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THE GENDER INEQUALITY AND PARTICIPATION OF WOMEN IN STEM FIELDS

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Abstract

It is both important and interesting to highlight the role of women in the general development of countries nowadays. Beyond the efforts done by the policymakers and the civil society towards empowering and inclusion of women in political, social, and economic life, Albania is amongst those countries that have a long road ahead to really improve the gender equality situation.

This paper studies the relationship between the Gender Inequality Index and the number of women graduates in the STEM field, trying to reveal what kind of correlation exists between them. The instruments used are descriptive statistics and correlation analysis.

The main result is: there is a statistically significant linear relationship between the two variables.

Keywords: Gender Inequality Index, women empowering, STEM field, higher education, correlation analysis

JEL: I20, I23, J16, J24, J31

Introduction

The efforts made in many countries and the contribution of all international organizations over the past 50 years have brought considerable progress in the issue of gender equality. Yet despite progress, women face obstacles and challenges of economic, social, psychological, and even legal nature. These barriers limit equal opportunities in education, career choice, employment, advancement, and consequently put women at every stage of life in a disadvantageous position to men. According to the last publications of the World Bank on this issue, "Women face these challenges in even the most developed economies. Worldwide they have, on average, just three-quarters of the rights of men" (World Bank, 2021).

The Global Gender Gap Report issued by the World Economic Forum since 2006 has been providing an overview of the global gender gap and of efforts and

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insights to close it. Tracking the progress on relative gaps between women and men on health, education, economy, and politics recently highlights the growing urgency for action. As Klaus Schwab states "Without the equal inclusion of half of the world's talent, we will not be able to deliver on the promise of the Fourth Industrial Revolution for all of society, grow our economies for greater shared prosperity or achieve the UN Sustainable Development Goals." (World Economic Forum, 2020).

Women in STEM

Women's participation in science, technology, engineering and mathematics (mostly referred by the acronym STEM) is one of the issues that has received much attention in recent decades in developed countries and has spread to other countries, especially in developing and in transition ones. The growing demand of industries and the public sector for skilled workers in STEM has prompted a large number of institutions to study the current situation and find ways to encourage young people to get involved in the fields of technology and science for a greater contribution in the worldwide economic development. Within this field, special attention is paid to the participation of women in STEM and the factors that cause different engagements between genders in this field (Blackburn, 2017).

At the same time, it is highly expected that the current digital transformation provides new avenues for the economic empowerment of women and can contribute to greater gender equality. The international surveys and reports suggest coordinated and complementary actions based on the explicit belief that "The Internet, digital platforms, mobile phones and digital financial services offer "leapfrog" opportunities for all and can help bridge the divide by giving women the possibility to earn additional income, increase their employment opportunities, and access knowledge and general information." (OECD, 2018).

The gender gap – a global view

The gender gap is obvious and evidenced in several dimensions. In 2020, the Global Gender Gap score (based on the population – weighted average) stands at 68.6%. Political Empowerment and Economic Participation and Opportunity are the dimensions where the differences between women and men remain significantly larger. (World Economic Forum, 2020).

Almost in all countries women are persistently less present in the labor market than men and this contributes to the Economic Participation and Opportunity gap. Their participation in the labor market is highly affected by the time they spent in unpaid work at home, bringing economic, social, and other consequences to them. According to OECD data, the differential in men's median income and

women's median income is about 13.5%. Looking at the trend, the average wage gap in OECD countries is closing but at a very slow rate: it was 14.5% a decade ago and is now 13.5%, and it has therefore reduced by 1 percentage point in 10 years, from 2009 to 2019 (World Economic Forum, 2020). From another point of view, it is possible to compare wage gap trends in OECD countries and all other countries. Data shows that while in OECD countries gender equality is improving, albeit slowly, in the rest of the world, on average equality is worsening. Consequently, the negative average trend observed in non-OECD countries overweighs progress achieved in high-income (OECD) countries.

The gender gap in two other dimensions, Educational Attainment and Health and Survival is narrower on the global level, yet the country differences are considerable.

According the Global Gender Gap Index, the situation in 2021, as expected, was worldwide affected by the pandemic, causing a slight decrease in the overall score to 68%. As to Albania, according to the World Economic Forum report, it is ranked 25 out of 156 countries, with 0.770 score in 2021.

Data collected from ILO, LinkedIn and other international organizations have offered timely analysis of the impact of the COVID-19 pandemic on gender gaps in economic participation. Early projections from ILO suggest 5% of all employed women lost their jobs, compared with 3.9% of employed men. LinkedIn data further shows a marked decline of women's hiring into leadership roles, creating a reversal of 1 to 2 years of progress across multiple industries.

The latest surveys show that actually gender gaps are more likely in sectors that require disruptive technical skills: in Cloud Computing, women make up 14% of the workforce; in Engineering, 20%; and in Data science and Artificial Intelligence, 32% (World Economic Forum, 2021).

Promoting women to increase their education level, gain most recent knowledge and required skills in order to have higher chances of employment and better access to financial resources and the economic situation is at the centre of this paper. Generally, in countries with a higher level of education for women the gender gap is smaller. However, studies have found that countries with high levels of gender equality have some of the largest STEM gaps (data in favor of men) in secondary and tertiary education and this is called *the educational-gender-equality paradox* (Stoet and Geary, 2018). This pattern extends through countries, whereby the graduation gap in STEM decreases when the level of gender inequality is higher. Our study intends to highlight the relationship between gender inequality and women STEM participation in Albania. This interest builds on our belief that empowering women in all dimensions would contribute to a wealthier country and a better place of living for the Albanian society.

Limitations: The restricted number of observations

Literature review

The STEM pipeline has been initially used as a term to describe the educational pathway for students in the fields of science, technology, engineering, and mathematics since 1983 (Blackburn, 2017). Although debated, it has been a useful concept to stimulate the policies and programs contributing to the push for STEM education from the early stages of education to graduation and to the whole career of individuals involved in these fields. STEM education was considered especially by universities with the intention to increase the total number of graduates. It was also regarded as an important approach in order to increase the number of underrepresented minorities and women in STEM fields (UNESCO, 2015).

Studies from Hill et al (2010, 2015) reveal that the transition between high school and college or university is a critical moment when many young women turn away from a STEM career path. Although women are the majority of college students, they are far less likely than their male peers to plan to major in a STEM field (Hill et al, 2015). In an international framework, public policy aiming at gender equality is combined with initiatives from universities in different countries to promote enrolment of girls in STEM programs, as well as to support them until graduation (OECD, 2014).

As Silbey (2016) points out, engineering educators have focused on curriculum reform for decades, in order to attract more women to the field, especially by promoting girls' interest in math and science. While these efforts have brought in more women to study engineering, the problem is that many quit during and after school. This situation is evidenced also in other fields STEM includes.

Stoet and Geary (2018), in their study on *the educational-gender-equality* state "if absolute performance, interest, joy, and self-efficacy alone were the basis for choosing a STEM career, we would expect to see more women entering STEM career paths than do so". However, there are several reasons affecting the choice of entering to science and engineering, as well as to retention in them. Different studies, a considerable number of them with the contribution of women associations (AAUW, UWE), point to environmental and social barriers, including stereotypes, gender bias, and the climate of science and engineering courses that continue to hinder women's progress in STEM.

The research from William and her colleagues indicates that bias, not pipeline issues or personal choices, pushes women out of science – and that bias plays out differently depending on a woman's race or ethnicity (Williams, 2015). Research shows that men and women had similar reasons for enrolling in science, engineering, math, IT, and other similar sub-fields. They describe being good at math and science in high school and wanting interesting, well-paid professional opportunities in the future. However, women, more often than men, add that

they want to become socially responsible professionals, working to solve major problems and making a difference in people's lives. This affirmation shows that women are significantly more interested than their male counterparts in work that is "socially conscious". Moreover, this goes in line with the trend for a broader notion of work, that goes beyond the jobs framework, to confront persistent challenges such as human deprivations, inequalities, unsustainability, and gender imbalances in paid and unpaid work (UN, 2015).

Stereotypes like "science and math fields are for males and humanities and arts fields are for females" negatively influences the interest, participation, and progress of women in STEM fields. According to Hill (2010), the bias can affect decisions in all stages of the STEM pipeline: it may prevent girls and women from pursuing science from the beginning, play a role in evaluations of girls' and women's course work in STEM subjects, influence parents' decisions to encourage or discourage their daughters from pursuing science and engineering careers, and influence employers' hiring decisions and evaluations of female employees.

Retention of women in the pipeline is considered both in university and at work. The ultimate goal in student recruitment, retention, and graduation is to prepare a successful career force. The experience has shown that an informative, supportive graduate program experience can lead to successful career trajectories in the end in both higher education and the private sector (OECD, 2014), but women who experience unsupportive graduate programs are less likely to view academia as a viable career (Blackburn, 2017).

After graduation, the workplace environment is one key factor that plays a crucial role in the retention of women in STEM. Many women do encounter a series of challenges at mid-career that contribute to their leaving careers in STEM industries. Unsupportive work environment, extreme work schedules, unclear rules about advancement, and success are among the major factors in women's decision to leave the field. STEM fields are mostly described as characterized by inflexible, exclusionary, male-dominated cultures that are not supportive of or attractive to women and minorities. The lack of women in STEM work brings also to fewer role models for the younger generations of girls/ women to motivate them for establishing their careers.

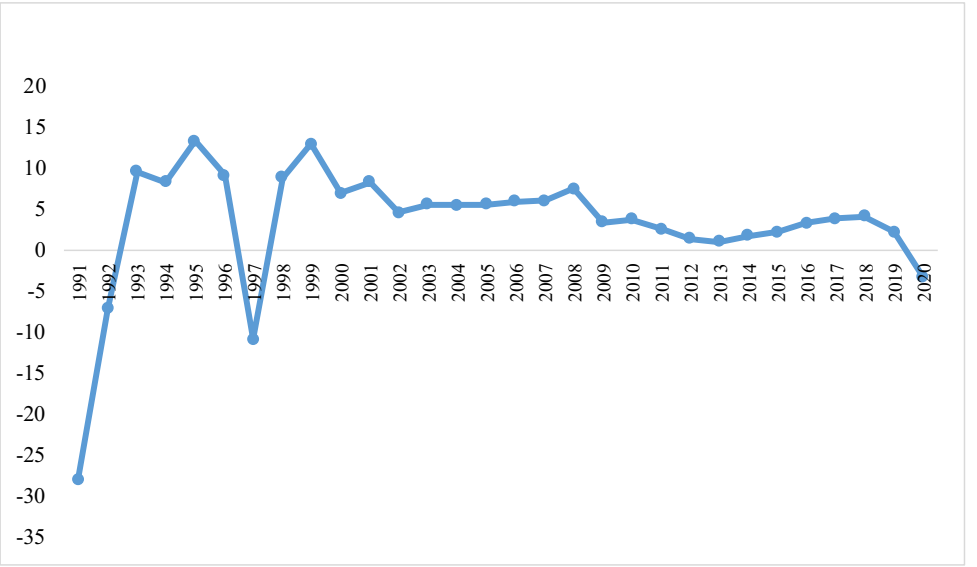
Among women and men with families, women generally are the primary caregiver and they tend more to leave work or exit the field entirely when they must choose between work and family (Jiang, 2020).

Data about Albania

The earthquake of November 2019 and the COVID 19 pandemic severely damaged the Albanian economy. While in 2018 the economic growth in Albania was 4.1%, in 2019 it dropped to 2.2% while in 2020 to -3.3%.

This situation came as a result of the shock experienced by the tourism sector and the severe impact of the pandemic in some EU economies with which our country has intensive economic relations.

Below the growth of the Albanian economy in % from 1991 to 2020 is shown.



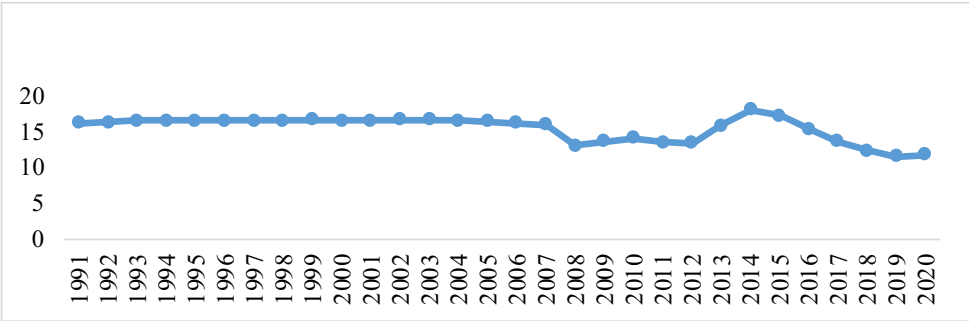
Source: World Bank (2021).

Figure 1: Economic growth (annual %) in Albania from 1991 to 2020

The population of Albania on the 1st of January 2021 was 2,829,741, decreased by 0.6% throughout 2020. During this year the number of women in Albania decreased by 0.4%, while the population of men decreased by 0.7%. The women population accounts for 50.2% of the total.

The COVID-19 crisis dealt a blow to the labor market in the region and beyond. Data on the performance of the labor market until 2020 show that the unemployment rate in 2020 was 11.7% (% of total labor force, modeled ILO estimate).

Below are the data on unemployment in % from 1991 – 2020.



Source: World Bank (2021).

Figure 2: Total unemployment rate (%) in Albania from 1991 – 2020

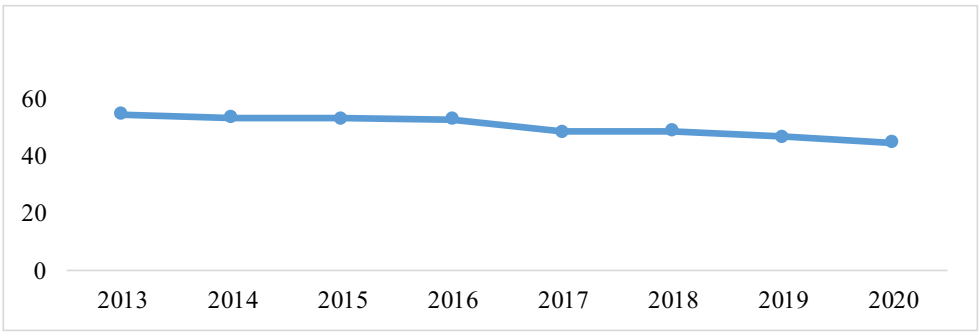
As it pertains to gender participation in the labour market, according to the labour force survey, women are less likely to participate in it. Regarding the population aged 15-64, the participation of women in the labor force has decreased from 61.6% in 2019 to 61.2% in 2020 (INSTAT, 2020).

The gender pay gap in 2020 was 6.6%, men having an average monthly gross wage of 6.6% higher than women. This represents a decrease of the gender pay gap in 2020 by 3.5 percentage points compared to 2019.

The educational participation by gender in all education cycles provides evidence of the existence of gender differences at various education levels. The percentage of boys attending pre-university education is higher compared to girls, whereas 60.4% of students in higher education are girls. This is reflected in the gender equality index (on GER), amounting to 1.54 for higher education (INSTAT, 2021).

The number of higher education graduates in the academic year 2019-20 was 33 thousand students, 65.3% of whom were girls. The number of graduate girls decreased by 1.1% compared to the previous year. Most of the diplomas were obtained in the following fields of study: business sciences, administration, and law. The fields of study with most women graduates are business, administration, and law (28.4%); health and well-being (16.3%); arts, and humanities (13%). On the other hand, men graduate the most in business, administration, and law (29.3%); engineering, manufacturing and construction (20%); and health and well-being (9.2%).

Below, the data for the period 2013 – 2020 regarding the percentage of female graduates in STEM field is presented.



Source: Calculation of the authors, based on the data of INSTAT

Figure 3: Women graduates in the STEM field (%) from 2013 – 2020

Referring to the data in the EU-27, relative to the 20-29 age group, the number of tertiary graduates in computing, science, manufacturing and construction, mathematics, engineering has increased recently. There were nearly twice as many male as female graduates in the EU-27 in 2018: 25.6 per 1000 men aged 20-29 years and 13.4 per 1000 for women aged 20-29 years.

Relatively, the gender gap for this field of education was most marked in Belgium and Luxembourg, where the number of male graduates was 2.9 and 3.4 times as high as the number of female graduates. In addition to that, there were also relatively large differences in Austria, Finland, Germany (excluding vocational academies graduates), Spain, France and the Netherlands (Eurostat, 2018).

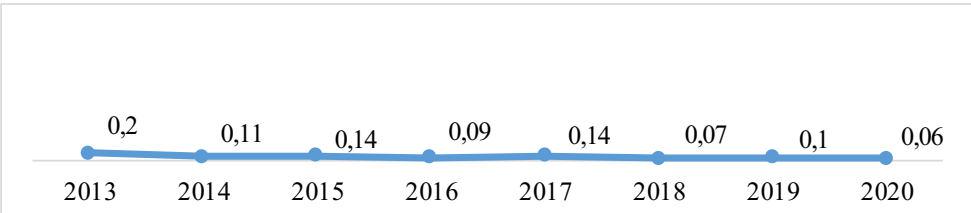
Given this and the relatively high number of girls graduating in Albania in the fields of STEM, we have raised the question of whether this is related to inequality and gender differences in Albania.

Since the Gender Equality Index (GII) first came out in 2020, the values of the Gender Inequality Index were used in this paper.

GII presents gender disadvantages from three different perspectives: reproductive health, empowerment, and lastly the labor market. This index marks potential loss in human development as a consequence of inequalities between achievements of women versus men in these aspects. The values of GII vary from 0 to 1: the higher the GII, the greater the disparities between men and women and the higher the loss in human development.

According to INSTAT, during 2020 the value of the GII has decreased from 0.10 to 0.06 compared to last year. This indicates a loss in human development as a consequence of a gender inequality rate of 6.0%. The significant improvement of the Gender Inequality Index compared to the previous year resulted from improvement of the maternal mortality rate, which has been nearly halved. All

the indicators used in the calculation of GII have SHOWN slight improvements over the years, except for maternal mortality, which has greatly fluctuated and has been a major factor in the fluctuation of this indicator also.



Source: INSTAT

Figure 4: Gender Inequality Index from 2013 – 2020

Methodology and Empirical Analysis

In this paper, the main goal is to test the hypothesis:

Hypothesis: The greater the gender inequality, the greater the number of women graduates in the STEM field.

In order to test empirically the hypothesis, the correlation analysis and the Pearson correlation coefficient have been used.

The data about the Gender Inequality Index are taken from INSTAT for the period from 2013 till 2020. Also, the data in absolute values about Women graduates in the STEM field (Natural sciences, mathematics and statistics, information and communication technologies and engineering, manufacturing and construction) are taken from INSTAT and then the proportions of Women that graduated in the STEM fields for the period 2013 – 2020, are calculated.

The bivariate Pearson correlation indicates: 1. Whether a statistically significant linear relationship exists between two continuous variables. 2. The strength of a linear relationship. 3. The direction of a linear relationship

But, to use the Pearson correlation, the data must meet the following requirements:

1. The data must be continuous. 2. Non-missing values on both variables. 3. The variables must be independent. 4. There exists a linear relationship between variables and the data have no outliers 5. The variables must be normally distributed

As the first three requirements are satisfied, to verify the existence of outliers and the existence of a linear relationship between the variables, the graph of the points with the coordinates gender inequality index and participation of women in STEM fields is presented below. From figure 5, it appears that there are no outliers in our data and that a linear relationship between variables exists.

Regarding the fulfilment of the fifth condition, the Kolmogorov-Smirnov test of normality is used.

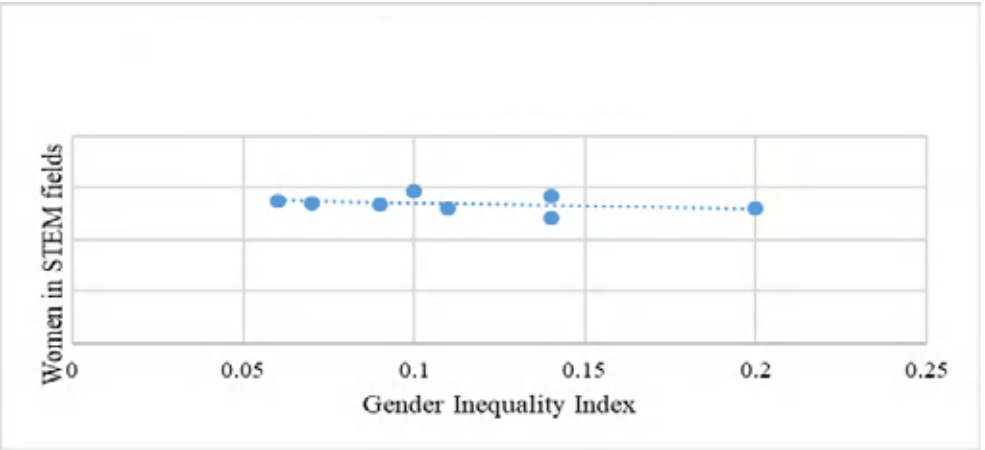


Figure 5: The graph of the relationship between GII and participation of women in STEM fields

Below, the result taken from Kolmogorov-Smirnov and Shapiro-Wilk tests of normality, using IBM SPSS Statistics 25 is presented.

Table 1: The result from tests of normality

Tests of Normality						
	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
GII	0.158	8	.200*	0.938	8	0.592
Women Graduated in STEM Fields	0.255	8	0.133	0.901	8	0.298
*. This is a lower bound of the true significance.						
a. Lilliefors Significance Correction						

From the table above, as the p-value for both variables at Kolmogorov-Smirnov test is greater than $\alpha = 5\%$, we conclude that both variables are normally distributed. This result is the same as that obtained from the Shapiro-Wilk test. So, the five requirements of performing the correlation analysis and of using the Pearson correlation are met.

The table below presents the Pearson correlation coefficients between Gender Inequality Index and Women that Graduated in the STEM Field (in %) in Albania from 2013 till 2020 and significance (1-tailed) value.

Table 2: The results for the Pearson Correlation Coefficient and significance (1-tailed) value

	Pearson Correlation Coefficient
	Women that Graduated in STEM Fields
GII	0.646
Sig.(1-tailed)	0.042

Based on the above results, we can state the following:

- GII and Women Graduated in STEM fields have a statistically significant linear relationship ($r = .646$, $p < .05$).
- The direction of the relationship is positive (i.e., GII and Women that Graduated in STEM fields are positively correlated), meaning that these variables tend to increase together (i.e., greater GII is, the greater Women that Graduated in STEM fields (%) is).
- The magnitude of the association is strong ($r > 0.5$).

Conclusions and Recommendations

In this paper, the relationship between the Gender Inequality Index and Women that Graduated in STEM Fields (in %) in Albania was studied. Based on the correlation analysis and Pearson correlation coefficient, we concluded that the greater the values of GII, the greater the values of women that graduated in STEM fields (in percentage).

This result can be explained with the fact that in Albania, although positive steps have been taken towards gender equality, a lot remains to be done in order to further ameliorate women's position in society.

Women are choosing STEM fields because potentially these paths guarantee them a secure future, a good job and financial independence in a situation when there is a lack of economic stability.

It is our duty as academics to encourage women to continue their studies in STEM fields and beyond that, to pursue a career in STEM.

As recommendations we suggest to work more on the issues related to unpaid work and parental life.

In Albania women are mainly responsible for unpaid domestic work, raising children, taking care of the elderly, etc. On average, employed women spend four times as much time doing unpaid work compared to employed men while, unemployed women spend six times as much time doing unpaid work compared to unemployed men.

Also, even though improvements have been made in some legal aspects related to time off for men after a baby is born, women still mostly take care of these babies in the early growth stages. If men would spend more time caring for children, then potentially women would have more time to dedicate to their education and career growth.

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