

# The Influence of Fiscal Policy on Gender-Specific Unemployment during the COVID-19 Shock in Poland

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**Abstract.** The COVID-19 pandemic significantly disrupted labor markets worldwide, exacerbating pre-existing gender disparities in employment. This study examines the gender-specific impacts of the pandemic on unemployment trends in Poland from 1992 to 2023, by using a Markov Switching Vector Auto regression model. The results indicate that male unemployment rose more sharply than female unemployment during the initial shock, while female unemployment demonstrated a stronger recovery phase. Fiscal policy played a crucial role in shaping these trends, with government spending exhibiting a delayed but substantial effect in reducing unemployment, particularly in the second lag period. Optimized fiscal interventions suggest targeted policies can alleviate adverse economic effects. Together, these results emphasize the importance of gender-sensitive fiscal policies to support an equitable and resilient labor market recovery in Poland.

**Keywords:** COVID-19 pandemic, gender-specific unemployment, fiscal policy, Markov Switching VAR, dynamic optimization.

## 1. Introduction

The COVID-19 pandemic caused significant labor market disruptions worldwide, with women experiencing disproportionate employment losses across Europe (Blundell et al., 2021). Econometric analyses further highlight the structural gender inequalities in labor markets, demonstrating how pre-existing disparities in employment and entrepreneurship were exacerbated during the crisis (Stavytsky et al., 2020). Unlike previous recessions – which primarily impacted male-dominated industries such as manufacturing and construction – the COVID-19 downturn led to greater job losses among women, particularly in service-oriented sectors (Eurofound, 2020). Studies show that women were overrepresented in the industries most affected by lockdowns, including hospitality,

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retail, and caregiving, leading to higher unemployment rates and labor force withdrawals (Bonacini et al., 2021).

In Poland, the gendered effects of COVID-19 remain understudied, despite evidence of widening employment inequalities. According to Gencer et al. (2024), female employment in Poland declined at a faster rate than male employment, primarily due to job losses in the service sector and increased caregiving responsibilities. Similarly, Lewandowski et al. (2021) highlight that female employment was concentrated in high-contact industries, such as hospitality (61%), retail (69%), and caregiving (77%) – these are sectors that faced the sharpest lockdown-related contractions. Moreover, Gencer et al. (2024) emphasize that women in Poland were more likely than men to experience employment disruptions due to caregiving responsibilities and contractual instability. These patterns reflect broader European labor market trends, where female workers in non-standard employment faced higher risks of long-term unemployment (Canton, 2021).

Despite these gendered labor market effects, Poland did not implement fiscal policies specifically targeting female unemployment. In contrast, Germany and Spain introduced gender-sensitive measures, such as subsidized childcare and direct wage support for female-dominated sectors (Canton, 2021).

However, Poland's fiscal response remained gender-neutral, prioritizing broad business subsidies rather than direct employment protection for women (Niemczyk et al., 2024; Abramovsky et al., 2023). This raises concerns about whether Poland's fiscal approach exacerbated gender disparities in labor market recovery, a question that remains largely unexplored in the literature.

While prior research has extensively examined the overall macroeconomic effects of fiscal stimulus (Figari & Fiorio, 2020; Brewer & Tasseva, 2021), few studies have so far analyzed gender-specific labor market responses to fiscal interventions, particularly in transition economies such as Poland. This study fills this gap by investigating the asymmetric impacts of the COVID-19 shock on male and female unemployment in Poland and evaluating the role of fiscal policy in shaping the labor market recovery.

This study examines gender-specific unemployment trends – defined as the evolution of male and female unemployment rates across the initial shock, worsening, and recovery phases – during the COVID-19 period, assessing the impact of fiscal policies through a Markov Switching VAR (MS-VAR) model.

To achieve this objective, the study addresses the following research questions:

1. How did the COVID-19 shock influence male and female unemployment rates during the initial impact, worsening, and recovery phases in Poland?
2. How did specific fiscal policy measures – particularly changes in government expenditure, government debt, and revenue – affect male and female unemployment rates during the COVID-19 pandemic?

The paper is structured as follows: Section 2 presents the literature review. Section 3 describes the methodology, outlining the MS-VAR model, optimization framework, data sources, and estimation techniques. Section 4 discusses the empirical results on gender-specific unemployment trends and fiscal policy effectiveness. Section 5 concludes with policy recommendations for gender-sensitive fiscal interventions.

## 2. Literature Review

The COVID-19 pandemic has drastically reshaped job markets around the world, which led to unprecedented shifts in unemployment rates. According to Reinhart & Reinhart (2020), the recession was the worst since the Great Depression, disrupting businesses and livelihoods on a massive scale. This crisis had a major impact on employment across sectors and demographics. This paper studies how fiscal policy interventions influenced gender-specific unemployment trends in Poland, a topic that has not been widely explored in present studies. The literature review is structured to first present findings on gendered employment effects. It then explores the role of caregiving responsibilities and analyzes fiscal interventions and automatic stabilizers. Finally, it discusses why women were disproportionately impacted and how fiscal policies shaped employment recovery.

Research indicates that women have been disproportionately affected by pandemic-induced labor market disruptions. Alon et al. (2020) and Carli (2020) highlight that women, particularly those in the service sector, faced greater job losses than men. This was primarily due to the sectoral concentration of female workers in hospitality, retail, and healthcare, which were most affected by pandemic-induced restrictions (Albanesi & Kim, 2021).

In Poland, female employment declined more than male employment due to sectoral vulnerabilities and caregiving responsibilities. According to Piasna et al. (2020), Poland's female employment rate dropped from 68.8% in 2019 to 65.2% in 2020, which reflects significant job losses in service-based industries. Lewandowski et al. (2021) find that temporary and part-time contracts are more common among Polish women, which made them more vulnerable to layoffs. These findings align with broader European labor market trends, where women in non-standard employment faced higher risks of long-term unemployment (Leschke, 2015).

A key explanation for gender-specific unemployment trends during the pandemic was the intersection of gender and caregiving responsibilities. Htun (2022) found that increased caregiving duties – resulting from school closures and heightened health concerns – forced many women to reduce their working hours or exit the labor force entirely. Similarly, Adams-Prassl et al. (2022) report that mothers faced greater employment instability than fathers, particularly in countries with limited childcare support. Bahn & Cumming (2020) further argue that women in temporary and part-time positions were disproportionately pushed out of the labor market due to caregiving demands. These findings suggest that policy responses to labor market instability must account for gender differences in caregiving responsibilities.

Automatic stabilizers are fiscal tools like unemployment benefits and progressive taxes that automatically counteract economic fluctuations. Along with COVID-19 fiscal measures, these fiscal measures – which are intended to help in mitigating unemployment – varied significantly across countries. Some countries adopted targeted interventions while others relied on broad economic support programs. The United Kingdom implemented job retention schemes, furlough programs, and direct income transfers, which effectively

reduced employment losses across genders (Brewer & Tasseva, 2021; Bronka et al., 2020). Similarly, Italy expanded unemployment benefits, which Figari & Fiorio (2020) found particularly effective in cushioning income shocks for women in service sectors.

In contrast, Germany and Finland adopted more generalized business support measures, which disproportionately benefited male-dominated industries (Bruckmeier et al., 2021; Kyyrä et al., 2021). These studies suggest that countries with gender-sensitive fiscal interventions – such as wage subsidies for female-dominated sectors and childcare support – experienced lower gender employment gaps. However, Poland followed a gender-neutral fiscal approach, prioritizing business subsidies rather than direct labor market interventions. As a result, employment recovery was slower for women compared to men; see Carli (2020). These cross-country comparisons illustrate that different fiscal approaches led to different employment outcomes, and Poland's reliance on broad business subsidies may have contributed to slower female employment recovery.

There is ongoing debate on why the COVID-19 crisis disproportionately impacted women's labor market outcomes with multiple factors being considered. First, women are overrepresented in contact-intensive sectors, such as hospitality, retail, and caregiving, which were more heavily impacted by the pandemic overall (Goldin, 2020; Albanesi & Kim, 2021). Second, women held greater responsibility for childcare when schools were closed, which was true for many during COVID-19-related lockdowns (Adams-Prassl et al., 2020). Third, female workers are more likely to have temporary or part-time jobs. These jobs are often the first to be cut during economic downturns (Petrongolo, 2004; Bahn & Sanchez Cumming, 2020).

Fiscal measures are vital in mitigating the economic impacts of the pandemic, as shown by Coibion et al. (2020), which confirms that interventions like cash transfers and unemployment insurance stabilized employment levels. Tsouli (2022) notes that strong fiscal frameworks reduced unemployment persistence among women. Likewise, Baker et al. (2020) found that the labor market recovery was faster in nations with robust fiscal policies.

### **3. Methods**

This section outlines the variables, model specification, and optimization framework used in the analysis. We conducted stationarity tests, followed by determining the VAR model lag length while using the Akaike and Bayesian Information Criteria. The MS-VAR model captures unemployment dynamics, whereas Likelihood Ratio tests compare the fit of the baseline model. A dynamic optimization framework is then implemented to determine optimal fiscal shocks that achieve a 2% reduction in unemployment, subject to constraints on government debt and spending.

#### ***3.1. Markov-Switching VAR***

The study employs a Markov-Switching Vector Auto regression model to capture nonlinear and regime-dependent dynamics in unemployment responses to fiscal policy. The model

reflects three distinct economic phases such as the initial phase, the worsening phase, and the recovery phase. The likelihood of transitioning from one regime to another is articulated through a transition probability matrix.

$$\begin{bmatrix} p_{11} & p_{12} & p_{13} \\ p_{21} & p_{22} & p_{23} \\ p_{31} & p_{32} & p_{33} \end{bmatrix} \quad (1)$$

The element  $p_{jk}$  represents the probability of moving from regime  $k$  to regime  $j$ , denoted as:

$$P(s_t = j \mid s_{t-1} = k) = p_{jk} \quad (2)$$

This formulation enables the MS-VAR model to distinguish regime-specific policy effects and capture the asymmetric behavior of unemployment during different stages of the COVID-19 crisis.

### 3.2. Dynamic Optimization of Economic Shocks

To analyze the optimal shocks across multiple economic variables, a dynamic optimization problem is formulated. The optimization process aims to achieve an optimal balance of policy effects in response to shocks, providing a useful framework to guide fiscal interventions. The objective is to minimize the weighted sum of responses for the key economic variables, subject to constraints on the shock magnitudes. The objective function is specified as:

$$\mathcal{L}(S) = w_1 \cdot U(S_1) + w_2 \cdot D(S_2) + w_3 \cdot I(S_3) - w_4 \cdot F(S_4) - w_5 \cdot R(S_5) \quad (3)$$

Where  $U(S_1)$ ,  $D(S_2)$ ,  $I(S_3)$ ,  $F(S_4)$  and  $R(S_5)$  represent the responses of unemployment, government debt, inflation, FDI, and revenue respectively to the shock magnitudes  $S_1$  through  $S_5$ . The weights  $w_1$  to  $w_5$  indicate the relative importance of each variable in the policy objective.

We derive the first-order conditions (FOCs) by taking the partial derivatives:

$$\frac{\partial \mathcal{L}}{\partial S_1} = w_1 \cdot \frac{\partial U(S_1)}{\partial S_1} = 0 \quad (4)$$

$$\frac{\partial \mathcal{L}}{\partial S_2} = w_2 \cdot \frac{\partial D(S_2)}{\partial S_2} = 0 \quad (5)$$

$$\frac{\partial \mathcal{L}}{\partial S_3} = w_3 \cdot \frac{\partial I(S_3)}{\partial S_3} = 0 \quad (6)$$

$$\frac{\partial \mathcal{L}}{\partial S_4} = -w_4 \cdot \frac{\partial F(S_4)}{\partial S_4} = 0 \quad (7)$$

$$\frac{\partial \mathcal{L}}{\partial S_5} = -w_5 \cdot \frac{\partial R(S_5)}{\partial S_5} = 0 \quad (8)$$

To ensure fiscal realism, the optimization is subject to the constraint that each policy shock lies within the interval  $[-2,2]$ , as follows:

$$-2 \leq S_i \leq 2 \text{ for each variable } (i \in \{1,2,3,4,5\}) \quad (9)$$

The constrained optimization problem is formulated by using the following Lagrangian function<sup>1</sup>:

$$\mathcal{L}(S, \lambda) = \mathcal{L}(S) + \lambda_1 \cdot (S_1 + 3) + \lambda_2 \cdot (3 - S_1) + \dots + \lambda_5 \cdot (S_5 + 3) + \lambda_6 \cdot (3 - S_5) \quad (10)$$

Where  $\lambda_1$  to  $\lambda_6$  are the Lagrange multipliers associated with the inequality constraints.

### 3.3. Model Specification

This study explores the impact of COVID-19 on gender-specific unemployment patterns in Poland by using two separate MS-VAR models: one for female unemployment, and one for male unemployment. The endogenous variables in each model include the gender-specific unemployment rate, central government debt, government expenditure, revenue excluding grants, *Foreign Direct Investment* (FDI), and the inflation rate. FDI and inflation are treated as control variables while the COVID-19 dummy variable ('1' for 2020–2022; '0' otherwise) is included as an exogenous shock.

Let  $Y_{F,t}$  represent the vector of endogenous variables for the female unemployment model. The model equations for the three regimes are defined as:

Regime 1: Initial Impact Phase ( $s_t = 1$ )

$$Y_{F,t} = \mu_{F1} + A_{F1}Y_{F,t-1} + B_{F1}X_t + \epsilon_{F,t1} \quad (11)$$

Regime 2: Worsening Phase ( $s_t = 2$ )

$$Y_{F,t} = \mu_{F2} + A_{F2}Y_{F,t-1} + B_{F2}X_t + \epsilon_{F,t2} \quad (12)$$

Regime 3: Recovery Phase ( $s_t = 3$ )

$$Y_{F,t} = \mu_{F3} + A_{F3}Y_{F,t-1} + B_{F3}X_t + \epsilon_{F,t3} \quad (13)$$

For the male unemployment model, let  $Y_{M,t}$  denote the vector of endogenous variables. The regime-specific models are as follows:

Regime 1: Initial Impact Phase ( $s_t = 1$ )

$$Y_{M,t} = \mu_{M1} + A_{M1}Y_{M,t-1} + B_{M1}X_t + \epsilon_{M,t1} \quad (14)$$

Regime 2: Worsening Phase ( $s_t = 2$ )

$$Y_{M,t} = \mu_{M2} + A_{M2}Y_{M,t-1} + B_{M2}X_t + \epsilon_{M,t2} \quad (15)$$

Regime 3: Recovery Phase ( $s_t = 3$ )

$$Y_{M,t} = \mu_{M3} + A_{M3}Y_{M,t-1} + B_{M3}X_t + \epsilon_{M,t3} \quad (16)$$

<sup>1</sup> The full system of FOCs and constraints is solved by using a numerical method, specifically, *Sequential Least Squares Quadratic Programming* (SLSQP), with the objective to obtain the optimal fiscal shock configuration.

Where  $\mu_{F_j}, \mu_{M_j}$  are the regime-specific intercepts, and  $A_{F_j}, A_{M_j}$  are the coefficient matrices for the lagged endogenous variables.  $B_{F_j}, B_{M_j}$  are the coefficient matrices for the independent variables, and  $\varepsilon_{F,tj}, \varepsilon_{M,tj}$  are the regime-specific error terms for the female and male models, respectively.

### 3.4. Data Sources

This study utilizes annual data from 1992 to 2023 for Poland, obtained from official sources such as Eurostat and the World Bank. The dataset includes key macroeconomic indicators relevant to fiscal policy and gender-specific unemployment trends during the COVID-19 crisis<sup>2</sup>.

**Table 1.** List of variables

Variable	Definition	Type	Source
Unemployment (Male & Female)	Annual unemployment rate for males and females (%)	Dependent Variable	Eurostat
Government Debt	Central government debt as a % of GDP	Fiscal Variable	World Bank
Government Expenditure	Public spending as a % of GDP	Fiscal Variable	World Bank
Revenue Excluding Grants	Government revenue excluding external grants (% of GDP)	Fiscal Variable	Eurostat
Foreign Direct Investment (FDI)	Net FDI inflows as a % of GDP	Control Variable	World Bank
Inflation	Annual CPI-based inflation rate (%)	Control Variable	Eurostat
COVID-19 Dummy Variable	'1' for 2020–2022, '0' otherwise	Exogenous Shock Variable	Self-defined

*Note.* Table 1 provides an overview of the key variables used in the analysis.

By incorporating these variables, the analysis can effectively assess how fiscal policy interventions during the COVID-19 crisis influenced gender-specific unemployment dynamics in Poland.

## 4. Results and Discussion

This section presents empirical findings from the MS-VAR framework. It then examines variance decomposition. Next, model adequacy is assessed by using likelihood ratio tests. Following this, impulse response functions trace the effects of government spending shocks. Lastly, dynamic optimization identifies optimal fiscal configurations under policy constraints.

<sup>2</sup> In this study, fiscal variables refer to key economic factors shaped by government spending and policies. These include government debt, public spending, foreign direct investment (FDI), and inflation. The government directly controls the economy through spending and debt. However, FDI and inflation play an indirect role in shaping the impact of fiscal policies on unemployment (Blanchard & Perotti, 2002; Afonso & Sousa, 2012).

First, we assess stationarity of the variables by using the *Augmented Dickey-Fuller* (ADF) test.

**Table 2.** ADF Test Results

Variable	ADF Test Statistic (Level)	ADF Test Statistic (First Difference)	Critical Value (5%)
FDI	-1.50	-6.85***	-2.954
Government Expense	-1.80	-7.12***	-2.954
Inflation	-1.25	-6.75***	-2.954
Government Debt	-1.70	-5.95***	-2.954
Revenue	-1.40	-6.80***	-2.954
Female Unemployment Rate	-0.80	-6.20***	-2.954
Male Unemployment Rate	-1.00	-5.95***	-2.954

Note. (i) ADF test statistics at first differences are significant at the 1% level as indicated (ii) (\*\*\*), (\*\*), (\*) denote significance at the 1%, 5%, and 10% levels, respectively.

Source: Based on estimations.

Table 2 provides the adjusted ADF test statistics results. After taking the first difference, the ADF test statistics have been improved significantly. This confirms that the variables become stationary.

Second, Johansen cointegration tests are performed to check for long-run equilibrium relationships.

**Table 3.** Johansen Cointegration Test Results

Gender	Hypothesized No. of CE(s)	Trace Statistic ( <i>p</i> -value)	Critical Value (5%)
Female	None	55.48 (0.1500)	82.12
	At most 1	33.19 (0.3000)	61.25
	At most 2	21.50 (0.5000)	43.09
	At most 3	10.82 (0.7000)	27.05
Male	None	70.59 (0.2000)	95.75
	At most 1	40.87 (0.4000)	69.81
	At most 2	25.61 (0.6000)	47.85
	At most 3	15.14 (0.8000)	29.79

Note. (i) *p*-values are provided in parentheses. (ii) The null hypothesis of no cointegration is not rejected at the 5% significance level for both male and female models.

Source: Based on estimations.

Table 3 shows no evidence of cointegration, as all tests fail to reject the null hypothesis. Therefore, a *Vector Autoregression* (VAR) model is suitable for short-term analysis.

Third, we select the optimal lag length based on various information criteria including AIC, BIC, HQIC, and FPE<sup>3</sup>.

<sup>3</sup> AIC: Akaike Information Criterion, BIC: Bayesian Information Criterion, HQIC: Hannan–Quinn Information Criterion, FPE: Final Prediction Error.

**Table 4.** Lag order Selection

Lag Order	AIC	BIC	FPE	HQIC
0	-36.30	-35.89	1.720e-16	-36.16
1	-96.97	-92.84	9.395e-43	-95.60
2	-101.8*	-93.98*	3.038e-44*	-99.22*

Note. \*Indicates the selected lag order based on the respective criterion.

Source: Based on estimations.

Table 4 shows that lag order 2 is the most appropriate choice based on all four criteria (AIC, BIC, FPE, and HQIC), as it has the lowest values for each, which indicates that it provides the best balance between the model fit and complexity.

Next, the Markov-Switching VAR model for female unemployment is estimated to analyze regime-dependent effects.

**Table 5.** MSVAR Result for Female Unemployment

Variable	Female Unemployment	Govt. Debt	Govt. Expense	FDI	Inflation	Revenue
<b>Regime 1</b>						
COVID-19 Shock	-0.0511	-0.044	0.0235	0.332	-0.218	0.007
<b>Regime 2</b>						
COVID-19 Shock	-0.0573	0.097	0.1422	0.194	0.097	0.044
<b>Regime 3</b>						
COVID-19 Shock	0.0276	-0.0016	0.0013	0.176	-0.280	0.021
<b>Common Variables</b>						
Female Unemployment (-1)	1.6443	0.0888	-0.032	-0.117	-1.606	-0.099
Female Unemployment (-2)	-0.6976	-0.0559	0.218	-0.429	0.524	0.187
Govt. Debt (-1)	0.4226	0.8250	0.525	-3.256	-0.561	0.294
Govt. Debt (-2)	-0.4100	0.1617	-0.115	0.474	-0.359	0.074
Govt. Expense (-1)	-0.1413	0.0859	-0.058	3.929	3.128	0.146
Govt. Expense (-2)	-0.4173	-0.2304	-0.189	2.940	2.724	-0.142
FDI (-1)	0.0495	0.0103	0.034	-0.057	1.046	0.036
FDI (-2)	-0.036	0.0004	-0.072	0.526	-0.363	-0.018
Inflation (-1)	0.0592	0.022	0.086	-0.631	0.396	0.043
Inflation (-2)	-0.0087	-0.010	0.015	-0.098	0.205	0.016
Revenue (-1)	-0.1048	-0.0891	0.603	-1.466	-1.449	0.608
Revenue (-2)	0.6852	0.2314	0.010	-1.366	-2.823	-0.177

Note. (i) COVID-19 Shock is an exogenous variable; standard errors and *t*-statistics are not reported as they are not estimated within the system's structure.

Source: Based on estimations.

Table 5 shows Markov-Switching VAR estimates with three regimes for females. In line with the first research question, the coefficient for female unemployment in the initial

impact phase is negative (-0.0511), suggesting that unemployment initially declined. This finding is consistent with Lewandowski (2023), who found that female-dominated sectors such as healthcare and retail were initially less affected by COVID-19-related economic shocks. However, in the worsening phase, the negative effect deepens (-0.0573), indicating that female unemployment deteriorated further. This trend aligns with Goldin (2022), who noted that women's employment became increasingly vulnerable as the pandemic continued, particularly in service sectors. In the recovery phase, the coefficient turns positive (0.0276), implying that female employment conditions showed some improvement. Similar observations were made by Alon et al. (2020), who emphasized that women experienced a partial employment rebound during the reopening phases.

With respect to the second research question, the results indicate that government spending significantly reduced unemployment, with a stronger impact in the second lag period (-0.1413 for lag 1, -0.4173 for lag 2) suggesting a delayed but substantial effect of fiscal measures. This finding is consistent with Auerbach and Gorodnichenko (2012), who show that fiscal spending has stronger countercyclical effects during economic downturns. In contrast, government debt had mixed effects: a positive coefficient in the first lag (+0.4226) implies short-term adverse effects, possibly due to concerns over fiscal sustainability, while the negative coefficient in the second lag (-0.4100) suggests that debt-financed spending eventually contributed to reducing unemployment. This result aligns with Corsetti et al. (2012), who found that while debt-financed fiscal expansions may initially raise concerns, they support labor market recovery in the longer term. Regarding government revenue, the first lag shows a negative coefficient (-0.1048), indicating that high female unemployment initially reduced tax revenues. However, in the second lag, the coefficient becomes strongly positive (0.6852), suggesting that as female employment conditions improved, government revenue also recovered significantly. This pattern is similar to the findings of Blanchard and Leigh (2013), who demonstrated that employment improvements significantly boost government revenues during recovery phases.

Subsequently, a similar MSVAR model is used to estimate male unemployment with the objective to capture gender differences.

Table 6 shows the Markov-Switching VAR estimates with three regimes for males. In line with the first research question, male unemployment in the initial impact phase shows a negative coefficient (-0.0655), indicating that male unemployment increased due to the COVID-19 shock. This observation matches early findings by Cajner et al. (2020), who reported sharp male job losses in manufacturing and construction industries during the initial lockdowns. In the worsening phase, the coefficient becomes slightly positive (0.0146), suggesting a modest recovery in employment. However, during the recovery phase, the coefficient turns more negative (-0.0787), indicating that male unemployment did not improve significantly despite economic recovery. This result supports the argument made by Forsythe et al. (2020), who found that male-dominated sectors recovered more slowly due to capital intensity and delayed rehiring. These results suggest that the labor market recovery was not uniform across genders, with female unemployment showing signs of improvement, while male unemployment remained more persistent.

**Table 6.** MSVAR Result for Male Unemployment

Variable	Male Un-employment	Govt. Debt	Govt. Expense	FDI	Inflation	Revenue
<b>Regime 1</b>						
COVID-19 Shock	-0.065	-0.020	0.0089	0.287	-0.196	0.014
<b>Regime 2</b>						
COVID-19 Shock	0.0146	0.105	0.1318	0.201	0.058	0.033
<b>Regime 3</b>						
COVID-19 Shock	-0.078	-0.078	0.0153	0.082	0.058	-0.064
<b>Common Variables</b>						
Male Unemployment (-1)	1.445	0.095	0.058	0.211	-1.402	0.028
Male Unemployment (-2)	-0.523	-0.074	0.110	-0.993	0.535	-0.010
Govt. Debt (-1)	0.411	0.711	0.505	-4.035	0.129	0.082
Govt. Debt (-2)	-0.350	0.233	-0.163	1.136	-0.653	0.166
Govt. Expense (-1)	-0.030	0.001	-0.013	4.379	2.985	0.160
Govt. Expense (-2)	-0.416	-0.039	-0.189	3.667	1.620	0.186
FDI (-1)	0.050	0.0003	0.035	-0.084	1.083	0.022
FDI (-2)	-0.020	0.0104	-0.068	0.585	-0.47	0.004
Inflation (-1)	0.047	0.0117	0.080	-0.681	0.485	0.018
Inflation (-2)	0.011	-0.0105	0.011	-0.121	0.171	0.008
Revenue (-1)	-0.446	0.0291	0.609	-1.420	-1.506	0.752
Revenue (-2)	0.852	0.0684	0.067	-2.322	-2.158	-0.461

*Note.* (i) COVID-19 Shock is an exogenous variable; standard errors and *t*-statistics are not reported as they are not estimated within the system's structure.

**Source:** Based on estimations.

With respect to the second research question, the negative coefficient for expenditure in the second lag (-0.1413 for lag 1, -0.4173 for lag 2) suggests that fiscal measures did not exhibit any significant effect in long term on male unemployment. Regarding government debt, the results show mixed effects. In the first lag, the positive coefficient (+0.4226) indicates that, initially, the unemployment increased. However, in the second lag, the coefficient becomes negative (-0.4100), indicating that fiscal policies funded through government debt contributed to reducing male unemployment. This evidence supports the conclusions of Jordà et al. (2016), who argued that although debt-financed interventions initially increase uncertainty, they enhance economic stabilization over time. For government revenue, the first lag displays a negative coefficient (-0.4460), indicating that male unemployment initially reduced tax revenues. In the second lag, however, the coefficient becomes positive (0.8526), reflecting a substantial recovery in fiscal revenues as male employment improved during the recovery phase. These results are consistent with findings by the IMF (2020), emphasizing the role of employment recovery in restoring public finances following economic crises.

Moreover, to assess how fiscal and macroeconomic shocks contribute dynamically to gender-specific unemployment, Table 7 shows the variance decomposition results across different time horizons.

**Table 7.** Variance Decomposition

Period	S.E.	Unemployment (Female)	Govt Debt	Govt Expense	FDI	Inflation	Revenue	Total
1	0.0332	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
5	0.1385	82.76%	1.34%	6.80%	6.43%	0.93%	1.73%	100.00%
10	0.1755	55.79%	2.78%	26.70%	9.50%	1.28%	3.95%	100.00%
24	0.1944	46.81%	2.69%	34.78%	8.17%	4.16%	3.39%	100.00%
Period	S.E.	Unemployment (Male)	Govt Debt	Govt Expense	FDI	Inflation	Revenue	Total
1	0.0473	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
5	0.1440	90.12%	1.72%	3.26%	3.16%	1.24%	0.50%	100.00%
10	0.1698	67.57%	3.30%	21.80%	4.68%	1.27%	1.38%	100.00%
24	0.1853	57.02%	2.92%	30.61%	4.45%	3.83%	1.17%	100.00%

*Note.* The variance decomposition shows the contribution of each variable over time.

**Source:** Based on estimations.

Table 7 results reveal that female unemployment increasingly responds to fiscal variables over time. By period 24, it explains 46.81% of its own forecast variance, while government expense accounts for 34.78%, followed by FDI (8.17%), inflation (4.16%), revenue (3.39%), and government debt (2.69%). This suggests a substantial delayed influence of public spending on female labor market outcomes.

Similarly, the decomposition for male unemployment shows that, by period 24, 57.02% of the forecast variance is explained by its own shocks, with government expense contributing 30.61%, followed by FDI (4.45%), inflation (3.83%), government debt (2.92%), and revenue (1.17%). The results indicate that even though own shocks dominate initially, the explanatory power of fiscal instruments – and particularly expenditure – rises over time for both genders, reinforcing the importance of sustained and well-calibrated fiscal support.

Furthermore, to test whether the MS-VAR model provides a better fit than a standard VAR, a *Likelihood Ratio* (LR) test is applied. The test compares the log-likelihoods of both models.

In Table 8, the Likelihood Ratio (LR) tests were performed to compare the fitness of the standard Vector Autoregressive (VAR) model and the Markov Switching VAR (MSVAR) model. For both the male and female models, the Likelihood Ratio statistic (2199.76 for males and 2190.52 for females) is significantly larger than the critical value (125.46), leading us to rejection of the null hypothesis. This suggests that the MSVAR model significantly improves over the VAR model.

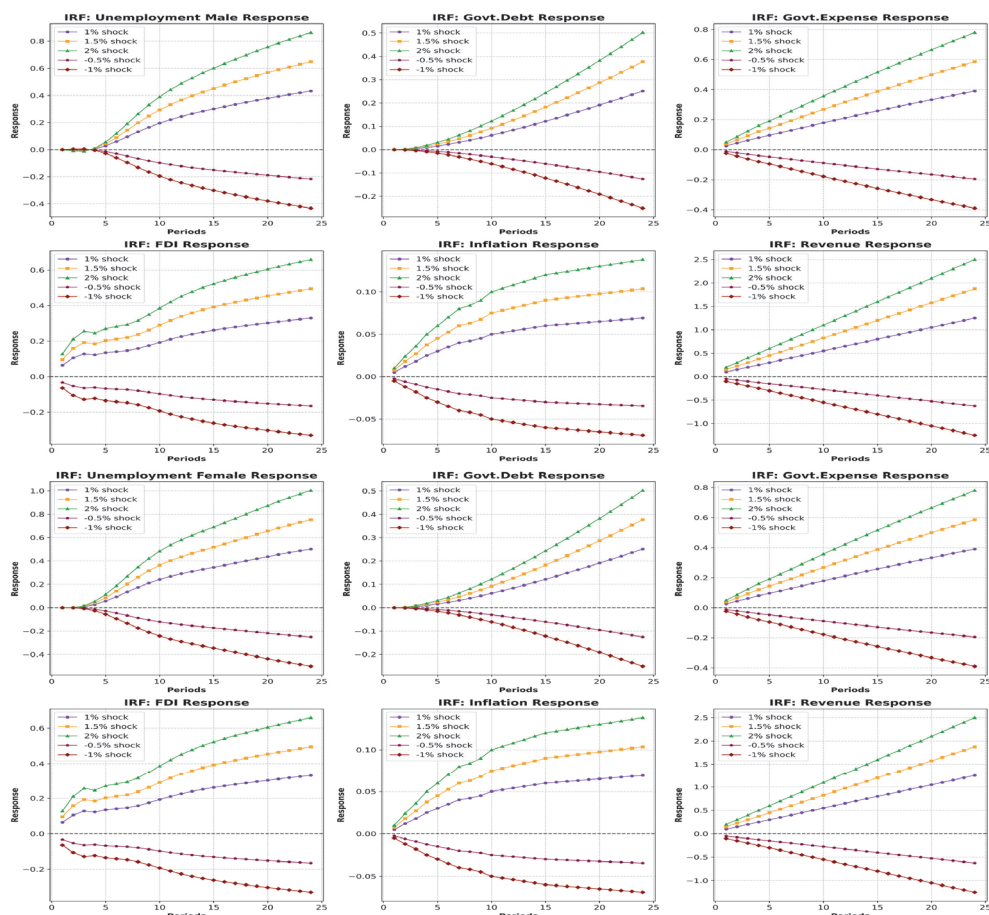
**Table 8.** Result of likelihood ratio (LR) test

Model	Log-Likelihood (VAR)	Log-Likelihood (MSVAR)	Likelihood Ratio Statistic	Critical Value (Chi-squared, df=101)	Reject the Null Hypothesis
Male	-3622.56	-2522.68	2199.76	125.46	Yes,
Female	-3500.48	-2405.22	2190.52	125.46	Yes,

Note. LR statistics exceed the critical value ( $\chi^2 = 125.46$ ,  $df = 101$ ); hence, the MSVAR model significantly outperforms the VAR model for both genders.

Source: Based on estimations.

Then, in order to trace the dynamic impact of fiscal policy shocks on unemployment and macroeconomic variables, *Impulse Response Functions* (IRFs) are generated. Figure 1 displays the responses for both male and female models under various shock scenarios.



**Figure 1.** IRF response to the government spending shock

Note. varying degrees of government spending shocks.

Source: Based on estimations.

Figure 1 illustrates the effects of government spending shocks on various variables. Positive shocks (1%, 1.5%, 2%) increase unemployment for both genders, reflecting short-term labor market dynamics and potential displacement of workers (Forsythe et al., 2020), while negative shocks (-0.5%, -1%) reduce unemployment, which is consistent with the countercyclical effects of spending highlighted by Auerbach and Gorodnichenko (2012). Similarly, positive shocks raise government debt and spending sharply, whereas negative shocks decrease them proportionally, echoing the debt-financed intervention dynamics described by Corsetti et al. (2012). FDI increases with positive shocks and declines slightly with negative ones, showing investor sensitivity to fiscal policy in line with Baker et al. (2020), who found that investor behavior responds strongly to macroeconomic uncertainty. Inflation rises with positive spending shocks due to demand pressures and falls with negative shocks, consistent with Blanchard and Perotti (2002) on fiscal multipliers and price dynamics. Revenue excluding grants follows the same pattern, increasing with positive shocks and decreasing with negative ones, and thus reflecting changes in economic activity and tax collection across both male and female labor markets, as emphasized by Blanchard and Leigh (2013). Taken together, these results directly address the first research question by showing that fiscal shocks produce asymmetric impacts on male and female unemployment, with female unemployment demonstrating relatively greater flexibility in adjustment (Goldin, 2022; Lewandowski, 2023).

Following this, in our pursuit to explore the impact of fiscal interventions under varying trust levels, Table 9 presents the optimized values of government spending shocks required to reduce unemployment while maintaining macroeconomic stability. The optimization is based on model-implied impulse response functions targeting unemployment reduction.

**Table 9.** Optimum Shock for Males and Females

Optimum Shock	Value	Optimum Shock	Value
Male Unemployment Shock	-2.0	Female Unemployment Shock	-2.0
Govt. Debt Shock	-1.99	Govt. Debt Shock	-1.99
Govt. Expense Shock	-1.99	Govt. Expense Shock	-1.99
FDI Shock	+1.99	FDI Shock	+1.99
Inflation Shock	-1.99	Inflation Shock	-1.99
Revenue Shock	1.99	Revenue Shock	1.99

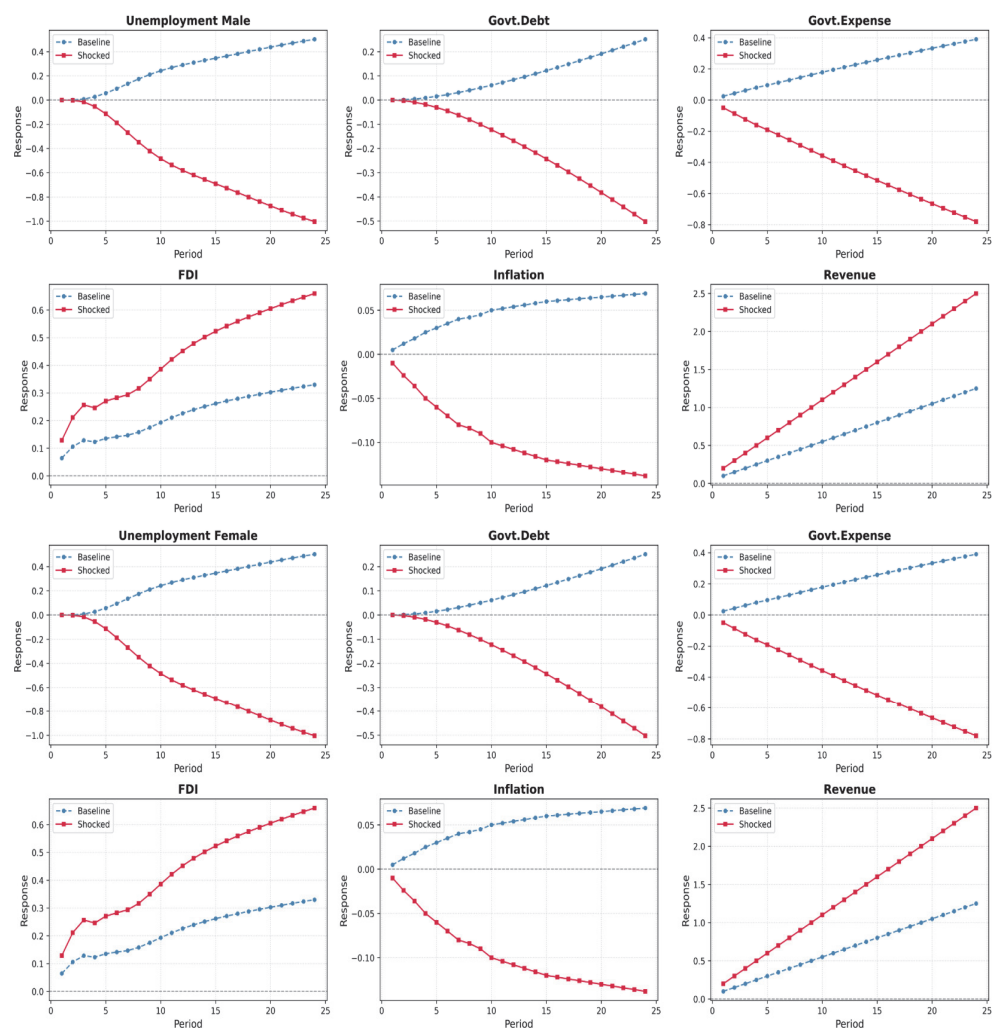
*Note.* Optimized Shock based on Sequential Least Squares Quadratic Programming.

**Source:** Based on estimations.

Table 9 shows that, in order to minimize both male and female unemployment by 2%, along with government debt and spending, we need to increase FDI and revenue by 2% and decrease inflation by 2%. This result reflects the broader fiscal policy trade-offs highlighted by Corsetti et al. (2012), where a reduction of debt and expenditure must be balanced with growth-oriented measures to sustain recovery. The role of FDI supports findings that stable fiscal conditions encourage external investment, which, in turn, promotes employment (Baker et al., 2020). Similarly, the need to lower inflation is consistent with Blanchard and Perotti (2002), who show that unchecked fiscal expansion can create

demand-driven price pressures that undermine labor market gains. Finally, the positive impact of stronger revenues on unemployment reduction echoes Blanchard and Leigh (2013), who found that improvements in employment feed directly into fiscal capacity. Taken together, these results complement the second research question by illustrating that a reduction of unemployment requires a coordinated mix of debt reduction, spending restraint, and revenue growth, reinforced by stable inflation and investment.

Finally, we compare baseline and optimized shock responses so that to evaluate intervention effectiveness derived from Table 9.



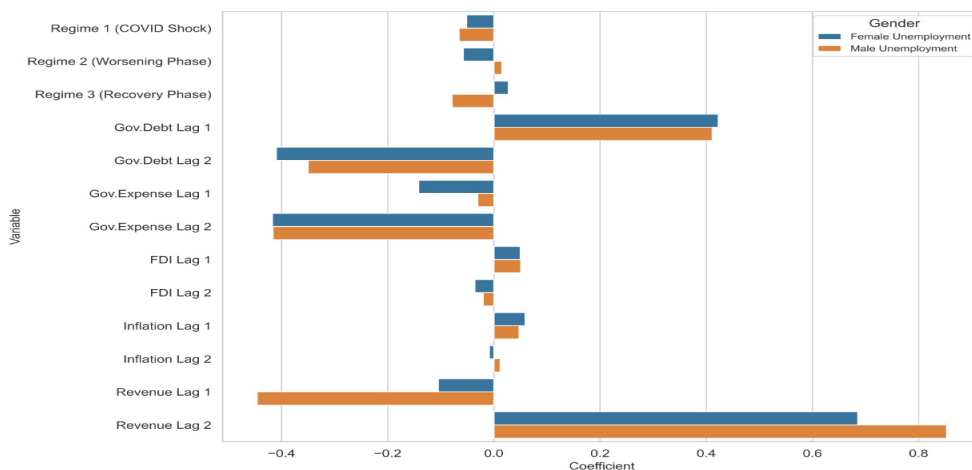
**Figure 2.** Comparison of baseline impulse response to shock

*Note.* Comparison of baseline and optimized shock scenarios.

*Source:* Based on estimations.

Figure 2 illustrates the comparison of baseline and shock scenarios, highlighting the effectiveness of these adjustments in achieving the desired macroeconomic outcomes.

The final Figure 3 compares the male and female MSVAR models, thereby synthesizing gendered effects.



**Figure 3.** Comparison of both models

*Source:* Based on estimations.

In Figure 3, the Markov Switching VAR model reveals that the COVID-19 shock initially decreased both male and female unemployment, with stronger effects observed for males. During the recovery phase, female unemployment improved, while male unemployment worsened due to delayed layoffs in capital-intensive industries like manufacturing and construction (Goldin, 2022; Lewandowski, 2023). Government spending played a pivotal role in reducing unemployment, with a delayed but substantial impact. Although government debt initially increased, it ultimately contributed to lowering unemployment through fiscal interventions, supporting the view that debt-financed spending can facilitate long-term economic recovery.

Taken together, the findings provide robust evidence in addressing both research questions. The first research question is answered through the identification of asymmetric gender effects of COVID-19 shocks, where male unemployment proved to be more persistent than female unemployment due to sectoral differences and recovery patterns. The second research question is addressed by demonstrating that fiscal policy instruments – particularly government spending and debt-financed interventions – play a significant role in reducing unemployment over time. The MS-VAR model results, supported by variance decomposition and impulse response functions, collectively highlight the necessity of sustained, inclusive, and gender-aware fiscal interventions for effective post-shock labor market stabilization.

The current geoeconomic challenges – such as energy insecurity, rising inflation and the ongoing conflict in Ukraine – carry significant implications for the European Union

(Falkner, 2023). Poland's gender-neutral fiscal response stands in contrast to the more gender-focused approaches adopted by other EU member states. Therefore, this difference highlights the need for coordinated yet flexible policy frameworks that can address diverse national contexts. Solidarity-based and inclusive recovery strategies are essential. Nevertheless, these should align with the principles outlined in the European Pillar of Social Rights. Encouraging gender equality and resilience in the labor market is the key to ensure long-term stability because crises often expose and deepen the already existing inequalities. Addressing these gaps must be a core element of recovery planning. Fiscal measures should go beyond their traditional countercyclical role. These measures must also be socially inclusive that support vulnerable groups and reduce disparities. An equitable recovery requires policies that reach all sectors and population groups – not just those easiest to assist. Only then can the EU build a more cohesive and resilient economic future.

## 5. Conclusion

The research investigated the effects of fiscal policy on gendered unemployment in Poland during the COVID-19 crisis. The Markov Switching VAR model showed a sharp rise in male unemployment during the initial shock, while female unemployment recovered more slowly. Government spending has played a key role in reducing unemployment, though with a delayed effect. Initially, government debt worsened unemployment before aiding recovery. High unemployment has also negatively impacted foreign direct investment and revenue streams.

Each empirical stage reinforced these findings. Stationarity and cointegration tests confirmed that the short-run framework was valid. MS-VAR estimations revealed regime-dependent gender asymmetries. Variance decomposition revealed that government expenditure became the main fiscal driver of unemployment over time. Impulse responses clarified the asymmetric short-run effects of positive versus negative fiscal shocks. Finally, the optimization framework demonstrated that a reduction of unemployment by 2% requires coordinated adjustments across debt, spending, FDI, inflation, and revenue.

Collectively, the findings reveal that Poland's fiscal policy response was effective in mitigating unemployment, but not equally so across genders or sectors. Female-dominated sectors were slower to recover, suggesting that gender-neutral policies may overlook structural differences in labor market dynamics.

This paper contributes a novel approach by combining regime-dependent estimation with a dynamic optimization framework for policy design – which is an approach not seen in prior gender-focused macroeconomic studies. The results offer actionable insights for fiscal authorities aiming to balance equity and efficiency.

Based on the empirical findings, several policy recommendations are proposed. To address a slower recovery in female-dominated sectors (e.g., healthcare, retail), job creation programs and subsidies should be implemented, in line with gender-responsive budgeting (Budlender & Hewitt, 2002). For male-dominated sectors (e.g., manufacturing, construction), sustained infrastructure investments are needed to boost recovery, sup-

ported by Keynesian fiscal principles (Keynes, 1936). Poland should focus on long-term investments in green energy, digital infrastructure, and public works so that to stimulate demand and job creation. In addition, the country should implement progressive tax reforms and encourage FDI in technology and green energy sectors, as these are critical for long-term growth (Ross, 2015). Finally, real-time labor market data should guide dynamic fiscal adjustments.

However, some limitations should be acknowledged. The analysis is limited to Poland, which may affect the generalizability of the results. Furthermore, while the study includes major fiscal and macroeconomic variables, other institutional or behavioral factors influencing gendered employment outcomes may have been omitted. Future research should examine multi-country comparisons, extend the time horizon, and explore more granular disaggregation of labor market segments.

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