustillo, E. V. (2024). What are we learning from impact evaluation studies about teacher incentives and education quality? *Recap*, *1*, 1–15. [CrossRef]

Cho-Baker, S., Kell, H. J., & Fishtein, D. (2022). Factors considered in graduate school decision-making: Implications for graduate school application and acceptance. *Ets Research Report Series*, *2022*, 1–18. [CrossRef]

Dawud, S. A. (2020). The impact of human capital development on economic growth in Ethiopia. *American Journal of Theoretical and Applied Business*, *6*(4), 47–51. [CrossRef]

Dobrovolska, O., Sonntag, R., Ortmanns, W., Kadyrus, I., & Rudyanova, T. (2023). Structural and comparative analysis of R&D funding impact on the level of innovation development: The empirical evidence of GII's leaders and Ukraine. *Innovative Marketing*, *19*(4), 310–322. [CrossRef]

Dokhkilgova, D. M., Saralinova, S., & Malganova, I. G. (2023). Human resource development in the context of global trends. *SHS Web of Conferences*, *172*, 02010. [CrossRef]

European Commission & Directorate General for Education, Youth, Sport and Culture. (2023). *Technical annexes to the final report of the study on the state and effectiveness of national funding systems of higher education to support the European universities initiative. Volume II*. Publications Office. [CrossRef]

Filippova, O. V., Grigoriev, A. V., Murzagalina, G. M., Sorgutov, I. V., Latifzoda, D. N., & Kalimullin, D. D. (2021). Trends in economic development and education of future economists. *Linguistics and Culture Review*, *5*(1), 397–405. [CrossRef]

Fuchs, F., Füss, R., Jenkinson, T., & Morkoetter, S. (2022). Should investors care where private equity managers went to school? *Review of Corporate Finance*, *2*(3), 451–492. [CrossRef]

Iheanacho, E., & Nwaogwugwu, C. (2021). Public education funding and economic growth in Nigeria; ARDL-VECM and causal inference approach. *Asian Journal of Economics Business and Accounting*, *21*(18), 30–41. [CrossRef]

Jackson, C. K., Wigger, C., & Xiong, H. (2021). Do school spending cuts matter? Evidence from the great recession. *American Economic Journal Economic Policy*, *13*(2), 304–335. [CrossRef]

Jackson, E., & Hotte, S. J. (2022). Disparity in public funding of systemic therapy for metastatic renal cell carcinoma within Canada. *Canadian Urological Association Journal*, *16*(11), E516–E522. [CrossRef]

Jia, H. (2023). The impact of educational development on the economy in China and the United States. *Highlights in Business Economics and Management*, *19*, 158–164. [CrossRef]

Kelchen, R., Ortagus, J., Rosinger, K., Baker, D., & Lingo, M. (2023). The relationships between state higher education funding strategies and college access and success. *Educational Researcher*, *53*(2), 100–110. [CrossRef]

Kuijpers, A., Dam, M., & Janssen, F. (2024). A systems thinking approach to capture the complexity of effective routes to teaching. *European Journal of Education*, *59*, e12623. [CrossRef]

Mallillin, L. L. D. (2022). Adaptive theory approach in leadership: A guide to educational management system and mechanisms. *European Journal of Education Studies*, *9*(7). [CrossRef]

Maneejuk, P., & Yamaka, W. (2021). The impact of higher education on economic growth in ASEAN-5 countries. *Sustainability*, *13*(2), 520. [CrossRef]

Mobegi, F. O., & Kara, A. M. (2022). Methods of financing university education and their implications on access, quality and completion rates: An experience shared from undergraduate education students, Maasai Mara university, Kenya. *European Journal of Education and Pedagogy*, *3*(3), 280–287. [CrossRef]

Motala, S., Oketch, M., Ouma, G. W., & Masutha, M. (2023). Higher education funding, justice and equity-critical perspectives. *South African Journal of Higher Education*, *37*(6), 1–7. [CrossRef]

Ogawa, K. (2025). The effectiveness of vocational secondary education on entry-level job outcomes in Japan: Safety net for low-educated youth in a vocationally weak educational system. *Japanese Journal of Sociology*, *34*(1), 186–205. [CrossRef]

O'Hagan, K. G., & Stiefel, L. (2025). Does special education work? A systematic literature review of evidence from administrative data. *Remedial and Special Education*, *46*(2), 103–117. [CrossRef]

Ortagus, J. C., Kelchen, R., Rosinger, K., & Voorhees, N. (2020). Performance-based funding in American higher education: A systematic synthesis of the intended and unintended consequences. *Educational Evaluation and Policy Analysis*, *42*(4), 520–550. [CrossRef]

Önder, A. S. (2024). Women in STEM graduate education: Case of the German excellence initiative. *Higher Education Quarterly*, *78*, 971–987. [CrossRef]

Papík, M., Mihaľová, P., & Papíková, L. (2022). Determinants of youth unemployment rate: Case of Slovakia. *Equilibrium Quarterly Journal of Economics and Economic Policy*, *17*(2), 391–414. [CrossRef]

Rahaman, A. B. A., & Abdul-Rahman, N. (2022). Government expenditure on education and its impact on access: A narrative of the Czech Republic. *Education Quarterly Review*, *5*(4), 279–289. [CrossRef]

Rosinger, K., Kelchen, R., Baker, D. J., Ortagus, J., & Lingo, M. D. (2022). State higher education funding during COVID-19: Lessons from prior recessions and implications for equity. *AERA Open*, *8*(1), 1–19. [CrossRef]

Sebki, W. (2021). Education and economic growth in developing countries: Empirical evidence from GMM estimators for dynamic panel data. *Economics and Business*, *35*, 14–29. [CrossRef]

Shobande, O. A., & Asongu, S. (2022). Has knowledge improved economic growth? Evidence from Nigeria and South Africa. *Journal of Public Affairs*, *22*(S1), e2763. [CrossRef]

Spilioti, N., & Anastasiou, A. (2024). European structural and investment funds (ESIFs) and regional development across the European Union (EU). *Journal of Risk and Financial Management*, *17*(6), 228. [CrossRef]

Trisnaningsih, S., Sutrisno, S., Permatasari, Y., Hendra, F. H., & Sulistyowati, E. (2020). Contingency model to increase the uptake of higher education graduates in the job market. *Journal of Asian Finance, Economics and Business*, *7*(4), 197–203. [CrossRef]

Zając, T., Żółtak, T., Bożykowski, M., & Jasiński, M. (2023). All that glitters is not gold-mixed early labour market outcomes of STEM graduates in Poland. *European Journal of Education*, *58*, 477–497. [CrossRef]