
Estimation Of Some Aspects Of Gender Equality on the Labour Market Using Methods Of Multiple Linear Regression and ANOVA¹

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ABSTRACT

Gender inequality is one of the social and economic challenges of society. Women actively contribute to social and economic development as employees, entrepreneurs and service providers. However, they are increasingly faced with unequal labour market conditions compared to men. Thus, the purpose of this research is to assess certain aspects of gender inequality in the labour market based on data selected from a gender questionnaire developed by the STCU project team using multiple linear regression and ANOVA methods necessary to monitor this situation. Of the twenty-seven indicators of the questionnaire, five were selected: perceptions of the existence of inequality in the workplace, gender, age, level of education and the economic activity sector. The results of the regression analysis and quantitative assessment of factors revealed that in spite of the significantly low level of education of men, compared to women, they occupy the most qualified jobs with significantly higher wages; women with even higher qualifications are less in demand in the private sector, both in leadership positions and in higher paid ones; for both men and women, age has the same impact in the workplace.

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Key words: ANOVA method, gender inequality, labour market, gender questionnaire, least squares method, multiple linear regression.
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INTRODUCTION.

Gender-related problems are one of the key issues widely argued over, the tackling of which is the objective of policies in most of the modern democracies. There is a variety of entities that deal with these issues from social, economic, ideological and other perspectives from feminist NGOs to international organizations, as well as scientific institutions.

Gender equality is one of the sustainable development goals of United Nations. Gender equality, as well as the empowerment of women and girls, have been recognized as key drivers for achieving all sustainable development goals. Within the framework of the Millennium Development Goals, certain successes have been achieved in the field of gender equality. However, throughout the world, women and girls continue to suffer from discrimination and violence, including in the labour market. Over the past years, noticeable changes have taken place for the better: the number of women in elected positions in government bodies and state institutions has increased; the gender gap was reduced among primary school students, to a lesser extent in secondary schools; the presence of women in the labour market and in international labour migration has increased. These changes in women's lives are associated with the social transformations that accompany economic development. The problems of men and women, including in the labour market, have become one of the central issues in the global and national debates. In many cases, changes in the status of women are caused or accelerated by state reforms and social movements.

To conduct a competent state policy in the field of gender equality, including for equal chances for men and women in the labour market, regular monitoring of the situation is necessary, which consists in applying the correct methodology and includes qualitative and quantitative analyses of the current situation. In this regard, the development of tools and methods for analyzing various aspects of this issue is the task of experts and researchers economists dealing with this problem. The main task of scientists in this matter is to develop the correct methodology, given the fact that the methods of qualitative and quantitative analysis must be applied together, otherwise the result will be incomplete or completely unreliable.

Qualitative researches, in contrast to quantitative, do not focus on statistical measurements, but rely on the understanding, explanation, and

interpretation of empirical data and are the source of the formation of hypotheses and productive ideas. If quantitative research does answer the question “How much?”, then qualitative research answers the questions “What?” “How?” and “Why?”. In qualitative research, projective and stimulating techniques are widely used - unstructured, non-prescriptive ways to ask questions that help the researcher to reveal motives, circumstances, attitudes, preferences, values, degree of satisfaction, respondents’ problems, etc., regarding the object under research. Projective techniques help to overcome communication difficulties, such as verbalization of feelings, relationships, etc., as well as the identification of latent motives, implicit attitudes, repressed feelings, etc.

This research is based on data from a survey done in the framework of the STCU project for further quantitative analysis of the situation of gender equality in the labour market. Thus, the unique data from this questionnaire were used for our calculations.

Quantitative research is the main tool for obtaining the necessary information for planning and decision-making in the case when the necessary hypotheses regarding the main gender problems in the labour market are already formed or formulated. The methods of quantitative research are always based on clear mathematical and statistical models, which allows the result to be based not on opinions and assumptions, but on exact quantitative or numerical values of the studied indicators. The main merit of quantitative research is that they reduce the risk of making wrong decisions and choosing inaccurate planning parameters. Confidence that even without research everything is known about the problem, often turns into insufficiently thought out and insufficiently effective actions and resembles the trial and error method. Thus, quantitative studies are the most appropriate way to numerically assess or examine the depth of the problem.

The gender studies often offer a secondary role to quantitative aspects of gender inequality, to which factors contribute to a positive or negative perception of the gender issues. That’s why, the authors are attempting to cover this gap and focus on these aspects by researching the degree of influence of these factors. The research is focused on the Moldovan data and presents an unique econometric model that quantifies the degree of influence of socioeconomic characteristics on the perception of gender inequality in the Republic of Moldova. Thus, the purpose of this research is the estimation of some aspects of gender equality on the labour market by applying a quantitative scientific approach, such as regression analysis of the results of the questionnaire, elaborated by the authors, on gender problems on the labour market, necessary for monitoring the situation in the country.

THE DEGREE OF SCIENTIFIC APPROACH AND REFLECTION IN THE SPECIALIZED LITERATURE

The problem of gender equality, especially on the labour market, has been researched for many years by scientists from different fields and countries. At the initial stage of research on gender equality, mainly only qualitative research methods were used. With the development of this area many researchers began to use the mathematical apparatus to measure the depth of the problem being studied and one of the types of its intellectual tools is statistical models and methods. Since, gender studies contain different types of regression analysis for the estimations of different aspects of the investigated object. For example, such econometric models as: probit, logit, multiple linear regression models, multiple non-linear regression models, etc. were applied by scientists for quantitative analysis in gender studies.

Applying the apparatus of production functions and estimating its coefficients began with the works of Gary Becker [4-5]. Subsequently, his results were supplemented and developed in practical works of J. Mincer [9-10, 19], R. Anker [2], O. Duncan [17], R. Oaxaca [21], A. Blinder [6], B. Chiswick [5, 7-10], etc., as well as in the theoretical works of T. Shultz [25], L. Thurow [27], etc. Nowadays, the multiple linear regression by the type of extended Mincer earnings equation for gender groups was traditionally used for the estimation of the influence of the human capital and other socioeconomic factors on payment of men and women and was applied by the scientists from the developed and developing countries. For example, this method was applied by: M. Baker and N. Fortin using Canada's data [3], F. Pastore and A. Vereshchagina using Belarusian data [23-24], D. Andren and Th. Andren using Romanian data [1], C. Ogloblin using Russian data [22], S. Roshchin and O. Gorelkina using Russian data [34], A. Oshchepkov using Russian data [32], T. Stuken using Russian data [36], D. Jolliffe using Bulgarian data [18], T. Colesnicova using Moldovan data [14] and scientists from other countries.

Also, the econometric regression analysis as probit-model traditionally used to reveal and estimate the influence of various factors on the probability to be employed for men and women was applied by the scientists from many countries. For example, this method has been applied by: F. Pastore and A. Vereshchagina [23]; I. Mal'tseva and S. Roshchin [33]; S. Roshchin [35]; K. Abazieva [28], T. Bandjukova [29], T. Colesnicova [14].

Also, the examples of applying in gender researches the quantitative methods can serve as the calculations of various indices by international organizations. For example, to quantify the gender inequality the United Nations Development Programme in their yearly Human Development Reports present a composite index and a comparison between world countries.

Another indicator of gender inequality is presented and analyzed by the international organization World Economic Forum in their annual Gender Gap reports. The non-governmental organization World Economic Forum has developed a quantitative method for assessing gender equality (*Gender Gap Index*). Since 2006, analysts at the World Economic Forum have been calculating this Index for most countries in the world; another report was published at the end of 2018. The index takes into account the gap between men and women in the economic, political and other fields, as well as the tendency of its change over time. According to the authors of the research, the world is moving very slowly towards the full realization of the potential of women. According to World Economic Forum estimates, at the current rate of change in the Index, global gender equality will be achieved in 108 years [26].

As well, International Monetary Fund in many of their publications analyze various gender-related indicators that focus on inclusion, employment and technology.

Aspects of gender inequality are quantified by many others indicators – quantitative indicators, like: Duncan Segregation Index, Gender Parity Index, Gender Equity Index, Gender Empowerment Measure and many others more or less specific indicators.

The issues of women's involvement in the production process, the participation of women and men in the labour market, discrimination of women in the field of employment, analysis of gender problems in Moldovan SMEs are reflected in autochthonous scientific researches with the participation of the authors of this paper and are edited in scientific journals recognized in the country and in the materials of national and international conferences [11-15, 20, 30-31].

Scientific novelty of this research is in the applying methods of multiple linear regression and analysis of variance – ANOVA for the estimation of some aspects of gender equality on the labour market. Also, the originality of this work is in the using of the new information sources – dates from the authors' questionnaire on gender problems, elaborated by the team of the STCU project. The feature of this research is that it is based not on the time series data, but on the binary variables obtained as a result of the survey, which could not be drawn up as time series data.

DATA SOURCES AND USED METHODS

In the research the multiple linear regression is applied. Multiple is the linear regression, in the model of which the number of independent variables is two or more. The multiple linear regression equation has the form (*Figure 1*):

The multiple linear regression equation

Figure 1

$$Y = b_0 + \sum_{i=1}^n b_i x_i + \varepsilon,$$

where Y – estimated dependent variable, b_0 – intercept, n – number of independent variables ($n \geq 2$), b_i – coefficients of the independent variables, x_i – independent variables, ε – error term

As in the simple linear regression, the b_i parameters of the model are calculated using the least squares method. The difference between simple and multiple linear regression is that instead of a regression line, it uses a hyperplane. The advantage of multiple linear regression over simple is that the use of several input variables in the model allows to increase the share of the explained variance of the output variable, and thus improve the model's fit to the data, in other words, by each new variable added to the model, the coefficient of determination increases.

ANOVA (ANalysis Of VAriance) is a method in mathematical statistics aimed at finding dependencies in experimental data by examining the significance of differences in average values. The essence of analysis of variance is to study the effect of one or more independent variables, usually referred to as factors, on the dependent variable. Analysis of variance was developed by R. Fisher to analyze the results of experimental studies.

For the elaboration of the econometric models, 245 questionnaires of respondents were selected from the Republic of Moldova, that's why 245 Moldovan people participated in the survey. The results were divided on gender basis: out of which 46.6% were male respondents, and 53.4% - female respondents; by age group: under 35 years – 44.3%, and persons over 35 years – 55.7%; by education level with higher education: licentiate/master degree – 57.3%, doctorate/post doctorate – 42.7%; by economic activity sector: government sector – 59.2% of people, from private sector – 40.8% of respondents.

Based on the responses presented on 27 positions, five indicators were selected and they received binary values: one and zero.

The data of the elaborated questionnaire were adapted to the binary data structure (0, 1) by combining insignificant indicators, the values of which surpassed two variants of response. For example, the age indicator: under 35 years = 1; 35-50 years = 2; over 50 years = 3 was replaced by: under 35 years = 1; over 35 years = 0, given the insignificant number of those surveyed over 50 years. The gender indicator was noted as follows: female gender - 1;

male gender - 0. At the level of education, the indicator of the respondents with licentiate / master's studies was 1 and in the case of those with doctoral / postdoctoral studies - 0. The private sector was labeled by binary value 0 and the state sector - by value 1. In the case of the dependent variable (the perception of gender inequality), the perception of its existence was denoted by the value 0, and the perception of the absence - by the value 1. In the regression was used: ordinary least squares method; multiple linear regression method; ANOVA method, Data Analysis/Regression application in Microsoft Excel[®].

THE FORMULATION OF THE PROBLEM AND THE OBTAINED RESULTS

The dependent variable selected from the gender questionnaire for our regression function is *the existence of inequality at the workplace* (ineq_labour) in relation to independent variables: *age* (age), *education level* (educ_level), *gender* (gender), *economic activity sector* (sector).

The regression obtained for the respondents of both sexes is indicated in the **Figure 2**.

Equation of regression for respondents of both sexes

Figure 2

<i>Men and women</i>				
ineq_labour =	0.205*gender	+ 0.2994*age	+0.358*educ_level	+0.294*sector
σ	(0.0827)	(0.0766)	(0.0688)	(0.0688)
t	[2.4789]	[3.9068]	[5.2049]	[3.4028]
$R^2=0.7479$; $R^2_{adj}=0.7342$; $F=94.943$				

Source: Elaborated by authors based on questionnaire data

The coefficients of the estimated regression function are significant, which is confirmed by the values of Student statistics (t -statistics), greater than 2.81 (except the first one from the gender variable, which shows the significance level of 0.01, therefore does not fall within the significance level of 0.005). At the same time, the standard error values - σ - are small enough.

The coefficients of determination R^2 and adjusted R^2_{adj} indicate the fact that the selected regression function is a good one, expressing the degree of correspondence of the model of statistical dependence between the dependent variable *labour inequality* and independent variables: *gender*, *age*, *education level* and *the economic activity sector*.

The values of the estimated coefficients themselves determine the impact of each of the coefficients on the dependent variable, namely: about 35.8% is due to the education level, about 29.9% - to the age, with almost the same percentage – 29.4% influences the sector of activity, and on the last position with only about 20.5% is the influence of the gender variable. It should be noted that the examined sample includes both women and men.

Shows interest the evaluation of the separate opinion of women and men. In order to perform this assessment, it is necessary to divide the questionnaire responses separately for women and men.

Two behavioural functions dependent on the same independent variables will be estimated. The results of the separate assessment of the gender inequality in the workplace of women and men are presented in the *Figure 3* and *Figure 4*.

Equation of regression for male respondents

Figure 3

<i>Men</i>			
ineq_labour = 0.3292*age +0.3599*educ_level+0.4395*sector			
σ	(0.1582)	(0.1298)	(0.1642)
<i>t</i>	[2.0869]	[4.0917]	[1.9076]
$R^2=0.8310; R^2_{adj}=0.6897; F=28.19$			

Source: Elaborated by authors based on questionnaire data

Estimations of the coefficients of the behavioural function for men is dependent on three factors: age, education level and sector of activity and show us the influence of each factor on the issue of men's perceived inequality at work. Approximately 33% are due to age, almost 36% are the influence of the education level and approximately 44% is the impact of the activity sector. Student statistics are between the significance level 0.05 and the significance level 0.005 and standard deviations are moderate. The selected behavioural function shows a high degree of compliance to the statistical data.

Equation of regression for female respondents

Figure 4

Women			
$\text{ineq_labour} =$	$0.33 * \text{age}$	$+0.531 * \text{educ_level}$	$+0.313 * \text{sector}$
σ	(0.1582)	(0.1298)	(0.1642)
t	[2.0869]	[4.0917]	[1.9076]
$R^2 = 0.8310; R_{adj}^2 = 0.6897; F = 28.19$			

Source: Elaborated by authors based on questionnaire data

Estimations of coefficients of the behavioural function for women dependent on the same three factors as for men, i.e. age, education level and sector of activity show us the influence of each factor on the issue of inequality at work, as perceived by women. About 33% is due to age, 53.1% is the influence of the education level and about 31.3% is the impact of the sector of the activity. Student statistics are between 0.05 - the significance level (for the sector) and the significance level of 0.005 for the remaining variables. Standard deviations are moderate. The selected behavioural function shows a high degree of compliance to statistical data.

Let us calculate a few ratios using the estimated coefficients for women and men of the proposed behavioural functions (**Figure 5**):

Ratios based on estimated female and male coefficients of the proposed behavioural functions

Figure 5

$\text{age women/men} = 0.33/0.3292 = 1.002$
$\text{educ_level women/men} = 0.531/0.3599 = 1.475$
$\text{sector women/men} = 0.313/0.4395 = 0.712$

Source: Elaborated by authors based on questionnaire data

These coefficients show that women and men, involved in the economic activity, are approximately of the same age, but women's level of education is much higher than that of men, and fewer women are involved in the private and mixed (private and state) sectors.

In the **Figure 6** a synthetic indicator, showing the ratio between women and men is calculated according to the three indicators calculated above.

The ratio of women to men according to the three calculated indicators

Figure 6

$$\text{Synthetic indicator} = (\text{age women/men} + \text{educ_level women/men} + \text{sector women/men}) / 3 = 1.063$$

Source: Elaborated by authors

The synthetic indicator 1.063 calculated as average upon three ratios demonstrate the fact that on an average gender inequality on the labour market is at the level of 106.3%. A synthetic indicator reveals how many times the result is more than 1. As consequence, gender problem on the labour market is not so bad if we examine average indicators while at the sector and education level situation is not so good. The conclusion is that the empirical studies are needed to be done at the specific level, not at the average level.

CONCLUSIONS

As a result of the research, according to the elaborated econometric models, calculations were made that determine the degree or depth of gender inequality in the labour market in the Republic of Moldova on the basis of the identified relationship between some different socioeconomic factors in the gender aspect. The same apparatus applied in the research was used for the regression analysis. The novelty of this approach consists in using data from a questionnaire survey, presented in the form of logical variables.

The results of the research showed a high level approximation of the inequality indicator between women and men on the labour market of the data by the behavioural functions depending on four logical variables. According to the results of this research, a group of indicators was calculated, on the basis of which a synthetic indicator was compiled. The issue of gender equality in the employment is a matter of major significance. It is in this segment where the gender disparities are the most pronounced. Despite the fact that men's level of education has been much below that of women, the ratio being equal to 147.5%, they occupy more qualified jobs with higher wages. Women, even with a higher level of qualification, are less requested in the private sector both for senior positions and for better paid positions.

The sector of activity is a decisive factor, particularly the private sector, which for many reasons offer the predilection for men (43.95%), but only 31.3% - for women employed in the private sector, the ratio between women and men being equal to 71.2%. The elaborated econometric models have shown that, for men, the sector of activity (with 43.95%) is a factor with a higher influence on the perceived gender inequality in the workplace than the age, the influence of which is nearly the same (33.0% for women and

32.9% for men), the education level having a nearly similar impact for men (35.99%) as the age. On the contrary, for women the sector (with 31.3%) has the lowest impact on the perceived gender inequality (a little lower than the impact of the age (33.0%)), while education level had the highest influence (53.1%). For both men and women, age has the same impact.

In conclusion, it is necessary for women to be protected in one way or another when they participate in various competitions for valuable functions and positions. In turn, women have to attend interviews and contests on the same footing as men. For the future, it will better also to include in estimated behavioural functions such an indicator as human perception of the women and men on professional abilities when engaging on work position. Also, further research is needed for a quantitative assessment of the role of the analyzed factors by types of economic activities and by size of the companies and, also by the hierarchical positions inside the enterprises or other criterion.

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