



Do Global Excellence Initiatives Lead to an Increase in Research Productivity: The Case of Kazakhstan's World-Class University

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ABSTRACT. *Global excellence initiatives have been widely implemented across various regions to elevate the quality and standing of higher education institutions. The establishment of world-class universities has been one of the most frequent approaches to global excellence initiatives. A notable example of the successful establishment of a novel world-class university is Nazarbayev University in Kazakhstan, which is expected to transform Kazakhstani society by training high-qualified cadre, stimulating research and innovative activity in the country, and serving the larger society in terms of intellectual leadership and global citizenship initiatives. Despite the great promise, the university has been greatly scrutinized for the financial burden associated with its creation and maintenance. The public attention, however, has not resulted in a sufficient number of studies evaluating the various impacts of the university on Kazakhstani society and the Central Asian region at large. This study attempts to fill the gap by analyzing bibliometric data from the Web of Science to estimate the effect of the creation of Nazarbayev University on research productivity measures in Kazakhstan. More specifically, interrupted time series is applied to the data panel from 2000 to 2010 to determine whether trends in research productivity measured in terms of the number of publications, number of citations, and the size of the scholarly community (as a proxy for research capacity strengthening effect) have been affected by the establishment of the world-class university in the country. The study fills the existing gap in prior research on global academic excellence initiatives and world-class universities by suggesting quantitative insights on the research productivity effects of the initiatives.*

KEYWORDS: *Academic excellence initiatives, world-class university, research productivity, bibliometric, Nazarbayev University*

INTRODUCTION

Global excellence initiatives (GEI) are comprehensive strategies and efforts undertaken by countries, regions, institutions, or organizations to enhance the quality, competitiveness, and impact of education, research, and innovation on an international scale (Yudkevich, Altbach, & Salmi, 2023). These initiatives typically involve substantial financial investments aimed at transforming select institutions into world-class universities, i.e., institutions that excel in three key areas: high concentration of talent, abundant resources, and favorable governance (Salmi, 2009).

Global excellence initiatives have been widely implemented across various regions to elevate the quality and standing of higher education institutions (HEIs). Examples include (1) China's *Double First-Class Initiative*, aimed at increasing the status of its top research HEIs (Cao & Yang, 2023); (2) *the Top Global University Project* in Japan, which has funded 37 universities to enhance their international competitiveness and global ranking (Yonezava, 2023); (3) *the Brain Korea 21 project*, which focuses on fostering research talent and improving research infrastructure of the highest ranked Korean universities, contributing to significant advancements in academic output and international collaboration (Rhee & Yin, 2023). Similar initiatives have been pursued in Malaysia, Taiwan, Holland, France, Germany, and Russia (Yudkevich, Altbach, Salmi, 2023).

Kazakhstan has also become a prime example of pursuing GEIs by establishing its acclaimed Nazarbayev University (NU) (Kuzhabekova et al., 2018). Founded in 2010 with significant state support, Nazarbayev University has quickly become a leading research and educational institution in the region. It emphasizes international partnerships, high standards in education and research, and a strong focus on science and technology (Katsu & Saniyazova, 2018). In 2024, NU has debuted in the top 30 percent of international research universities in the Times Higher Education (THE) World University Rankings (NU, 2023). The successes of the university have recently inspired several other countries in Central Asia, such as Uzbekistan and Turkmenistan, to establish their world-class universities similar to NU.

While many countries have launched GEIs assuming that these initiatives have a promise of increasing the research capacity of higher education, the broader effects of the initiatives on the overall higher education system and society at large have not been sufficiently studied or understood (Salmi, 2009). Studies such as those by Hazelkorn (2013) suggest that the initiatives might have an immediate impact reflected in global rankings, however, a comprehensive understanding of their broader impacts is still lacking (De La Roza et al., 2023). Moreover, the propagation of WCUs around the world may be associated with some negative outcomes. Salmi, for example, argues that focusing solely on boosting a few universities can lead to negative consequences, such as diminished teaching quality and reduced opportunities for students from underprivileged backgrounds. Instead, Salmi advocates for a holistic approach that

enhances the overall quality and diversity of the entire higher education system (Salmi, 2011). In addition, multiple case-study explorations of AEIs by Yudkevich, Altbach, and Salmi (2023) have also revealed that AEIS can enhance research capabilities and global standings, but they may also inadvertently create disparities within the broader higher education system by concentrating resources on a few institutions.

Given the lack of studies exploring the impact of GEIs, the purpose of the paper is to evaluate the potential effect of one such initiative, the creation of Nazarbayev University, on the research productivity of a country. The study uses bibliometric data from the Web of Science to conduct descriptive and inferential statistical analysis to estimate the difference in research productivity trends in Kazakhstan in the quasi-experimental condition created by the establishment of Nazarbayev University. The research question of the study is: What is the effect of the creation of Nazarbayev University on research productivity as measured in terms of (1) the number of publications, (2) the number of citations, and (3) the size of the scholarly community/number of contributing authors?

REVIEW OF THE PRIOR RESEARCH

Most of the prior research has been devoted to conceptualization and the analysis of examples of GEIs and WCUs. The initiatives usually have a number of shared characteristics. Many GEIs are guided by long-term strategic goals and objectives aimed at achieving excellence and competitiveness in education, research, and innovation on a global scale (Feng, Guo, & Gia, 2024). They involve significant investments of financial resources, infrastructure, and human capital to support the development and implementation of initiatives and programs (Marginson, 2017). They emphasize collaboration and partnership with institutions, organizations, and stakeholders from different countries and regions to leverage expertise, resources, and opportunities for mutual benefit (Salmi, 2011). They focus on attracting and retaining top talent, including students, researchers, faculty, and professionals, through competitive funding, incentives, and support programs (Marginson, 2017). They incorporate mechanisms for assessing and monitoring performance, quality, and impact to ensure accountability, transparency, and continuous improvement (Yudkevich, Altbach, & Salmi, 2023). They promote innovation, knowledge creation, and technology transfer through research collaborations, entrepreneurship support, and industry partnerships (Salmi, 2009). Finally, they aim to enhance the global visibility, reputation, and influence of participating entities through active engagement in international networks, partnerships, and initiatives (Yudkevich, Altbach, & Salmi, 2023).

Prior research has attempted to conceptualize the various impacts of WCUs and GEIs. Articles on the impact of world-class universities highlight their potential multifaceted contributions to society, ranging from economic growth and technological innovation to global leadership and cultural enrichment (Altbach & Salmi, 2011; Hazelkorn, 2011; Salmi, 2009). Overall, the potential impacts can be classified in terms of the following

key areas: economic impact, effect on the national innovation system, concentration of talent, global influence, and socio-cultural impacts. Economic impacts refer to how WCUs contribute to local and national economies through job creation, research commercialization, and attracting investment (Altbach & Salmi, 2011). Innovation and research impacts refer to scientific breakthroughs, technological advancements, and innovation ecosystems, which emerge as a result of the creation of WCUs (Hazelkorn, 2011). Talent concentration effects refer to the ability of AEIs and WCUs to attract top talent, both students and faculty, from around the world, as well as to serve as hubs for intellectual exchange and collaboration, fostering a culture of excellence and innovation (Altbach & Salmi, 2011). The global influence of WCUs is often interpreted in terms of the ability of the universities to shape global discourse and policy through their research, partnerships, and alumni networks; as well as to act as thought leaders on pressing global issues, such as climate change, public health, and social justice (Salmi, 2009). Finally, social and cultural impact is understood as the significant role in shaping societal values, cultural norms, and public debate (Yudkevich, Altbach, & Salmi, 2023). They often serve as cultural hubs within their communities, hosting events, exhibitions, and performances that enrich the cultural landscape.

Empirical studies of impacts of WCUs and GEIs are limited. Some discussions are usually included in case-studies of WCUs creation in various countries of the world, for example in the edited volume exploring such cases by Yudkevich, Altbach, & Salmi (2023), as well as in earlier country-specific explorations (Chong, 2019). More extended studies, which entailed intentional data collection include the quantitative analyses of the effects of a world-class university in Taiwan on research productivity in the country (Chou & Chan, 2016; Fu, Baker, & Zhang, 2020), a bibliometric analysis of intended and unintended effects of a WCU initiative in Saudi Arabia (Schmoch, Fardoun, & Mashat, 2016), the analysis of the survey-based faculty members' perceptions of the various effect of a WCU in the context of China (Yang & You, 2018), and an interview-based investigation of the perceived impacts of the WCU initiative in Taiwan (Tang, 2018).

The effects of the establishment of Nazarbayev University have not yet been systematically analyzed. Only several studies have been conducted on the impact of international faculty members employed at the university on the development of local research capacity. These include a descriptive bibliometric analysis of publication data by Kuzhabekova and Lee (2018) and an interview-based study exploring factors shaping knowledge transfer between international and local faculty members at NU by Kuzhabekova and Lee (2020). More studies are necessary to understand both the effects of the creation of the university on research productivity in the country, as well as to assess other impacts of the institution on the country's development. This study contributes to previous empirical research on the impacts of the GEI in Kazakhstan by conducting a longitudinal statistical analysis of trends in research productivity from publication data using an interrupted time-series estimation.

METHOD

A quantitative longitudinal approach (Audulv et al., 2022) was used in this study to analyze publications-based research productivity measures in Kazakhstan during the period from 2000 to 2020 using metadata extracted from four indexes of the Web of Science (WoS): The Science Citation Index-Expanded (SCI-Expanded); the Social Sciences Citation Index (SSCI); the Arts & Humanities Citation Index (A&HCI); and the Emerging Sources Citation Index (ESCI). The longitudinal approach is appropriate to use when observing continuous measures over an extended period of time to explore the outcomes of some naturally occurring treatment (Caruana et al., 2015).

A number of reasons underlie the choice of WoS over other bibliographic databases as a source of data for analysis. First, the WoS remains as the standard and most widely used for bibliometric analysis (Singh et al., 2021). Second, the WoS is a multidisciplinary database and includes publications from a natural science and social science disciplines in more than 20,000 journals (Asubiaro et al., 2024). One limitation of the interdisciplinary database, which it shares with another widely used database – Scopus, is that it discriminates against publications in humanities and social sciences and is biased in favour of English-language publications (Mongeon and Paul-Hus, 2016). Compared with Scopus, however, WoS has been shown to be more accurate in its journal classification system (Wang and Waltman, 2016).

The data was gathered from the database in May 2024. The goal was to compare publication-based research productivity measures from 10 years before and 10 years after the creation of Nazarbayev University. The data from 2021, 2022, and 2023 were excluded intentionally to eliminate the potential effect of the COVID-19 pandemic, which could have had a negative effect on productivity measures. The data from 2024 was excluded because the year had not ended at the point the data was gathered.

The advanced search capability of the WoS was used to search for all publications in Kazakhstan (Cu=Kazakhstan). The resulting dataset was constrained to publications from the period of interest by applying filters (years from 2000 to 2010). No restrictions to language and the type of publications were applied because over 90% of publications were journal articles in English and other types of publications or publications in other languages were expected to not produce any significant effect on the patterns of change in productivity measures.

The search strategy retrieved a total of 25,321 hits. After the removal of duplicates, 23,467 publications were finally selected and retained for the study. For each of the documents obtained in the search, metadata was extracted including the title of the paper, the year of publication, the journal, the number of citations, and the authors' name, organization, and country. This metadata was then imported into Excel and was used in the actual analysis.

The resulting dataset was analyzed using descriptive and inferential statistics. First, frequency counts were obtained for the number of publications, number of citations, and number of authors in the dataset for each year of interest. Then, the general trends in the number of publications, authors, and citations per year were calculated. The trends were graphed with the help of Excel. Second, interrupted time series analysis (ITS) was used to determine whether the creation of NU had any significant effect on the level of research productivity in Kazakhstan as measured in terms of the number of publications, number of citations, and number of authors publishing on Kazakhstan or together with Kazakhstani authors in a particular year. A time series is a continuous sequence of observations on a population, taken repeatedly (normally at equal intervals) over time. ITS is a robust quasi-experimental design extensively utilized to evaluate the effects of interventions over time, particularly in policy research (Bernal, Cummins, & Gasparrini, 2017). ITS is used to assess immediate and long-term changes in outcome measures following an intervention, providing a clearer understanding of causal relationships than simple before-and-after comparisons (Wagner et al., 2002). In this study, ITS allowed us to assess the potential effects of creating Nazarbayev University on patterns of growth in research productivity in Kazakhstan.

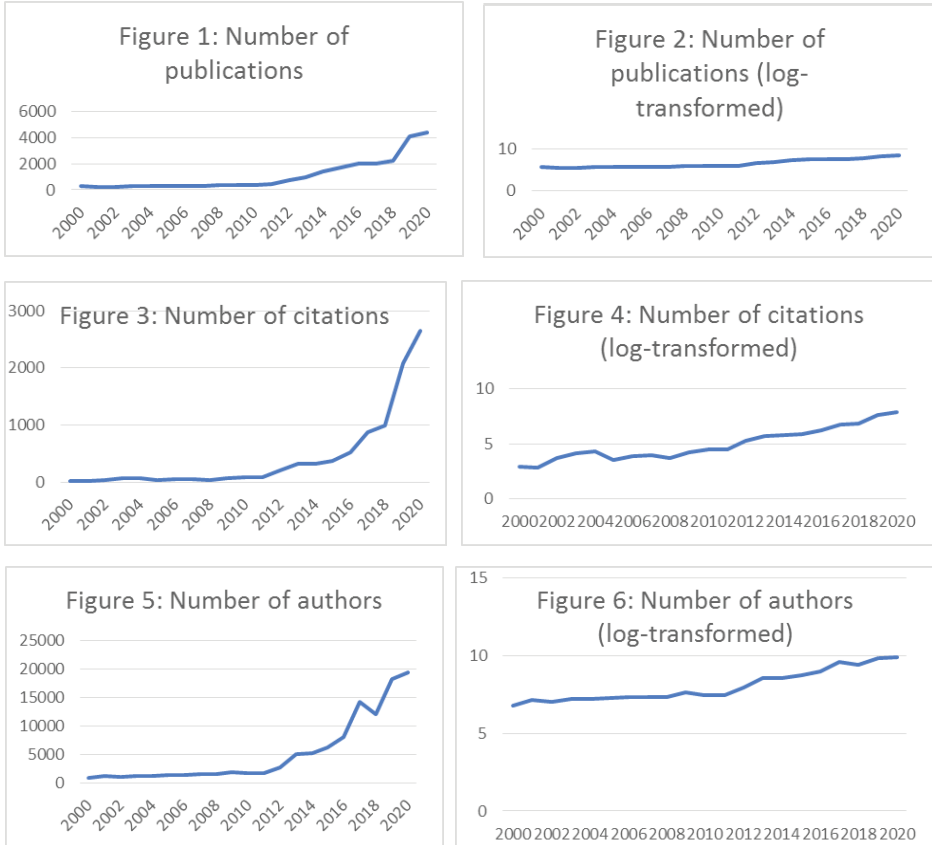
The inferential analysis was implemented in Excel alongside the descriptive analysis. Because the change in the productivity measures was exponential in nature, logarithmic transformation was applied to the data before analysis. The trends were graphed both in the original and the transformed formats. Research productivity was operationalized using three variables – number of publications per year of interest, number of citations per year of interest, and number of authors per year of interest. The latter measure is not conventionally used to assess research productivity. However, in the context of Kazakhstan, this measure makes sense. The country has a relatively low level of research capacity with a small number of publishing scholars and a low interest among the representatives of the global research community in any research on the country or in collaboration with authors from the country. We assumed that an effective intervention aimed at increasing the level of research productivity should also have a positive effect on the size of the scholarly community in the country or interest in writing about or collaborating with scholars from the country.

RESULTS

Throughout analysis, the total number of publications has grown from 283 in 2,000 to 4418 in 2020. The number of citations has grown from 18 to 2,644 correspondingly. Finally, the number of authors has increased from 886 in 2000 to 19,381 in 2020. The data is presented here in the form of figures showing the trends in the productivity data changes. Figures 1 and 2 present a change in the number of publications per year from the dataset vs. a change in logarithmically transformed data. Figures 3 and 4 present a change in the number of citations per year from the dataset vs. a change in logarithmically transformed data. Finally, Figures 5 and 6 provide a comparison between the change in the number of authors per year from the original dataset vs. a change in the transformed

data. One can see the apparent changes in the trends in the data growth, which occurred after the creation of Nazarbayev University. These changes are visible both in the original and transformed data for all three chosen measures of research productivity.

Figure 1. Search Strategy



To test whether the creation of NU has influenced the trends in productivity data, we used the interrupted time series analysis. The model included terms for the baseline trend, the immediate level change post-intervention, and the change in trend post-intervention. The model was specified as follows:

$$Y_t = \beta_0 + \beta_1 T_t + \beta_2 D_t + \beta_3 P_t + \epsilon_t$$

Where:

- Y_t = Outcome variable – level of research productivity measured as the number of publications, number of citations, or number of authors within a period of time t .
- T_t = Time since the start of the observation period at time t .

- $DtDt$ = Indicator variable for time periods post-intervention (0 before intervention, 1 after).
- $PtPt$ = Time since the intervention at time tt (0 before intervention, time since intervention after).
- $\epsilon t\epsilon t$ = Error term at time tt .

The coefficients in the model were interpreted in the following way:

- β_0 = Baseline level of the outcome at $Tt=0Tt=0$.
- β_1 = Pre-intervention trend (slope) of the outcome.
- β_2 = Immediate change in the level of the outcome following the intervention.
- β_3 = Change in trend of the outcome following the intervention.

We conducted the analysis using three measures of research productivity – number of publications, number of citations to the publications, and number of authors in the scholarly community. Given the exponential nature of the pattern of productivity growth in the graphs above, logarithmic transformation was applied to the data before ITS analysis with the values of coefficients recalculated to the original scale after the application of the statistical analysis.

In the rest of the section, the results of the inferential analysis for each of the versions of the outcome variable are summarized.

For the analysis of the effect of the creation of NU on research productivity measured in terms of number of publications, we obtained the following coefficients and the associated probability values:

Table 1. *Results of ITS analysis for the outcome variable measured in terms of number of publications*

<i>Coefficients type</i>	<i>Coefficients value</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%,</i>	<i>Upper 95%,</i>
β_0	5.51	0.089	62	0.000	5.32	5.69
β_1	0.04	0.017	2	0.045	0.01	0.07
β_2	-1.88	0.239	-8	0.000	-2.39	-1.38
β_3	0.21	0.022	9	0.000	0.16	0.25

Based on the results of the segmented regression analysis shown in Table 1, before the creation of NU, the number of publications was increasing in Kazakhstan at the rate of 4% per year (95% CI (1, 7), $p < 0.05$). After the creation of NU, the rate of change has increased to 21% per year (95% CI (16, 25), $p < 0.05$). This allows us to conclude that the intervention was effective in increasing research productivity as measured in terms of the number of publications.

For the analysis of the effect of the creation of NU on research productivity measured in terms of the number of citations we obtained the following coefficients and the associated probability values:

Table 2. Results of ITS analysis for the outcome variable measured in terms of number of citations

Coefficients type	Coefficients value	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
β_0	3.22	0.190	17	0.000	2.82	3.63
β_1	0.11	0.036	3	0.007	0.03	0.18
β_2	-2.11	0.511	-4	0.001	-3.18	-1.03
β_3	0.22	0.047	5	0.000	0.12	0.32

Based on the results of the segmented regression analysis shown in Table 2, before the creation of NU, the number of citations was increasing in Kazakhstan at the rate of 11% per year (95% CI (3, 18), $p < 0.05$). After the creation of NU, the rate of change has increased to 22% per year (95% CI (12, 32), $p < 0.05$). This allows us to conclude that the intervention was effective in increasing research productivity as measured in terms of the number of citations.

For the analysis of the effect of the creation of NU on research productivity measured in terms of the number of authors in the dataset we obtained the following coefficients and the associated probability values:

Table 3. Results of ITS analysis for the outcome variable measured in terms of the number of authors

Coefficients type	Coefficients value	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
β_0	6.93	0.086	81	0.000	6.75	7.11
β_1	0.06	0.016	4	0.001	0.03	0.10
β_2	-2.03	0.230	-9	0.000	-2.52	-1.55
β_3	0.19	0.021	9	0.000	0.15	0.24

Based on the results of the segmented regression analysis shown in Table 3, before the creation of NU, the number of citations was increasing in Kazakhstan at the rate of 6% per

year (95% CI (3, 10), $p < 0.05$). After the creation of NU, the rate of change has increased to 19% per year (95% CI (15, 24), $p < 0.05$). This allows us to conclude that the intervention was effective in increasing research productivity as measured in terms of the number of authors.

DISCUSSION AND CONCLUSION

The results of the interrupted time series analysis revealed that the GEI in Kazakhstan has been very effective in increasing research productivity as measured in three different ways – number of publications, number of citations, and the size of the research community (number of authors). The impact was somewhat higher on the number of publications and the number of authors, and somewhat lower on the number of citations to the articles published. These results are consistent with the conclusions of another statistical study, which used the difference in differences approach to compare the rate of change in the number of publications for Taiwanese universities, some of which were affected, and some, which were not affected by the global excellence initiative (Fu, Baker, & Zhang, 2018). The prior study also pointed to a modest effect of the GEI initiative on research productivity in Taiwan. In addition, the findings of this study are consistent with the results of a quantitative analysis of data collected from a faculty survey in China (Yang & You, 2017). The Chinese study revealed that the WCU project in China exhibited a positive effect on publications. However, the study also found that the effect was present only for international publications, while no significant impact on domestic publications and technology transfer took place. The latter specific observation from the Chinese analysis aligns with the results of a qualitative study of international faculty contribution at NU in Kazakhstan (Kuzhabekova & Lee, 2018), which concluded that international faculty tend not to collaborate with local scholars while pursuing extended international collaborations and publications.

This observation from the previous quantitative study in China and the qualitative study in Kazakhstan points to a potential limitation of this study. Our interrupted time series model did not account for a potential differentiation of the effect of the GEI on research output as measured in terms of international and domestic publications. Another limitation of the study is related to the relatively short observation period, which included only 10-time points before and 10 times points after the intervention. The short period of analysis could have several undesirable effects on the estimation (Bernal, Cummings, & Gasparrini, 2017). First, the short period of observation could have decreased the statistical power of the analysis. In addition, fewer data points could have led to increased variability, making it harder to distinguish between random fluctuations and real changes due to the intervention. A short pre-intervention period might have failed to provide a robust baseline to understand the natural trends and seasonal variations in the data, leading to inaccurate estimations of the intervention's effect. Finally, the intervention might have had a short-lived effect. Additional studies would need to be conducted to demonstrate whether the intervention's effects are long-lasting.

Despite the limitations, the study has filled the gap in the existing understanding of the GEI in Kazakhstan and offered some useful insights for the implementation of similar

initiatives in the region. It has provided the first statistical evidence of the positive effect of the policy intervention on the development of research capacity in Kazakhstan. This finding is particularly important in light of the current criticism of NU as an overly expensive project with dubious value for society (The Vlast, 2024). Our study reveals that the creation of NU has had positive effects and that there is a definite return on the government investment in the project.

However, further studies need to be conducted to provide additional evidence and a more comprehensive understanding of the impact of Nazarbayev University. One potential approach is to apply a difference-in-differences approach to explore the effect of the intervention by comparing changes in the patterns of research productivity before and after the implementation of the GEI for universities in Astana, where Nazarbayev University is located, and for the universities in Almaty, where no similar institution exists. In addition, another application of the interrupted time series model used in this study could attempt to differentiate the output variable in terms of publications in international and domestic journals. The suggested time series analysis might also be repeated after a certain period to include more time points in the analysis to increase the robustness of the estimation. A more detailed understanding of the impacts can be also achieved by the application of qualitative approaches, entailing interviews with faculty members and administrators of the WCU. In the long term, a comparative analysis of the impacts might be useful for NU and similar GEIs in Uzbekistan and Turkmenistan. Such an analysis should entail mixed-methods approaches, which would allow to identify factors, which might contribute to differentiation of the impacts across the country contexts in the region.

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