Employment of STEM Graduates in Kazakhstan: Current Situation

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Abstract

This article reflects the present employment of STEM (science, technology, engineering and mathematics) graduates in Kazakhstan by analyzing the official 2021 labor market data received from Bureau of National Statistics. The research results presented in the figure 1 depict the STEM graduates' immediate occupation after the graduation through the percentages of labor flows to the overall labor market of Kazakhstan. The official statistics from the Bureau of National Statistics on the labor market and universities performance are used as primary sources, along with secondary sources characterizing different aspects of graduates' integration at the start of their careers. The analysis indicates that directly after the graduation, the majority of STEM graduates in Kazakhstan is employed in STEM profile of activity. At the same time, vast majority of people getting a STEM job has no technical education. Also, the overall number of nationwide STEM job recruitments can potentially provide with suitable job less than half of the STEM graduates on all education levels (bachelor, master and PhD). The statistical data's and qualitative studies' analysis provides prerequisites for effective use of STEM graduates' education on the labor market. Also, the course for further research to obtain rather precise information is proposed considering the existing limitations in datasets.

Keywords: *STEM graduates, employment of graduates, employment in Kazakhstan.*

1. Introduction

The availability of high-skill specialists capable of working in Science, Technology, Engineering and Mathematics (STEM) is one of the key factors affecting economic growth and competitiveness of the country [1], [2], [3]. STEM graduates are considered the driving force for technological innovation [3]. Various countries have studied issues connected with the preparation of STEM specialists and their subsequent employment over the past decades [4]. The national economic competitiveness and the stimulus for its' further development vastly depends on STEM graduates' consistent integration into production processes [3], [5], [6]. Within this study, the categories of Kazakhstani STEM graduates' immediate post-graduation occupations are expressed as trajectories of their employment and compared with STEM degrees holders' overall employment trends.

Recently, STEM graduates have been an object of interest on the US labor market [6], [7], [8], [9], [10]. Studies of the STEM graduates' post-graduation occupations have also been conducted in the UK [11], [12], [13], [14], [15] Canada [16], [17], and some Asian countries [18], [19], [20]. Considerable part of research is devoted to gender-related issues in STEM education and employment [8], [10], [16], [18], [19].

The article relevance comprises of two: first, the uniqueness and significance of the STEM segment in the modern economy and second, the necessity of empirical assessment of the STEM graduates' behavior in Kazakhstani labor market. Object of the research is STEM graduates' labor market in Kazakhstan. Subjects are trajectories and features of STEM graduates' employment instantly after graduation. Aim is to model the trajectories of the STEM graduates' flows entering the local labor market from universities in Kazakhstan.

The research objectives are:
1. to model the trajectories of STEM alumnus' occupation directly after graduation;
2. to evaluate the categories of STEM alumnus' immediate occupation by relevance and percentage;
3. to indicate the premises for each of obtained employment trajectories;
4. to identify justifications for STEM graduates' decisions in the Kazakhstan's labor market.

2. Research methods and materials

The study uses primary and secondary sources as materials. The primary sources include unprocessed statistical information from public and private agencies (Bureau of National statistics, Agency for Strategic planning and reforms of the Republic of Kazakhstan). The secondary sources include investigations of other researches.

Research questions	Datasets used in the analysis
What trajectories do STEM graduates choose directly after graduation in Kazakhstan?	1. Bureau of National statistics - Statistics of education (Distribution of students by specialties); 2. Bureau of National statistics - Statistics of labor and employment (Bulletin "On the presence and movement of labor force by type of economic activity"); 3. Francesco et al. [21].
What are the quantitative characteristics of STEM graduates' flows?	1. Bureau of National statistics - Statistics of education (Distribution of students by specialties); 2. Bureau of National statistics - Statistics of labor and employment (Bulletin "On the presence and movement of labor force by type of economic activity").

Table 1. Interrelationship of research questions and data sources

Specific data sets, including Statistics of labor and employment and Statistics of education, are used as research pool to answer two research questions (Table 1). Scheme demonstrating the ratios between Kazakhstani STEM labor market and number of 2021 graduates is produced from analysis results (Figure 1).

The figure has two parts. Top part, calculated from Statistics of labor and employment, focuses on labor market proportions. Laborers' involvement and movement categorized by occupation is used to build top part. Specifically, Kazakhstan's total labor market and STEM division are compared. To estimate STEM segment's economic activity, authors consider workers involved in STEM positions in both tech related and nonrelated companies. According to the definition by Bureau of National statistics, set of STEM activities includes 13 types, e.g. industrial, engineering, construction and IT, research and etc. Bottom part, calculated from Statistics of education data, specializes on universities' efficiency indexes for undergraduate and postgraduate programs. The distribution of students by faculty, admission and graduation is utilized for modelling bottom part. Classification similar to bureaus' is used for STEM specialties identification. STEM education programs consists of 8 main and 6 enlarged study areas at the undergraduate and postgraduate programs.

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Classifying data enabled estimation of figure's proportions. Based on that, the labor market shall adapt through graduates' direct recruitment after graduation. The top part of the figure has four interconnected levels:

1) KZ STEM Labor Market;
2) Annual Recruitment;
3) Annual Recruitment of Higher education institutions (HEIs) Graduates;
4) Recruitment in accordance with HE program.

The "KZ STEM Labor Market" reflects overall STEM segment scale on the Labor Market of Kazakhstan. The "Annual Recruitment" portrays employees' quantity hired in 2021, compared to KZ STEM Labor Market. The "Annual Recruitment of HEIs Graduates" indicates employees' number who graduated and got accepted in 2021 compared to total annual recruitment. The "Recruitment in accordance with HE program" estimates ratio of employed workers hired in 2021 for jobs directly related to their higher education to those who graduated in 2021 and were hired in the STEM segment.

The lower part of the figure has two interconnected levels

1) Annual STEM Graduation;
2) Flows of graduates in accordance with the level of education.

The "Annual STEM Graduation" emphasizes graduates' number with directly related to the STEM segment education. This block represents a potential source of KZ STEM Labor Market's labor force. The "Alumni Streams by Level of Education" level represents the flows of graduates who not only form the "Annual STEM Graduation" level, but also go on to study at higher levels of education (for instance, Master or PhD). The flows of interactions are presented as dotted lines.

As a result, there is an interaction between two main blocks: KZ STEM Labor Market and Annual STEM Graduation. Let's look closer at the trajectories of STEM graduates directly after their graduation and highlight the quantitative characteristics of STEM graduates' flows.
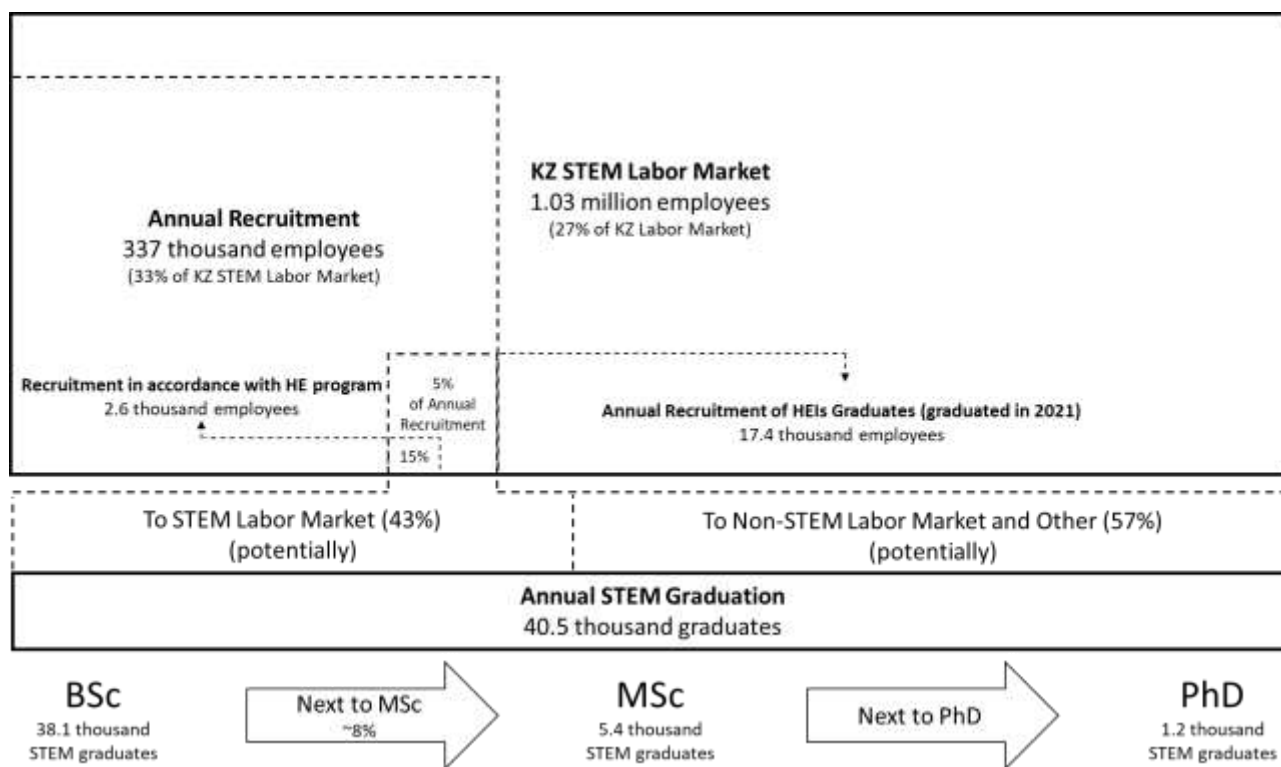

Figure 1. Proportions of annual STEM labor market's demand and STEM graduates' supply in Kazakhstan – 2021

3. Results

In 2021, the employees participating in KZ STEM Labor Market constituted around 1 million or 27% percent of the total KZ Labor Market (Figure 1). 337 thousand out of 1 million were new employees. Among 337 thousand employees hired for STEM profile, only 17.4 thousand people or 5% were university graduates who graduated in 2021. Of the 17.4 thousand people, only 15% were hired for positions corresponded to their received education.

In 2021, about 40.5 thousand people graduated STEM majors in Kazakhstani universities and received either undergraduate or postgraduate degree. The approximate share of graduates who directly after a bachelor's degree entered a master's program was 8% in 2021. Due to the lack of official statistics, the estimation of graduates applying for PhD programs right after master's program is not acquired.

The ratio between Annual Recruitment of HEIs Graduates and Annual STEM Graduation in 2021 indicates that only 43% of STEM graduates in all levels of education programs have potential opportunity of being hired after the graduation. Consequently, the remaining 57% of STEM graduates either enter labor market employed in non-technical occupations, or do not to enter the labor market at all by being engaged in activities, such as pursuing education or work abroad, initiating own business, participating in shadow employment, being unemployment etc. As for the 43% of STEM employed graduates, there is still a possibility of leaving the Kazakhstani STEM labor market in the future. The research is also limited by the lack of the data from official statistical organizations on graduates who regardless of having non-technical education degree, were hired for positions related to STEM.

The obvious output of the comparison between KZ STEM Labor Market and Annual STEM Graduation, is the fact that for the majority of STEM graduates' their immediate occupation after graduation in Kazakhstan is weakly associated with an entry into the STEM labor market. This contradiction leads the graduates to consideration of alternative occupations, like non-technical employment or proceeding with education. The quantitative description of STEM graduates' flows declares a considerable shift towards the KZ non-STEM Labor Market.

4. Discussion

The 2021 relationship between KZ STEM labor market's demand and KZ STEM graduates' supply can be described through the following statements:
1) The Annual Recruitment of HEIs Graduates in KZ STEM labor market offers number of positions covering less than half of STEM graduates annual number;
2) The actual portion of STEM graduates with immediate STEM employment constitutes absolute minority of all STEM graduates;
3) The most of STEM graduates directly after graduation are incorporated with non-STEM oriented occupations.

The results of Kazakhstani labor market analysis coincide with the UK and the USA studies [2], [3], [12]. However, the distinction between them is a larger shift towards the non-STEM segment of Kazakhstani graduates in the long term. In their research, [21] suggested explanation for this phenomenon, which may be applied to the current study regardless of the official statistics limitation to portray complete information on trajectories of STEM graduates.

In the recent years, the Kazakhstani STEM graduates have prioritized getting a degree, and then improving professional and educational proficiency [21]. According to KZ STEM labor market data, companies and organizations recruit for STEM segment jobs fewer graduates with the relevant education. The university surveys in Kazakhstan emphasize STEM graduates' further interest areas mainly as: (a) working to gain experience outside the STEM segment, (b) extending education, or (c) becoming an entrepreneur.

To recognize the reason for STEM graduates' prioritizing the experience in irrelevant areas over the ones related to their education, the sociological surveys of enterprises hiring Kazakhstani universities' graduates were considered. In 2020, lack of practical skills crucial in STEM activities and mostly theoretical preparation of students were defined as the main causes. Hence, graduates were usually unable to demonstrate to the employers the required expertise and obtain desirable high-positions.

The practical irrelevance of the higher education programs, the lapse between graduates' and employers' expectations, along with the availability of alternatives, e.g. pursuing the career outside the STEM in positions requiring low qualifications, moving abroad for education or employment, and continuing education without gaining any work experience, were all mentioned as reasons for an

imbalance in STEM labor market's demand and STEM graduates' supply. Within the framework of this study, the exact numbers of graduates' for each category and the change in these numbers with time were untraceable from quantitative sources, so instead, the answers to the mentioned questions were obtained from qualitative sources like surveys of STEM graduates in the labor market of Kazakhstan.

5. Conclusion

The relationship between Kazakhstan's labor market demand and STEM graduates' supply was analyzed. Based on the governmental statistics, STEM graduates' trajectories of immediate occupation after graduation were identified and expressed in terms of purpose and fraction. The analysis of the statistics indicates scarcity of recruitments by the actual Annual Recruitment of HEIs Graduates in KZ STEM labor market even for a half of STEM graduates on all education levels (bachelor, master and PhD). Moreover, among the STEM recruited only the absolute minority corresponds to STEM graduates immediately after college. The main trajectories of instant occupation after the graduation for STEM graduates are non-STEM oriented. The findings of this article are similar to those of Western developed countries. Although, in Kazakhstan's case the shift towards the non-STEM professions is much higher in the long-term. The revealed imbalance between STEM labor market's demand and STEM graduates' supply was caused by the nonconformity of the higher education with real labor inquiries, discrepancies in the graduates' and employers' expectations, and the availability of alternatives. To propose a new higher education policy, more qualitative analysis should be conducted to understand the STEM graduates' plans within the Kazakhstan's labor market.

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