The Influence of Human Capital on GDP Dynamics: Modeling in the COVID-19 Conditions

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Summary

COVID-19 struck labor markets around the world, exposing and exacerbating the gender inequalities within the human capital structure. The last, in its turn, jeopardizes the return of the national economies to the growth trajectory undermined by pandemic impact. The authors assume that COVID-19 disproportionately affected the employment rates of women and men, which led to increased gender inequality in the labor market, which, in turn, affected GDP growth rates in the EU. To prove this hypothesis two research questions are discovered: 1) whether there was a different correlation between the number of COVID-19 cases in the EU and indicators of the labor market for women and men; and 2) whether there was a link between the growth of gender inequality in the EU labor market and the GDP dynamics in these countries. The analysis of the correlation between the number of cases of COVID-19 and indicators of the labor market in the EU revealed faster growth of women's unemployment rates compared to men's ones as the COVID-19 incidence unfolded. Multiple linear regression and factor analysis have been used to investigate the influence of gender inequality in the labor market on GDP dynamics. Despite the methodological limitations, the proposed model is both a sound argument and an analytical basis in favor of gender-responsive economic recovery backed by the systematic and consistent gender equality policy of a government.

Keywords:
COVID-19, labor market, gender inequality, GDP growth rate, gender gap, unemployment, employment rate, financial fragility, unpaid care work.

1. Introduction

The coronavirus pandemic has exacerbated the pre-existing inequalities between the groups of countries and within the state , especially hitting economic activity of women. They have been disproportionally affected worldwide, with COVID-19 averaging 4,2% of women (54 million proposition) compared to 3% of men (60 million jobs). This is partly due to the fact that women are more likely to work in the service sector, as well as the need to bear most of the additional burden of childcare when schools and kindergartens are closed . In the regional dimension, the Americas suffered the most (the employment rate of women fell by 9,4 %). In Canada, women's labor force has fallen to its lowest level in 30 years . The second largest decline in the number of employed women was observed in the Arab states. In the period from 2019 to 2020, women's employment decreased by 4,1 % compared to 1,8 % for men.

In Europe and Central Asia, women's employment has fallen sharply for the second time in fifteen years. However, if during the crisis of 2008-2009 women's jobs were less affected than men's (-0,5% compared to -2,3%), then in 2020 compared to 2019, women's employment fell for 2,5% in comparison to -1,9% of men's jobs . At the same time, EU countries can be considered the least affected: the average unemployment rate for women in 2020 was 7,38% in comparison to 7,08% in 2019. For comparison, for men, these figures were 6,87% in 2020 versus 6,47% in 2019.

At the same time, the crisis caused by the coronavirus has jeopardized the progress made in the tackling gender inequality in recent decades and exacerbated the problem of gender policy disparities at the level of member-states. According to some research , the protection of the EU labor market from deepening gender disparities has succeeded not so much due to the long-term focus on achieving gender equality as one of the key values of the Union as a whole, but through the government programs on income compensation and active gender policy in the labor market. Thus, estimates based on a sample of 28 European countries showed that without wage subsidiaries, women would lose 8,1% of their wages in the second quarter of 2020 compared to 5,4 % for men .

The corona crisis reiterates the need for governments to develop proactive rather than reactive employment policies based on gender factors. After all, a number of studies contain convincing arguments about strong positive impact of gender equality on GDP. A separate niche should be occupied by scientific research on

the economic and mathematical justification of the links between the indicators of gender inequality and losses in the result of social production in the Covid-19 context. This will provide an analytical basis for regulatory adjustments aimed at returning the world's economies to the growth trajectory lost because of the pandemic.

2. Literature Review

The issue of gender in economics has not subsided since the emergence of this category in theoretical and applied scientific discourse. Scholars, politicians and international organizations argue in favor of gender equality, confirming their ideas through empirical research. COVID-19 has exacerbated a number of socio-economic problems, among which gender inequality in the labor market is of particular concern. The latter is a scientifically recognized fact, a widespread phenomenon that deepens the income disparity in society, and thus underlies economic backwardness of some countries from others.

Studies of gender inequality in the labor market in the COVID-19 context are particularly relevant and for quite rational reasons. Back in 2015, experts from McKinsey international consultancy company published the results of research on the potential impact of reducing gender inequality on GDP. For example, the approximation of the indicators of national gender inequality to the indicators of the leading countries for each region of the world could add to the projected world gross domestic product of 2025 for about usd 12 trillion. For almost half (46 of 95) of the countries surveyed, the deployment of such a scenario could bring more than 10% of GDP growth in 2025 compared to the usual course of events . The research of the European Institute for Gender Equality proved that the impact of gender equality on GDP growth can sometimes exceed the impact of regulatory measures in the labor market and education policy.

Similarly, The International Labor Organization (ILO) emphasizes the potential gain in GDP from reducing the gender gap in the labor market. The ILO estimates that if all countries met the G20 target of a 25% reduction in the employment gap between men and women by 2014, the global GDP growth would be usd 5,3 trillion. In could accelerate the state's important social challenges, as increasing women's participation in the labor force could bring in an additional usd 1,4 trillion in global tax revenue of usd 1,4 trillion. For EU countries, achieving equality between men and women in the labor market can bring an additional 15-45% of GDP to different member-states.

On the other hand, the deepening of gender inequality, in particular in the labor market, which is reflected in the growing gap between the level of participation in the labor force of men and women may lead to a long-term trend of loss about 10% per capita in

the EU and 27% – in the countries of Middle East and North Africa (MENA) (Cuberes and Teignier, 2016). From the standpoint of human capital losses, the impact of gender inequality is even more striking. The pay gap between women and men alone, excluding other indicators of inequality, total more than usd 160 trillion in samples of 141 countries (Wodon and Brière, 2018). Moreover, this not taking into account the negative impact of COVID-19.

McKinsey experts were among the first to assess the negative effects of the pandemic on gender equality. According to their estimates, women's workplaces were 1,8 times more vulnerable to the coronavirus crisis than men's work. Given the trends of 2020, it was found that without counteracting the gender regression scenario, the world GDP growth in 2030 could be usd 1 trillion lower than expected before the crisis. However, McKinsey calculations do not take into account the effects of gender imbalances in the labor market, such increasing the burden of childcare, bias, slower recovery or reduction of private and public spending on services such as education or childcare that force women to leave the labor market forever). Conversely, the introduction of measures to promote gender inequality against the negative impact of COVID-19 could add usd 13 trillion to the global GDP. If regulatory measures are taken by states only after the crisis subsides, the potential for GDP will be less by usd 5 trillion.

Of particular interest is the impact of COVID-19 through the increase of gender inequality in the labor market on the GDP dynamics in the EU countries, where in the run-up to the crisis year there was a positive trend to reduce the gap in many indicators of the labor market. Comparing the main dimensions of gender inequality in the labor market before the pandemic and their development during the COVID-19 crisis on the example of Eurozone, several researchers come to similar conclusions – the negative impact of the crisis on women was significantly stronger than on men. Differences were observed not only in unemployment rates at the beginning of the pandemic, but also in unemployment indicators and job expectations. Researchers also point to a higher risk of poverty for women, which against the background of lower incomes and skills compared to men, threatens to turn from a temporary to a systematic phenomenon. The analysis of empirical data of Eurozone also showed an exacerbation of such gender imbalances as childcare and home routine. Even before the pandemic, women spent on average two hours more on unpaid work at home than men, and as the effects of coronavirus unfolded, existing differences widened.

It should be noted that above and other studies on the COVID-19 impact on gender inequality are based on current data for 2019-2020 (usually, several quarters), while shocks in the labor market were manifested gradually. The growth of corresponding gaps in

unemployment rates for women and men responded to the number of cases of disease with a certain delay, forming delayed effects. Operating annual data limits in the ability to understand such impacts. This is pointed out, in particular, by M. Masherini and S. Nivakovska, who use quarterly data to assess how gender inequalities in employment have changed in response to the COVID-19 strengthening. Apart from the McKinsey work, there are currently no specific studies assessing the impact of gender inequality in the labor market on the GDP dynamics since the beginning of the pandemic, which determines the relevance of this study.

3. Methodology and research methods

The hypothesis of this study can be defined as follows: COVID-19 disproportionately affected the employment rates of women and men, which led to increased gender inequality in the labor market, which, in turn, affected GDP growth rates in the EU.

Question 1 of the research: whether there was a different correlation between the number of COVID-19 cases in the EU and indicators of the labor market (unemployment rate) for women and men.

Question 2 of the research: whether there is a link between the growth of gender inequality in the EU labor market and the GDP dynamics in these countries.

Macroeconomic data from EUROSTAT countries, as well as information on the COVID disease dynamics from the Hopkins University database, and the results of the online survey of Eurofound (European Foundation for the Improvement of Living and Working Conditions) Life, work and COVID-19 were collected and analyzed. The period covers 2019 – the first two quarters of 2021 for Question 1 of the research and 2019-2020 for Question 2 of the research. To establish a correlation between the number of cases of COVID-19 and indicators of the labor market, we used the average data from EU-27, as well as sampling out of 34 countries (27 EU countries, and Great Britain, Norway, Iceland, Switzerland, Turkey, the USA and Japan are additionally included). The sample for

modeling the relationship between the indicators of gender inequality in the labor market and the GDP dynamics included 23 EU countries for which the necessary statistics were included.

It should be noted that even with this reduction, the collected macrodata are quite conditional and far from ideal. First, not all data adequately reflect variables such as unemployment and the employment gap due to the informal employment sector, which accounts for 17% of EU countries. Secondly, it is possible to speak about the moment when the increase in the number of coronavirus diseases caused a counter-reaction in the labor market only very tentatively. Within our research, by determining the correlation between the number of cases of COVID-19 in the EU and the unemployment rate for women and men, we used growth rates of cases for three months, starting in March 2020, and unemployment growth rates for the last of three months of the current year compared to the value of the previous year. Attention should also be paid to the experts' warning of Hopkins University to underestimate the data on the disease due to limited testing for COVID-19. Third, for a source such as the Eurofound survey, the period for data collection on some indicators varies by country by several months. Finally, due to the data lack for many EU countries in the Eurofound survey for men (excluding which would lead to a significant sample reduction), only gender responses were used as the indicators of gender equality, but only female respondents. This simplification was used on the basis that a comparison of available data for men and women showed significant differences, negative in terms of the latter one in the labor market.

Based on the methodology for measuring gender gap of the McKinsey (McKinsey Global Institute analysis), we have identified a number of indicators of gender inequality in the labor market, which can be collected or calculated on the basis of the EUROSTAT data. For example, McKinsey experts suggest using five results-based indicators to measure gender equality at work (Table 1).

Table 1. Gender indicators in the labor market

Indicators of gender equality in the McKinsey Global Institute Analysis	Proposed indicators by the authors of gender inequality in the labor market
Labor-force participation rate (Female-to-male ratio of labor-force participation rate)	Gender gap in employment (Ratio of male employment to female employment), EUROSTAT data
Professional and technical jobs (Female-to-male ratio of representation in professional and technical jobs)	Comparable data for 2020 are not available
Perceived wage gap for similar work (Female-to-male ratio of wages for similar work)	Indicator of the women's financial vulnerability (Share of women with very limited means of subsistence in the total number of women surveyed, %), Eurofound data
Leadership positions (Female-to-male ratio of	Gender gap in employment (Ratio of the share of male

representation in leadership positions)	managers in the total number of employed men to the share of female managers in the total number of employed women), EUROSTAT data
Unpaid care work (Male-to-female ratio of time spent on unpaid care work)	Indicator of women's participation in unpaid domestic work (Share of women who found it difficult to concentrate at work due to domestic routine, in the total number of women surveyed, %), Eurofound data

Source: compiled by the authors on the https://ec.europa.eu/eurostat/web/main/data/database, https://www.eurofound.europa.eu/data/covid-19

Based on the hypothesis of the study of the reverse flow of gender inequality to the GDP growth in the EU using the E-Views software, a multifactor regression model was built and tested. Based on the data for 2020, the authors analyzed the correlation between the indicators of gender inequality in the labor market (Table 1) and the indicators of the GDP dynamics as the ratio of nominal GDP in 2020 to GDP in 2019 for a sample of 23 countries. In general, the model can be represented as follows:

$$GDPgr = f(GE, GF, GM, GC)$$

Where $GDPgr$ – is a correlation of nominal GDP for 2020 to GDP in 2019;

GE – gender gap in employment;

GF – indicator of financial vulnerability of women, %;

GM – gender gap in management;

GC – indicator of the women's participation in unpaid domestic work, %.

Within the analysis of the model, a correlation matrix was constructed, and the direction and strength of the relationship between the variables were developed. Studies of the adequacy model, autocorrelation testing, and heteroskedasticity have shown its suitability for reflecting the impact of gender inequality in the labor market on the GDP dynamics.

4. Results

Over the past decade, gender inequalities in the EU labor market have tended to decline. During 2010-2019,

the average value of the difference in employment rates for men and women for 27 member states decreased from 12,9% to 11,4%, the wage gap decreased from 15,8% to 14,1%, the difference in the share of men and women in management positions decreased from 3,5% to 2,6%. At the same time, despite the positive trend towards rapprochement, the share of women (25,6% in 2010 and 24,2% in 2019) who were forced to give up work due to the need performing unpaid household chorus – caring for children or other family members, remained significantly higher than the share of men (3,3% in 2010 and 4,3% in 2019) .

COVID-19 has had a negative impact on the employment of both men and women, but it has had different effects at different stages of the crisis and has been specific to the country. In general, during March 2020 – September 2021, according to the group of studied countries, the correlation coefficient of the disease growth rate for women was 0,26, which, although, indicating a very weak link density, but almost four times higher than for men - 0,07. Fig. 1 and Fig. 2 show that first measures to constrain the virus primarily affected jobs related to people-to-people contacts, in particular, in the service sector, i.e. those involving predominantly women. In September 2020, the unemployment rate for women was even higher than that for men, responding to the growing number of COVID-19 diseases, namely the quarantine restrictions imposed as a result of the situation.
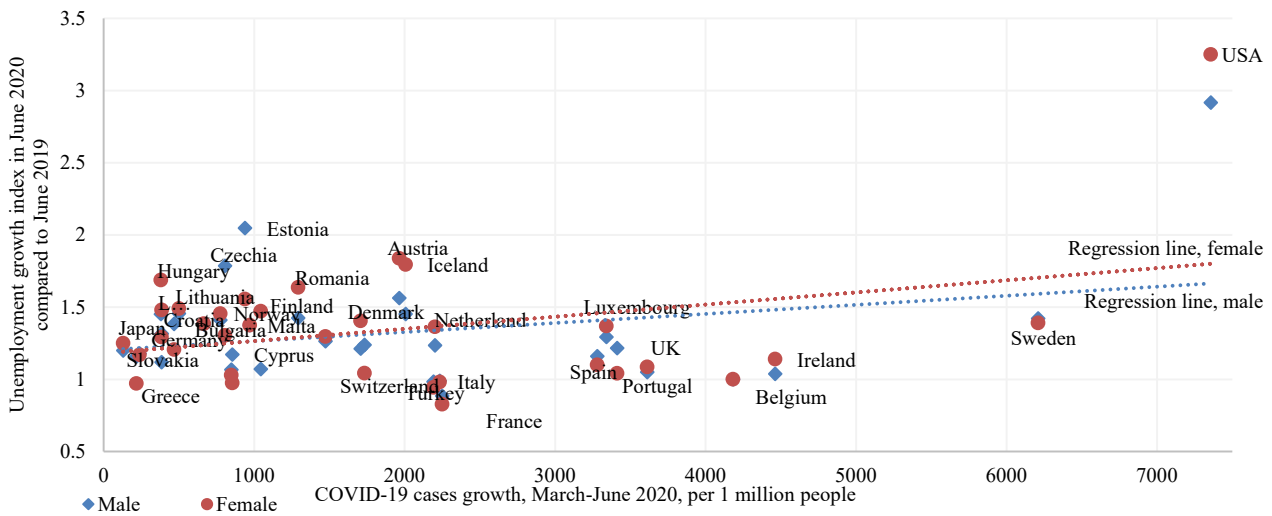
Fig. 1. Unemployment dynamics for women and men and the spread of COVID-19 diseases, March-June 2020
Source: compiled by the authors based on https://ec.europa.eu/eurostat/web/main/data/database, https://ourworldindata.org/covid-cases#cumulative-confirmed-cases-per-million-people

In addition, quarantine measures, including the closure of schools and kindergartens, have led to a significant additional burden on childcare. Although the impact of this additional burden on gender equality depends on a variety of factors, including household composition, number of children and employment status, in absolute terms, the number of women working on housekeeping and childcare has increased significantly.
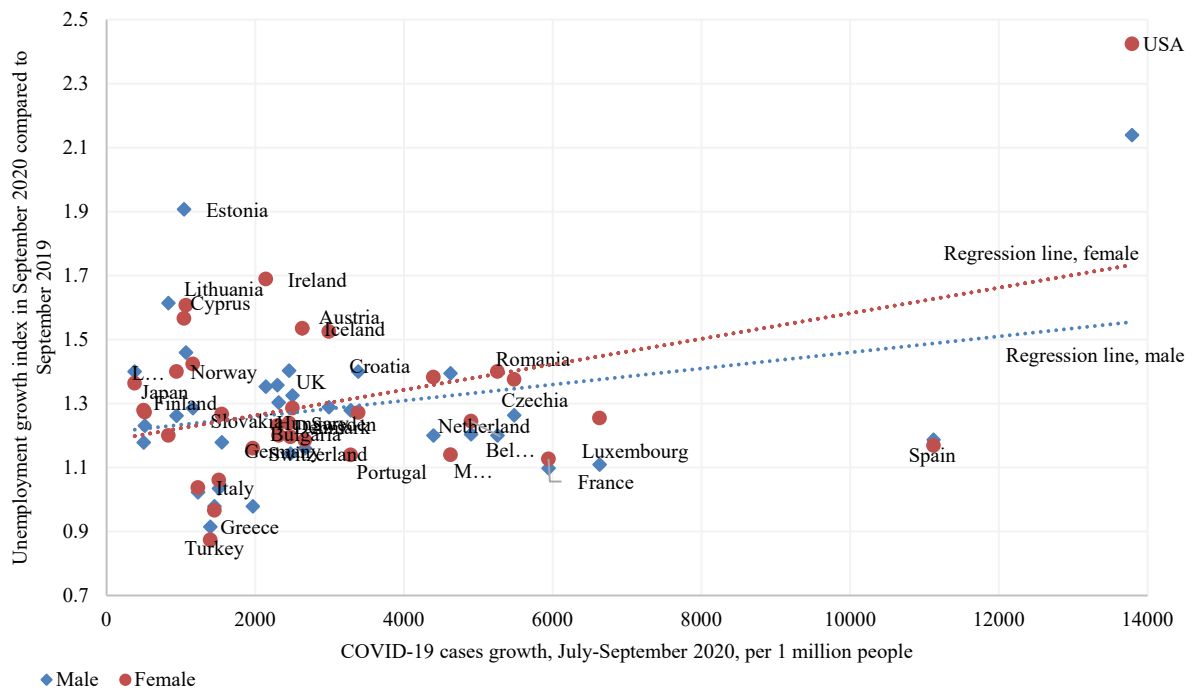

Fig. 2. Unemployment dynamics of women and men and the spread of COVID-19 diseases, July, 2020
Source: compiled by the authors based on https://ec.europa.eu/eurostat/web/main/data/database, https://ourworldindata.org/covid-cases#cumulative-confirmed-cases-per-million-people

However, as the crisis in the labor market unfolded due to the pandemic, its impact spread to men's jobs (Fig. 3). Among the reasons for the alignment of the angles of regression is the disruption of the cross-border value chains, which have negatively affected the men's employment, as they tend to work in the sectors and jobs that are more dependent on international trade. In general, in 2020 the volume of international trade in goods decreased by 7,4% compared to 2019. In the manufacturing industry, the decline in world trade affected the sectors where mostly men work. In the United States, for example, exports of capital goods, industrial materials, and the automotive industry have been severely affected. From August 2020, the unemployment rate among men began to rise. Meanwhile, in the countries where the spread of the virus has begun to slow down, governments started to ease quarantine measures by allowing people to return to work, especially women in the service sector.
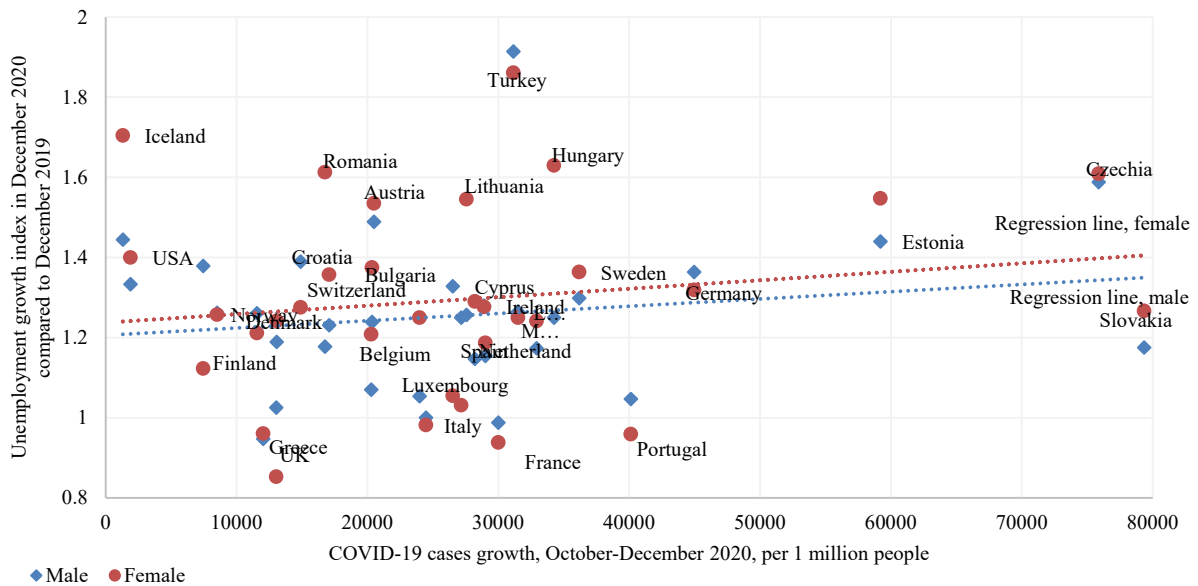

Fig. 3. Unemployment dynamics of women and men and the spread of COVID-19 diseases, October–December 2020
Source: compiled by https://ec.europa.eu/eurostat/web/main/data/database, https://ourworldindata.org/covid-cases#cumulative-confirmed-cases-per-million-people

Although the correlation between the unemployment index and the spread of COVID-19 diseases in October-December 2020 for women and men almost equalized, the unemployment rate for women remained higher in most sample countries. The available data show that against the background of higher employment rates in some countries in 2020 more women completely left the labor market. In Italy, for example, the number of employed women decreased by 249 thousand compared to 207 thousand of men, in Lithuania – by 19 thousand women against 1 thousand of men, in Finland - by 25 thousand and 12 thousand respectively, in Norway – by 7.3 thousand women and 6.2 thousand men.

Table 2. Initial data for building a multifactor regression model

Country	$GDPgr$	GE	GP, %	GF, %	GM	GC, %
Belgium	0,956	1,120	5,8	20,9	1,671	14,7
Bulgaria	0,996	1,127	14,1	34,6	1,224	6,7
Czechia	0,954	1,214	18,9	21	2,048	9,5
Denmark	1,007	1,084	14	10,3	2,284	1,7
Estonia	0,968	1,077	21,7	20,2	1,576	8,4
Ireland	1,046	1,172	11,3	14,5	1,482	8,7
Greece	0,902	1,373	10,4	37,6	1,767	8,9
Spain	0,902	1,186	11,9	23,7	1,564	11,8
France	0,945	1,100	16,5	28,1	1,713	12,8

Croatia	0,903	1,181	11,5	53,3	2,119	9,3
Italy	0,921	1,372	4,7	21,7	1,928	10,6
Latvia	0,963	1,042	10,1	33,5	1,154	3,8
Lithuania	1,013	1,018	21,2	19,2	1,633	5,2
Hungary	0,935	1,236	13,3	32,8	1,260	6,4
Netherlands	0,984	1,105	1,3	19,5	2,474	7,7
Austria	0,954	1,119	18,2	16,4	1,817	10,2
Poland	0,981	1,235	11,6	24,2	1,053	7,1
Portugal	0,933	1,075	14,6	26,8	1,756	12,2
Romania	0,978	1,319	19,9	39	1,380	5,2
Slovenia	0,969	1,087	8,5	20,1	1,261	10,4
Slovakia	0,979	1,189	10,6	39,1	1,496	6,5
Finland	0,984	1,038	3,3	13,5	1,542	7,5
Sweden	0,997	1,052	7,9	11,2	1,218	10,4

Source: compiled by the authors on the https://ec.europa.eu/eurostat/web/main/data/database, https://www.eurofound.europa.eu/data/covid-19

To answer Question 2 of the research, the data were collected and calculated for 23 EU countries, they are summarized in Table 2. Based on the logic described in Section Materials and Methods, the higher the value of the indicators of gender inequality, the lower the ratio of nominal GDP in 2020 to GDP in 2019. To establish the direction and closeness of the relationship between these indicators, let's calculate paired correlation coefficients (r) (Table 3).

Table 3. Matrix of paired correlation coefficients between GDP and the indicators of gender inequality in the labor market

	GDPgr	*GE*	*GF*	*GM*	*GC*
GDPgr	1	-0,45138322	-0,50720689	-0,200151861	-0,457348758
GE	-0,45138322	1	0,428443206	0,049389046	0,056305047
GF	-0,50720689	0,428443206	1	-0,092719728	-0,07998969
GM	-0,200151861	0,049389046	-0,092719728	1	0,071264162
GC	-0,457348758	0,056305047	-0,07998969	0,071264162	1

Source: compiled by the authors based on Table 2

The comparison of paired correlation coefficients indicates a direct relationship between $GDPgr$ and all indicators. In this case, all indicators should be taken into account as having a moderate relationship with $GDPgr$, except GM, with which there is a weak positive relationship (r = 0,2). There is a weak or moderate relationship between the indicators of gender inequality as planned regressive factors, which indicates the absence of multicollinearity, which means reliable estimates of regression. The model itself changes its general approach to:

$$GDPgr = f(GE, GF, GC)$$

Simulation results are presented in Table 4. Taking into account the requirements for the quality of factors, an acceptable level of the significance of 5% has been established. Based on the F-statistics, all regression level coefficients, except GE, are less 0,05, that means that they are statistically significant. The R-squared value indicates that the obtained model of 54,9% explains the change in regression while 45,1% is explained by the factors not included in the model. The correlation coefficient is 0,48, which indicates a moderate correlation. The probability of accepting the null hypothesis of the F-statistics = 0,001, i.e. close to 0, which confirms the need to accept the alternative hypothesis and indicates the importance of the equation as a whole.

Table 4. Results of the multifactor regression model of the GDP dynamics

Dependent Variable: GDPgr Method: Least Squares Sample: 1 23 Included observations: 21				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
GE	-0.084727	0.062489	-1.355867	0.1910
GF	-0.001558	0.000601	-2.593567	0.0178
GC	-0.005854	0.001895	-3.088348	0.0061
C	1.150768	0.067680	17.00317	0.0000
R-squared	0.549362	Mean dependent var		0.963916
Adjusted R-squared	0.478209	S.D. dependent var		0.037092
S.E. of regression	0.026793	Akaike info criterion		-4.244555
Sum squared resid	0.013640	Schwarz criterion		-4.047077
Log likelihood	52.81238	Hannan-Quinn criter		-4.194890
F-statistics	7.720822	Durbin-Watson stat		2.239563
Prob(F-statistic)	0.001430			

Source: authors' development

From the data obtained using the E-Views method of least squares, the resulting multifactor model will look like:

$$GDPgr = 1,151 - 0,085 \cdot GE - 0,002 \cdot GF - 0,006 \cdot GC) \qquad (1)$$

The equation (1) shows the dependence of GDP (*GDPgr*) on the indicators of gender inequality (gender gap in employment (*GE*), women's financial vulnerability (*GF*), the indicator of the women's participation in unpaid domestic chores (*GC*)) in the EU labor market. Coefficients of the equation show the quantitative influence of each factor on the performance indicator while the others remain unchanged; however, to expand the possibilities of the meaningful analysis, it is advisable to calculate partial coefficients of elasticity. The results of their calculation are as follows: with an increase in *GE* by 1%, *GDPgr* will decrease by 0,101%; with an increase in *GF* by 1%, *GDPgr* will decrease for 0,041%; with an increase in *GC* by 1%, *GDPgr* will decrease for 0,052%. Random deviation for the coefficient for *GE* variable makes 0,062; by *GF* variable– 0,001; by *GC* variable– 0,002; for an independent member – 0,068.

Actual value of the F- statistics distribution (7,721) is greater than the tabular value (for freedom degrees *k1* = 3 and *k2* = *n* – *m* –1 = 23 – 3 – 1 = 19, *Fkp*(3;19) = 3,13). This means that the coefficient of determination is statistically significant and the regression equation is statistically reliable.

Information criteria (Akaike, Schwarz, Hannan-Quinn, Durbin-Watson) are submitted in Table 4. The analysis of the deviations correlation was performed using the Durbin-Watson criterion. The statistics value of Durbin-Watson – 2,24; under Durbin-Watson Table for *n* = 23 and *k* = 3 (level of significance 5%) *d1* = 1,08; *d2* = 1,66. Since 1,08 < 2,24 i 1,66 < 2,24 < 4 – 1,66, there is no autocorrelation of residues. Heteroskedasticity was tested using the test of White, Glaser and Breusch-Pagon-Godfrey. In all three tests, we accepted the null hypothesis – the lack of heteroskedasticity, as its probability is much higher than 5%.

5. Conclusions

The corona crisis has shown how vulnerable women's positions in the labor market are compared to men's and how fragile all the achievements of gender policy in recent decades have been, even in the countries where gender inequality has been proclaimed as a fundamental value. The correlation analysis showed that as COVID-19 progressed, women's unemployment rates in most Eurozone countries, the United States, Japan and Turkey grew faster than men's. These statistics show a widening gap in many other indicators of gender equality in the labor market, which threatens to reverse progressive shifts in the women's empowerment.

The example of EU countries shows the connection between the growth of gender inequality in the labor market and the negative GDP dynamics in these countries. Although the proposed model is far from ideal due to significant limitations of the data for the analysis, as well as delayed effects of the pandemic impact on the labor market, it is another argument in favor of the systematic and consistent policy to achieve gender equality as the basis for economic growth. Reactive public policies (additional funding for the childcare sector, flexible working hours for caregivers or children with disabilities), even in the most developed countries, have been

insufficient to halt the widening income and employment gap between women and men. It is expected that the protracted and global nature of the pandemic will lead to further manifestations of gender inequality, which through various channels (e.g., lower employment and women's income –lower household income-reduced costs for education and health care), which will undermine strategic foundations of economic development. This means that investing in gender-responsive economic recovery, including relevant public services, social protection and social infrastructure. should be a long-term guideline for governments around the world.

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