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Article

How Do Monetary and Fiscal Determinants Affect Inflation? Evidence from Panel Data Analysis

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Abstract

The article evaluates the effects of certain macroeconomic indicators, including the minimum wage and unemployment, on inflation using panel analysis. Based on panel data covering 2000-2021 for 14 countries with different income levels, the Fixed Effects Model and the GMM model were applied and compared. The results indicate that the money supply's impact on inflation is insignificant. Fiscal measures may be more important if monetary policy does not affect inflation. The GMM model reveals that the minimum wage reduces inflation, while the minimum wage adjusted for purchasing power parity (PPP) increases it. Unemployment has a strong impact on inflation, confirming the Phillips curve theory, which suggests that a decline in unemployment leads to higher inflation.

Keywords: inflation; minimum wage; economic growth; panel analysis; unemployment; money supply

1. Introduction

The impact of inflation on economic development, income distribution, and social welfare varies depending on its speed, persistence, and unpredictability. Inflation reduces real incomes, leading to a decline in purchasing power. Population groups with fixed incomes, such as pensioners, public sector employees, and students, suffer the most from inflation. Inflation not only affects social welfare and income inequality but also indirectly influences health (Balcilar et al., 2018; N'Yilimon, 2015; Louie et al., 2023). The impact of inflation on overall economic activity, investments, and financial markets is also significant. Inflation slows economic growth (Cuaresma & Silgoner, 2014; Pappas & Boukas, 2025), leads to rising interest rates, and decreases the real value of money. Although nominal wages may increase during inflation, real purchasing power declines. Inflation also reduces competitiveness in foreign markets. Additionally, it raises government expenditures as wages and social spending increase.

Given the negative effects of inflation, every country pays special attention to its management. Inflation not only results from various macroeconomic changes but also causes different macroeconomic effects. Changes in economic growth, money supply, government spending, wages, exchange rates, and other indicators can influence inflation levels. Since inflation has different determinants and macroeconomic policies, including minimum wage policies, vary across countries, quantitatively assessing the impact of inflation in countries with different income levels is of both scientific and practical importance. Therefore, based on the macroeconomic indicators included in the study, several hypotheses are proposed:

Hypotheses:

The increase in the nominal minimum wage leads to inflation, regardless of income level.

1. *The increase in the minimum wage adjusted for purchasing power parity (PPP) leads to inflation, regardless of income level.*
2. *The increase in broad money leads to inflation, regardless of income level.*
3. *There is a negative relationship between the unemployment rate and inflation.*

The study includes 14 countries with significantly different income levels. However, some similarities exist among these countries. Eight of them (Azerbaijan, Armenia, Georgia, Kazakhstan, Kyrgyz Republic, Moldova, Russian Federation, Ukraine) are former Soviet republics. Four countries (Bulgaria, Czechia, Poland, and Romania) were part of the former socialist bloc. The remaining two countries, Israel and Turkey, are economically developed countries in the Middle East. The GDP per capita of the 14 countries included in the panel analysis ranges from \$52,600 (Israel) to \$2,000 (Kyrgyz Republic).

2. Literature Review: Theoretical Background & Empiric Evidence

The impact of the minimum wage (MW) on inflation is a widely debated issue in economic theory. Researchers primarily argue over whether MW increases inflation, under what economic conditions it may influence inflation, and how to measure the scale of its impact. There are three main approaches among economists regarding the effect of MW on inflation:

The first approach suggests that MW increases inflation (e.g., Keynesian and Cost-Push Theories). According to this theory, an increase in MW raises production costs and stimulates demand, leading to inflation. In turn, inflation further drives MW increases. For instance, *Blanchard & Katz (1999)* showed that wage growth in the U.S. contributes to inflation, while the OECD (2022) demonstrated that excessive MW hikes can lead to inflation.

The second approach, based on Neoclassical and Monetarist views, argues that MW has little or no impact on inflation. According to these perspectives:

1. The influence of MW on inflation is limited since, in the monetarist view, inflation is primarily caused by an increase in the money supply, not wage changes.
2. If production increases, inflation does not occur. That is, if labor productivity grows in line with wage increases, prices remain stable.
3. Market adjustments prevent MW from causing inflation, as employers can offset higher labor costs by reducing jobs, improving productivity, or automating processes.

A key argument in these approaches is that MW only affects inflation if it grows faster than productivity. *Friedman (1968)* asserted that inflation is primarily driven by monetary policy, not wage increases. Similarly, *Card & Krueger (1994)* found that MW increases in the U.S. had minimal effects on employment and inflation.

Some economic theories also argue that **the minimum wage (MW) can reduce inflation**. According to the **Endogenous Economic Approach**, under different economic conditions, an increase in MW may lead to lower inflation. The main arguments in this approach are:

- a) **MW increases consumption** among low-income groups, leading to a more stable economy.
- b) **MW growth fosters innovation and productivity** in the production sector, which can help keep prices stable.
- c) **A stronger domestic market** in developed countries can help control inflation.

A study by *Storm & Naastepad (2012)* supports these arguments, showing that the MW contributed to economic stability in European countries.

The effects of MW on inflation have also been analyzed in various empirical studies. *Card & Krueger (1994)* argued that MW has a weak impact on inflation, stating that MW increases do not significantly raise either inflation or unemployment. According to the **OECD (2022)** study, gradual wage increases in Europe have minimal effects on inflation.

In Turkey, a study by *Gürsel & Uysal (2017)* found that MW increases significantly affect price levels. Meanwhile, *MacDonald & Nilsson (2016)* claimed that the impact of MW on prices is relatively

small. Their research suggests that price increases mainly occur in the **first month** after MW adjustments take effect, and this impact is smaller than previously estimated. Furthermore, when MW increases are indexed to inflation, price rises tend to be more moderate, and **no significant difference is observed between changes at the federal or state level**. Using **machine learning techniques**, *Cazcarra (2024)* analyzed MW increases in Spain over the last two decades. The findings indicate that raising the MW **reduced income inequality without causing inflation or unemployment** and was associated with increases in both net employment and corporate profits.

Garnero (2023) examined how OECD countries adjusted the MW during periods of high inflation. The study highlights that **while MW increases help protect purchasing power, they also raise concerns about potential wage-price spirals and wage compression**. The impact of economic growth on inflation has been widely studied in economic theories. However, perspectives on this issue differ significantly. For instance, **Keynes and his followers** emphasize the **demand-driven** relationship between economic growth and inflation. According to their argument, if the economy operates **below full employment**, economic growth can occur **without causing inflation**. However, once the economy reaches full employment, rising demand leads to **demand-pull inflation**. Additionally, **expansionary government spending and credit growth** can also contribute to inflation. According to the **New Keynesian theory**, if economic growth occurs **only due to rising demand without an expansion in production capacity**, inflation will increase.

In contrast, the **Endogenous Growth Theory** suggests that if economic growth is driven by **productivity gains and technological advancements**, inflation may **remain stable**. However, excessive government intervention and **inefficient fiscal policies** can lead to higher inflation.

Empirical evidence supports these theoretical perspectives. Countries like **China and India** have sustained **high economic growth** through **productivity increases and investments**, maintaining **moderate inflation**. In contrast, during economic expansion periods in the **United States and the European Union**, inflation has tended to increase to some extent. Meanwhile, countries like **Venezuela and Zimbabwe** have experienced **extreme inflation without economic growth**, primarily due to **excessive money printing**, making inflation uncontrollable.

Based on economic theories and empirical studies, it can be concluded that the impact of economic growth on inflation **depends on economic policies, market structures, and institutional frameworks**. If growth is primarily driven by **productivity improvements and increased production capacity**, inflation may **remain low**. However, **demand-driven growth and excessive money supply** can intensify inflationary pressures.

The relationship between **money supply and inflation** holds a significant place in economic theories. The **Monetarist school**, particularly **Milton Friedman**, asserts that *inflation is always and everywhere a monetary phenomenon*. According to the **Quantity Theory of Money (QTM)**, expressed through **Fisher's equation**, if the **velocity of money circulation is stable** and the **economy is at full employment**, an increase in **money supply** will lead to **higher inflation**.

In contrast, **Keynesian economists** argue that **monetary policy** affects **inflation in the short run**, but it can be **balanced by economic growth**. If the **economy is below full employment**, an increase in **money supply** can **stimulate growth without causing inflation**. However, once **full employment is reached**, additional money supply will contribute to **higher inflation**.

Several studies have explored this relationship across different countries: *Gatawa et al. (2023)* in Nigeria, *Mbongo et al. (2014)* in Tanzania, *Koti and Bixho (2016)* in Albania, *Denbel (2016)* in Ethiopia, *Dekkiche (2022)* in other developing economies all find that **an increase in money supply leads to higher inflation**. However, *Ditimi et al. (2018)*, also studying Nigeria, argue that **money supply has a weak impact on inflation**, suggesting that **other structural factors** play a role.

Exchange rates play a crucial role in inflation through **import and export prices**. Exchange rate fluctuations impact **overall price levels**, particularly through **import costs**.

Empirical studies suggest that the relationship between **exchange rates and inflation** varies across countries. This relationship is **bidirectional: Depreciation (devaluation) increases imported**

goods' prices, leading to **higher inflation**, and in countries with **high inflation**, maintaining a **stable exchange rate** becomes difficult, increasing **devaluation risks**.

In **highly dollarized economies**, exchange rate changes have a **stronger impact** on inflation, as a significant portion of transactions are conducted in foreign currency. Empirical studies on the impact of **exchange rates on inflation** show that the relationship between these indicators **varies across countries**. For instance, research conducted by *Özen et al. (2020)*, as well as *Emikönel and Orhan (2023)* on **Turkey** indicates that the **depreciation of the national currency** leads to **higher inflation**. Similar findings were observed in **Sudan** by *Lado (2015)* and in **South Africa** by *Miyajima (2020)*, confirming that a weakening currency contributes to inflationary pressures.

The relationship between **unemployment and inflation** has been widely debated in economic theories. *Phillips (1958)* introduced the **Phillips Curve**, which suggests an **inverse relationship** between unemployment and inflation. As **unemployment decreases**, workers demand **higher wages**. This increases **production costs**, leading to **cost-push inflation**. Conversely, when **unemployment rises**, consumer demand falls, reducing price pressures and **lowering inflation**.

However, this inverse relationship is **not universal**. **High inflation and high unemployment can coexist**, a phenomenon known as **stagflation**.

According to the **New Keynesian** perspective, due to **wage and price rigidities**, an economy can remain in a **prolonged stagnation** phase. **Labor market rigidities** and **inflation expectations** can alter the traditional **inflation-unemployment tradeoff**.

Studies across different countries confirm that the relationship between **unemployment and inflation is not uniform**. Some studies confirm that **higher unemployment** leads to **lower inflation**. However, in other cases, such as in the research by *Rolim (2024)* and *Lai (2020)*, an **increase in unemployment** was accompanied by **higher inflation**, demonstrating that this relationship depends on country-specific economic conditions and policies.

3. Methodology

According to the research, the post-Soviet countries (Azerbaijan, Armenia, Georgia, Russia, Ukraine, Kazakhstan, Kyrgyzstan, and Moldova), Turkey, Poland, Bulgaria, Czech, Romania, and Israel have been included (Table 1).

Table 1. Analysis and Justification of the Selected Countries.

Country Group	Countries	Reason for Selection
Post-Soviet Countries (14 countries)	Azerbaijan, Armenia, Georgia, Russia, Ukraine, Kazakhstan, Kyrgyzstan, Moldova	Similar economic transition process: Transition from a planned economy to a market economy, different minimum wage policies.
Turkiye	Turkiye	Regional leader and economic transition model: Strong economic ties with post-Soviet countries.
European Countries (4 countries)	Poland, Romania, Czechia, Bulgaria	Countries of EU: The minimum wage policy is different, making it suitable for comparison.
Middle Eastern Country (1 country)	Israel	High-income, stable economy: This presents a different model related to inflation and the labor market.
High middle-income		High middle-income economy: Presents a different model related to inflation and the labor market.

Note: selected by the authors.

Although there are some advantages in the selection of these countries, there may also be challenges related to empirical analysis. For instance, there could be a heterogeneity problem in the Panel Data Model. Since the labor market structure differs between post-Soviet countries and

developed countries, Fixed Effects (FE) and Random Effects (RE) models may not yield accurate results. In such cases, Clustered Standard Errors and Mixed Effects Models will be used. On the other hand, the minimum wage in post-Soviet countries does not change frequently, and sometimes it is not officially determined. In countries like Israel, wage systems have entirely different approaches. Considering this, if necessary, Panel Cointegration Tests (Pedroni, Kao, Westerlund) may be applied. If endogeneity issues are observed, the Generalized Method of Moments (GMM) approach can be utilized.

In the panel study, the impact of various factors on inflation will be assessed for 14 countries, including the following variables: Minimum Wage (MW) calculated using Purchasing Power Parity (PPP) (*MW_PPP*), Minimum Wage in national currency (*MW_NC*), GDP growth (*GDP_growth*), the logarithm of M2 money supply (*logm2*), exchange rate (*Exch_Rate*), unemployment rate (*unemp*), the share of wage earners in total employment (*waged*), and government expenditure (*gov_EXP*). The evaluation will be based on data from the years 2000 to 2021. For the minimum wage (MW), three indicators could be used: a) MW with PPP, b) MW in US dollars, and c) MW in national currency. However, in the panel analysis, since the exchange rate (*Exch_Rate*) is included as an independent variable, the MW calculated in US dollars is not used. Since the objective is to analyze the effect of minimum wage on inflation both across countries and within each country over time, the variables “*MW_PPP*” (minimum wage based on 2021 PPP Dollar) and “*MW_NC*” (minimum wage in national currency) will be used.

For the panel analysis, you will use the following general form of the equation:

$$\text{inflation}_{it} = \beta_0 + \beta_1 * \text{MW_PPP}_{it} + \beta_2 * \text{MW_NC}_{it} + \beta_3 * \text{GDP_growth}_{it} + \beta_4 * \text{logm2}_{it} + \beta_5 * \text{Exch_rate}_{it} + \beta_6 * \text{unemp}_{it} + \beta_7 * \text{waged}_{it} + \beta_8 * \text{gov_exp}_{it} + \alpha_i + \varepsilon_{it}$$

4. Results

4.1. Descriptive Statistics

Descriptive statistics (Table 2) reveal that “Inflation” and several macroeconomic indicators influencing it—including “*GDP_Growth*,” “*M2*,” “*MW_PPP*,” “*MW_NC*,” “*EXCH_rate*,” “*Unemp*,” “*waged*,” and “*govExp*”—exhibit skewness and kurtosis values beyond acceptable thresholds, indicating that none of these variables follow a normal distribution. While panel analysis remains feasible under such conditions (as many panel regression models, such as Fixed Effects, Random Effects, and GMM, are based on the assumption of asymptotic normality—i.e., normality in large samples), concerns arise regarding the reliability of the model. Specifically, extreme skewness and kurtosis may signal the presence of outliers or heteroskedasticity, potentially distorting coefficient estimates and standard errors.

Table 2. Descriptive statistics of the variables.

	Mean	Median	Maximum	Minimum	Std.Dev.	Skewness	Kurtosis	Jarque-Bera	Prob.
<i>Inflation</i>	6.912535	5.187681	54.91537	-1.544797	7.816440	3.215552	17.19998	3118.480	0.000000
<i>GDP_Growth</i>	4.406969	4.500000	34.50000	-15.13647	5.087253	0.517403	9.550097	564.3407	0.000000
<i>M2</i>	3.58e+12	3.76e+11	7.53e+13	6.27e+08	1.07e+13	4.591176	25.59146	7631.852	0.000000
<i>MW_PPP</i>	374.5197	261.8975	1463.846	5.746000	344.7096	1.077761	3.256663	60.47257	0.000000
<i>MW_NC</i>	5384.153	1000.000	68000.00	1.100000	11264.92	3.442071	15.42796	2590.351	0.000000
<i>EXCH_rate</i>	59.22983	5.195975	578.7630	0.625219	127.0875	2.694045	9.132353	855.1783	0.000000
<i>Unemp</i>	8.314156	7.260000	20.71000	0.785000	4.544160	0.852171	3.242928	38.03541	0.000000
<i>waged</i>	65.93718	67.73626	95.51689	30.56397	20.14290	0.389933	1.831816	25.31815	0.000003
<i>Gov_exp</i>	16.18189	16.83204	25.34487	8.118775	3.678890	0.149686	2.368313	6.271044	0.043477
<i>Logm2</i>	11.45884	11.57535	13.87671	8.797558	1.103517	0.151108	2.635248	2.879525	0.236984
<i>logMW_PPP</i>	2.324467	2.418106	3.165495	0.759366	0.541834	0.661482	2.671719	23.84434	0.000007

<i>logMW_NC</i>	2.984351	3.000000	4.832509	0.041393	0.928743	0.274115	2.617836	5.731421	0.056943
<i>Wins_inflation</i>	6.283552	5.187681	19.71672	-0.118060	5.160121	1.026690	3.478519	57.04870	0.000000
<i>Wins</i>	4.335571	4.500000	18.62000	-9.901468	4.546210	0.352327	4.494063	35.01911	0.000000
<i>- GDP_growth</i>	1.017836	0.715626	2.762501	-0.203968	0.793466	0.636687	2.351703	26.20272	0.000002

Note: calculated by authors.

To address this issue, we will apply data transformations to adjust the skewness and kurtosis of these variables, improving their approximation to normality. We will utilize two transformation techniques: logarithmization and winsorization. In particular, "Inflation" will be winsorized at the 5th and 95th percentiles, while "GDP_Growth" will be winsorized at the 1st and 99th percentiles. Additionally, logarithmic transformations will be applied to "M2," "MW_PPP," "MW_NC," and "EXCH_rate." The updated descriptive statistics following these transformations are presented in Table 2.

4.2. Selection of Variables for Panel Regression

To ensure reliable results in panel regression, variables should not be highly skewed, have extreme kurtosis, or fail the normality test.

Based on normality, skewness, and transformations (Table 3), the following variables are best suited for panel regression: Dependent Variable: 1)Winsorized Inflation (instead of raw Inflation); 2)Independent Variables: a)Winsorized GDP Growth (instead of raw GDP Growth); b)logM2 (instead of raw M2); c)logMW_PPP (instead of raw MW_PPP); d)logMW_NC (instead of raw MW_NC); e)logExch_rate (instead of raw Exchange Rate);f)Unemp; g)Waged; h)Gov_exp.

Table 3. Characteristics of the variables.

Variable	Interpretation
Inflation	Highly skewed (3.21), extreme kurtosis (17.20), $p < 0.05$ → Outliers present. Winsorization already applied.
GDP_Growth	Slightly skewed (0.52), high kurtosis (9.55), $p < 0.05$ → Not normal, needs transformation. Winsorized version available.
M2	Extremely skewed (4.59) and high kurtosis (25.59) → Not suitable for direct inclusion. Log transformation needed (LogM2 is available).
MW_PPP	Skewed (1.07), moderate kurtosis (3.25), $p < 0.05$ → Acceptable for panel regression.
MW_NC	Highly skewed (3.44), extreme kurtosis (15.42) → Not suitable directly. Log transformation available (logMW_NC).
EXCH_rate	Highly skewed (2.69), extreme kurtosis (9.13), $p < 0.05$ → Needs transformation. Log version (logExch_rate) is available.
Unemp	Moderate skewness (0.85), kurtosis (3.24), $p < 0.05$ → Can be included.
Waged	Almost normal (Skewness: 0.38, Kurtosis: 1.83, $p < 0.05$) → Suitable for panel regression.
Gov_exp	Slight skewness (0.15), kurtosis (2.36), $p = 0.043$ (borderline normality) → Can be included.
LogM2 (Log of M2)	Normal (Skewness: 0.15, Kurtosis: 2.63, $p = 0.236$) → Best transformation of M2, suitable for analysis.
logMW_PPP	Normal (Skewness: 0.66, Kurtosis: 2.67, $p < 0.05$) → Suitable for analysis.
logMW_NC	Almost normal (Skewness: 0.27, Kurtosis: 2.61, $p = 0.056$) → Suitable for analysis.
Winsorized Inflation	Skewness reduced (1.02), kurtosis improved (3.48), $p < 0.05$ → Better for regression than raw inflation.
Winsorized GDP Growth	Skewness improved (0.35), kurtosis improved (4.49), $p < 0.05$ → More reliable than raw GDP growth.

logExch_rate Moderate skewness (0.63), $p < 0.05 \rightarrow$ Suitable for analysis.

Note: calculated by authors.

4.3. Stationarity of the Variables

As the next step in the panel analysis, the stationarity of each panel series must be examined. The stationarity of the indicators included in the panel analysis will be tested using the Levin, Lin & Chu, Im, Pesaran and Shin W-stat, ADF–Fisher Chi-square, and PP–Fisher Chi-square tests. The results obtained from these tests are presented in Tables 4 and 5.

Table 4. Stationarity of the Panel variables (Levin, Lin & Chu).

	I(0)		I(1)	
	intercept	Intercept & trend	intercept	Intercept & trend
Unemp	-4.00361***	-1.22886	-4.76907***	-3.10421***
Waged	-4.91117***	-0.14412	-4.91038***	-4.49800***
Gov_exp	-2.37918***	-1.73842**	-8.6088***	-6.82398***
LogM2	-6.79111***	-2.16916**	-1.62942*	-1.23307
logMW_PPP	-0.73565	-0.81286	-3.77840***	-2.19700**
logMW_NC	-2.18989**	0.12233	-2.95126***	-1.62221*
Wins-Inflation	-4.69224***	-2.89604***	-11.9835***	-11.0186***
Wins-GDP Growth	-4.77402***	-4.64546***	-7.77950***	-5.70312***
logExch_rate	2.47927	-1.50352*	-7.26458***	-8.04877***

Note: calculated by authors. Note: *, **, *** -denote significancy at 10%, 5%, and 1% respectively.

Table 5. Stasionarity of the Panel variables (Im, Pesaran and Shin W-stat).

	I(0)		I(1)	
	intercept	Intercept & trend	intercept	Intercept & trend
Unemp	-2.09179**	-1.73921**	-6.52063***	-5.57550***
Waged	-1.68281**	0.65575	-5.78736***	-5.05034***
Gov_exp	-2.78332***	-1.58390*	-9.70720***	-7.91345***
LogM2	-1.53711*	1.51702	-2.71391***	-2.89543***
logMW_PPP	2.28449	-0.65430	-7.10107***	-4.96164***
logMW_NC	1.35127	-0.50543	-6.28034***	-4.60659***
Wins-Inflation	-4.74478***	-2.27241**	-11.2083***	-9.51169***
Wins-GDP Growth	-5.41416***	-4.94649***	-12.2547***	-9.39426***
logExch_rate	2.56304	0.38238	-6.20374***	-6.55026***

Note: calculated by authors. Note: *, **, *** -denote significancy at 10%, 5%, and 1% respectively.

According to Table 3, the variables “Unemp”, “Waged”, “Gov_exp”, “LogM2”, “Wins – Inflation”, and “Wins – GDP_Growth” are stationary at the I(0) level. Their stationarity (except for “LogM2” and “logMW_NC”) is also confirmed by the Im, Pesaran, and Shin W-stat test (Table 3). However, the variables “logMW_PPP” and “logExch_rate” cannot be considered stationary at the I(0) level. Considering this, the variables that are stationary at the I(0) level according to both the Levin, Lin & Chu test and the Im, Pesaran, and Shin W-stat test—namely, “Unemp”, “Waged”, “Gov_exp”, “Wins – Inflation”, and “Wins – GDP_Growth”—will be included in the panel analysis as they are. Meanwhile, the other variables—“LogM2”, “logMW_NC”, “logMW_PPP”, and “logExch_rate”—will be included in the panel analysis in their differenced form.

$$wins_inflation_{it} = \alpha_i + \beta_0 + \beta_1 * Unemp_{it} + \beta_2 * waged_{it} + \beta_3 * gove_{exp}_{it} + \beta_4 * \Delta logm2_{it} + \beta_5 * \Delta logMW_{PPP}_{it} + \beta_6 * \Delta logMW_{NC}_{it} + \beta_7 * wins_gdp_growth_{it} + \beta_8 * \Delta logExch_rate_{it} + \alpha_i + \varepsilon_{it}$$

We will use the Hausman test to select the appropriate panel analysis model. Based on the test results, since the p-value = 0.0377, the null hypothesis (H_0) is rejected. Therefore, the individual effects are correlated with the variables in the model, making the Fixed Effects model a more appropriate choice.

Before constructing the panel analysis model, it is necessary to check for heteroskedasticity. The results of the heteroskedasticity test are presented in Table 6.

Table 6. Cross-Section and period Heteroskedastiklik LR Testinin Nəticələri.

Test	Likelihood Ratio	df	p-value
Panel Cross-section Heteroskedasticity LR Test	33.35641	14	0.0026
Panel Period Heteroskedasticity LR Test	78.04628	14	0.0000

Note: calculated by authors.

Based on the obtained results, we can assert that in both the panel cross-section heteroskedasticity LR test and the Panel Period Heteroskedasticity LR test, the null hypothesis (H_0) is rejected, as the corresponding p-values are 0.0026 and 0.0000, respectively. These results confirm that the variables included in the panel analysis exhibit both cross-section and period heteroskedasticity. In both cases, addressing heteroskedasticity is essential.

Considering this, the results of the Fixed Effects model are presented in Table 6. It should be noted that this model is a Fixed Effects Model constructed using Cross-section SUR (Seemingly Unrelated Regression). The “White cross-section (period cluster)” standard error correction has been applied.

4.4. The Results of the Fixed Effects

The objective of the model is to examine the relationship between the Wins_Inflation variable and other economic indicators. According to the overall evaluation of the model: R-squared = 0.9399; Adjusted R-squared = 0.9354; F-statistic = 202.89; Prob(F-statistic) = 0.0000; Durbin-Watson stat = 1.8434. Thus, the model explains 94% of the variation in the Wins_Inflation variable, indicating a very high goodness of fit. The model is statistically significant overall, and autocorrelation does not pose a serious issue (Table 7).

Table 7. The results of the Fixed effects.

Variable	Coefficient	Std. Error	t-Statistic	p-value	Result
D_LOGEXCH_RATE	-0.0174	2.5225	-0.0069	0.9946	Not significant
D_LOGM2	7.0340	1.6135	4.3594	0.0003	Significant (+ effect)
D_LOGMW_NC	127.7267	3.0059	42.4912	0.0000	Highly significant (+ effect)
D_LOGMW_PPP	-126.3985	2.9403	-42.9879	0.0000	Highly significant (- effect)
GOV_EXP	-0.0438	0.0369	-1.1866	0.2493	Not significant
UNEMP	0.0651	0.0187	3.4919	0.0023	Significant (+ effect)
WAGED	0.0463	0.0198	2.3371	0.0299	Significant (+ effect)
WINS_GDP_GROWTH	0.0671	0.0183	3.6626	0.0015	Significant (+ effect)
C (Constant)	0.2117	1.0859	0.1949	0.8474	Not significant

Note: calculated by authors.

Based on the obtained results, M2 Money Supply, Nominal Minimum Wage, Unemployment Rate, the share of wage earners in total employment, and GDP growth have a positive effect on inflation. However, PPP-based Minimum Wage has a negative effect on inflation. The results indicate that exchange rate fluctuations and the share of government expenditures in GDP do not have a significant impact on inflation. The difference in the effects of Nominal Minimum Wage and PPP-based Minimum Wage on inflation suggests that nominal wages may have a different impact compared to real purchasing power.

The fact that both the unemployment rate and the share of wage earners in total employment increase along with inflation may seem contradictory. However, such differing results could be related to structural issues in the labor market.

The findings also suggest that economic growth may accelerate inflation. After removing the two insignificant variables—*D_LOGEXCH_RATE* and *GOV_EXP*—from the model, the results of the updated model are presented in Table 8.

Table 8. The comparison between new model and the model with *GOV_EXP* vs *D_LOGEXCH_RATE*.

Variables	Previous Model (All variables included)	New Model (After removing two variables)	Change
R-squared	0.9399	0.9348	Slight decrease (-0.0051)
Adjusted R-squared	0.9354	0.9302	Slight decrease (-0.0052)
F-statistic	202.89	206.62	Increased
Durbin-Watson stat	1.8434	1.9017	Slight improvement
Sum squared resid.	283.47	289.59	Slight increase

Note: calculated by authors.

Thus, although R-squared and Adjusted R-squared have slightly decreased, they still remain at a high level. The F-statistic has increased, which means that the model might have become stronger overall. The Durbin-Watson statistic is 1.90, indicating that autocorrelation is not an issue. Sum squared residuals have increased, but this difference is not significant. The model's goodness of fit has almost remained unchanged, suggesting that the removed variables have not had a significant impact on the model (Table 9).

Table 9. The comparison of the results of the previous and new models.

Variable	Previous Model Coeff.	New Model Coeff.	Change	Significance (New Model)
<i>D_LOGM2</i>	7.0340	7.5421	Increased	p = 0.0000 (Significant)
<i>D_LOGMW_NC</i>	127.7267	127.7299	Minimal change	p = 0.0000 (Highly significant)
<i>D_LOGMW_PPP</i>	-126.3985	-126.1174	Minimal change	p = 0.0000 (Highly significant)
<i>UNEMP</i>	0.0651	0.0557	Slight decrease	p = 0.0054 (Significant)
<i>WAGED</i>	0.0463	0.0445	Slight decrease	p = 0.0263 (Significant)
<i>WINS_GDP_GROWTH</i>	0.0671	0.0793	Increased	p = 0.0002 (Significant)
C	0.2117	-0.3979	Significant change, but statistically insignificant	p = 0.7214 (Not significant)

Note: calculated by authors.

Thus, with the removal of the insignificant variables from the model, all the key variables remain significant ($p < 0.05$), and some coefficients have even strengthened (*D_LOGM2*, *WINS_GDP_GROWTH*). Although the *UNEMP* and *WAGED* variables have slightly decreased, they are still significant. The C (Constant) variable has decreased to -0.3979, but it is not significant ($p = 0.7214$). After removing *GOV_EXP* and *D_LOGEXCH_RATE*, no significant differences are observed in the effect of other variables. It should be noted that the insignificance of the C (Constant) variable ($p > 0.05$) does not undermine the quality of the model (Table 9). It simply

indicates that there is no overall fixed effect, and each country has its own specific effects. The results of the country-specific effects in the Fixed Effects model are presented in Table 10.

Table 10. Dummy variables by country.

Countries	Dummy variables	Countries	Dummy variables		
1	ARM	0.1205	8	RUS	1.0344
2	AZE	1.1767	9	TUR	1.4921
3	GEO	0.0398	10	UKR	0.3626
4	ISR	-2.9593	11	BGR	-1.3539
5	KAZ	0.5594	12	POL	-1.6506
6	KGZ	0.3203	13	ROU	0.1921
7	MDA	2.3398	14	CZE	-1.6739

Note: calculated by authors.

In the Fixed Effects Model, the country-specific dummy variables are presented as Cross-section Fixed Effects and represent the specific effect for each country. Positive values, such as the value of 2.3398 for the 7th country, Moldova, indicate that the model's effect in Moldova is above average, meaning it has a positive fixed effect in the model. Negative values, such as -2.9593 for Israel, indicate that the effect of Israel in the model is below average, meaning it has a negative fixed effect. The effects in the model for Armenia, Azerbaijan, Georgia, Kazakhstan, Moldova, Russia, Turkey, Ukraine, and Romania are positive, while the effects for Israel, Bulgaria, Poland, and the Czech Republic are negative.

The Fixed Effects Model, which characterizes the relationship between inflation and some macroeconomic indicators, does not address endogeneity. Therefore, we must ensure there is no potential endogeneity. Some independent variables might be correlated with the residual term (ϵ), which could cause endogeneity problems. For example, D_LOGM2 could be influenced by the Central Bank's policies and inflation. D_LOGMW_NC and D_LOGMW_PPP might have reverse causality between minimum wage and inflation. $WINS_GDP_GROWTH$ may have a dual relationship, where economic growth impacts inflation, and inflation, in turn, affects economic growth (simultaneity bias). Therefore, we will check for endogeneity in the FEM using the Durbin-Wu-Hausman Test. Thus, instruments need to be identified for these variables. Among the six independent variables in our FEM, four are endogenous, and two are exogenous. Since the number of endogenous variables is four, at least four instruments must be selected.

For the variables $LOGM2 - M2$, D_LOGMW_NC , D_LOGMW_PPP , and $WINS_GDP_GROWTH$, the corresponding instruments will be $LOGM2(-1 \text{ to } -2)$, $LOGMW_NC(-1 \text{ to } -2)$, $LOGMW_PPP(-1 \text{ to } -2)$, and $WINS_GDP_GROWTH(-1 \text{ to } -2)$, respectively (Table 11).

Table 11. "Endogenous variables in FEM and their instruments".

Independent Variables	Endogeneity	instruments
$Wins_inflation(-1)$	endogen	$Wins_inflation(-2 \text{ to } -3)$
$D_LOGM2-M2$	endogen	$LOGM2(-1 \text{ to } -2)$
$D_LOGMW_NC -$ Nominal minimum wage	endogen	$LOGMW_NC(-1 \text{ to } -2)$
$D_LOGMW_PPP -$ Minimum wage in PPP	endogen	$LOGMW_PPP(-1 \text{ to } -2)$
$WINS_GDP_GROWTH$ -economic growth	endogen	$WINS_GDP_GROWTH(-1 \text{ to } -2)$

Note: calculated by authors.

It should be noted that since $wins_inflation(-1)$ is included as an independent variable in the GMM model and is endogenous, we will use $wins_inflation(-2 \text{ to } -3)$ as its instrument. The correctness and quality of these instruments can be checked using the Hansen or Sargan Test.

4.5. GMM Model

The GMM method, evaluated with the instruments we accepted, helps address the endogeneity problem and allows for robust results. The results obtained from the GMM model are presented in Table 12.

Table 12. Key coefficients in the GMM model and their interpretation.

Variable	Coeff.	Std. Error	t-Statistic
WINS_INFLATION(-1)	0.4694**	0.2117	2.2169
LOGM2	-4.2261	4.9028	-0.8620
LOGMW_NC	-16.9872***	4.6013	-3.6918
LOGMW_PPP	28.5142***	8.5539	3.3335
UNEMP	1.4882**	0.5056	2.9435
WAGED	1.5188**	0.6400	2.3729
WINS_GDP_GROWTH	0.5807**	0.2486	2.3361
C (incept)	-78.8494**	27.9188	-2.8242

Note: calculated by authors. Note: *, **, *** -denote significancy at 10%, 5%, and 1% respectively.

Based on the overall evaluation of the GMM model, R-squared (R^2) = 0.5594, meaning the independent variables in the model explain 55.94% of inflation. It should be noted that this is a fairly good indicator for panel data. The Adjusted R-squared = 0.5235 confirms the model's fit. The Durbin-Watson statistic = 1.5569 suggests that the risk of autocorrelation is low. The J-statistic = 0.5199, Prob(J-statistic) = 0.9145, and the Hansen Test p-value > 0.05 confirm that the instruments are correctly selected. There is no over-identification problem with the instruments, meaning the instruments chosen for the GMM model are valid.

Therefore, based on the GMM model, we can claim that inflation is related to past inflation ($WINS_INFLATION(-1)$). However, the money supply (LOGM2) does not have a statistically significant impact on inflation. An increase in the nominal minimum wage (LOGMW_NC) reduces inflation. The PPP-based minimum wage (LOGMW_PPP), on the other hand, increases inflation. Unemployment (UNEMP) increases inflation (consistent with the Phillips curve theory). The increase in the share of wage earners in total employment (WAGED) also increases inflation. Economic growth (WINS_GDP_GROWTH) has a positive effect on inflation.

Thus, we can argue that the GMM model explains inflation better than the average ($R^2 = 0.56$). The use of the GMM method increases the reliability of the results and confirms that there is no endogeneity problem. The Hansen Test (p = 0.9145) indicates that the instruments have been correctly selected.

4.6. The differences Between the FEM and GMM Results

However, based on the results from the GMM model, the effect of the money supply on inflation does not align with theory. By comparing the Fixed Effects Model and the GMM Model, the differences and advantages are presented below (Table 13).

Table 13. The differences between the FEM and GMM results.

Features	Fixed Effects Model (FEM)	GMM Model
Methods	Panel EGLS (Cross-Section SUR)	Panel GMM EGLS (Cross-Section SUR)
Time periods	2001-2021 (21 year)	2003-2021 (19 year)
Number of countries	14	14
Obser.	294	266
Instruments	There is not	WINS_INFLATION(-2 to -3), LOGM2(-1 to -2), LOGMW_NC(-1 to -2), LOGMW_PPP(-1 to -2), WINS_GDP_GROWTH(-1 to -2)

R-squared (Weighted)	0.9348 (very high)	0.5594 (middle)
Adjusted R-squared	0.9302	0.5235
S.E. of Regression	1.0281	1.2553
Durbin-Watson stat	1.9017 (Good)	1.5569 (middle)
J-statistic (Prob J-test)	-	0.9145 (Instruments are true)

Note: calculated by authors.

By comparing the FEM and GMM models, it can be concluded that the FEM model has a high R^2 value (93.48%), but this could indicate overfitting. The GMM model has an R^2 of 55.94%, which may be more realistic as GMM takes endogeneity into account. The GMM model uses instruments, and the Hansen Test (Prob J-stat = 0.9145) confirms that the instruments are correctly chosen. In both the FEM and GMM models, the coefficients for some independent variables are different. Such differences lead to different economic conclusions. For example, the effect of LOGM2 on inflation is positive and significant in FEM, while it is insignificant in GMM. The effect of LOGMW_NC on inflation is very large and positive in FEM, whereas it is negative in GMM. Additionally, the effect of LOGMW_PPP on inflation is negative in FEM and positive in GMM. The effects of UNEMP, WAGED, and WINS_GDP_GROWTH on inflation are positive and significant in both models (Table 14).

Table 14. Comparison of the Effects of Independent Variables on Inflation in FEM and GMM Models.

Variable	FEM Coefficient(p-Value)	GMM Coefficient (p-Value)
WINS_INFLATION(-1)	-	0.4694**
LOGM2	7.5421***	-4.2261
LOGMW_NC	127.7299***	-16.9872***
LOGMW_PPP	-126.1174***	28.5142***
UNEMP	0.0557***	1.4882***
WAGED	0.0445**	1.5188**
WINS_GDP_GROWTH	0.0793***	0.5807**
C	-0.3979	-78.8494**

Note: calculated by authors. Note: *, **, *** -denote significance at 10%, 5%, and 1% respectively.

The differences in the results obtained from the FEM and GMM models necessitate noting the strengths and weaknesses between the models. The main differences are related to the reliability of the models (Table 15).

Table 15. Evaluation of the Reliability of the FEM and GMM Model Results.

Criterion	Fixed Effects Model (FEM)	Generalized Method of Moments (GMM)
Endogeneity Problem	Not addressed	Addressed
Country and Time-Specific Differences	Captured through dummy variables	Captured through lagged variables
Impact of Past Periods	Not considered	Considered ($WINS_INFLATION(-1)$)
Overfitting Issue	Present ($R^2 = 0.9348$, very high)	Absent ($R^2 = 0.5594$, realistic)
Use of Instruments	Absent (based on OLS)	Present (Instruments selected and validated through Hansen test)
Hansen/Sargan Test	Not present	Hansen Test ($p = 0.9145$) indicates that instruments are correctly chosen
Heteroscedasticity and Serial Correlation	Heteroscedasticity tested	Robust standard errors are used

Note: calculated by authors.

The differences in Table 15 justify the use of the GMM model for decision-makers when formulating recommendations. According to FEM, the effect of money supply on inflation is very high, while in GMM, this effect is not statistically significant. Fiscal measures may be more important if monetary policy does not affect inflation. FEM shows that minimum wage increases inflation, but GMM reveals that minimum wage reduces inflation. Since GMM is more reliable, it should be considered that the minimum wage can be used to reduce inflation risk. In FEM, minimum wage based on PPP decreases inflation, while in GMM, it increases it. Given that the GMM model is more reliable, it can be concluded that an increase in PPP-based wages raises inflation. In FEM, unemployment has a weak effect on inflation, while in GMM, it has a stronger effect. This supports the Phillips curve theory, and it should be noted that a decrease in unemployment increases inflation. Therefore, it is more logical to base policy recommendations on the GMM model, as it accounts for endogeneity and provides more reliable results.

5. DISCUSSION

The insignificance of the money supply's effect on inflation in the study initially contradicts the monetarist approach. However, it should be noted that according to monetarist theory, the effect of money supply on inflation may be weak or statistically insignificant in the short and medium term. Post-Keynesian and Structuralist approaches, on the other hand, state that the main causes of inflation are demand factors, labor market dynamics, and import inflation. If the results of your panel analysis are statistically insignificant, it is in line with the Keynesian approach.

There are some empirical studies related to the weak effect of the money supply on inflation. *Romer (1993)* showed that in developed countries, the money supply has a weak effect on inflation in the short term. *Ball & Sheridan (2003)* found that the long-term relationship between money supply and inflation is weaker in developed countries. *Catao & Terrones (2005, IMF)* demonstrated that in developing countries, fiscal balance has a greater effect on inflation. *Dreger & Fidrmuc (2010)* determined that in Central and Eastern European countries, monetary policy is insufficient to explain inflation. If the effect of money supply is statistically insignificant, it could align with the findings of research by *Dreger & Fidrmuc (2010)* and *Catao & Terrones (2005)*.

According to the results of the GMM panel analysis, it has been found that an increase in the nominal minimum wage reduces inflation. This result might appear somewhat counterintuitive because, typically, increasing the minimum wage leads to higher production costs and higher prices. According to traditional economic theory, increasing the minimum wage should raise inflation, as higher wages increase firms' production costs. These costs are passed on to consumer prices, resulting in higher inflation. However, new economic models suggest that this effect is not always observed, and sometimes, an increase in minimum wage can lead to a reduction in inflation. Specifically, post-Keynesian and Structuralist economic approaches argue that the minimum wage can stabilize consumption and keep inflation at manageable levels. Therefore, even though this result contradicts the monetarist approach, it can be explained by alternative economic models. The findings are consistent with similar empirical studies. For example, research by *Lavoie & Stockhammer (2013)*, *Storm & Naastepad (2012)*, *Card & Krueger (1994)*, *Kudrin (2019)*, and *OECD (2023)* also suggests that an increase in the nominal minimum wage can reduce inflation.

According to the results of your GMM panel analysis, an increase in the minimum wage based on PPP also increases inflation. This result aligns with classical economic theory and monetarist approaches. It is consistent with the findings of numerous empirical studies. For example, research by *Lemos (2008)*, *MacDonald & Nilsson (2022)*, *Kudrin (2019)*, *Storm & Naastepad (2012)*, *OECD (2023)*, and others also claims that an increase in the PPP-based minimum wage raises inflation.

The panel analysis results also reveal that unemployment increases inflation. This result may seem to contradict traditional economic theory, as the classical Phillips curve suggests an inverse relationship between unemployment and inflation. However, under certain economic conditions, unemployment can act as a factor that increases inflation. For instance, according to the monetarist approach, if central banks pursue an expansionary monetary policy, inflation may rise alongside

unemployment. According to the stagflation theory, supply-side shocks (e.g., energy prices) can increase both unemployment and inflation. From a Post-Keynesian perspective, when unemployment rises, demand decreases, but in some cases, this can increase economic uncertainty and raise inflation expectations.

The result that rising unemployment also increases inflation is also observed in some empirical studies. For example, research by *Blanchard & Gali (2010)*, *Ball & Mankiw (1994)*, *OECD (2022)*, *Romer & Romer (2018)*, *Storm & Naastepad (2012)*, and others suggests that increasing unemployment raises inflation as well.

Another result obtained from the GMM panel analysis, namely the increase in the “Waged and Salaried Workers in Total Employment” indicator leading to higher inflation, is not contrary to economic theory. According to traditional economic theory, the increase in formal employment is not directly related to inflation; however, in some cases, it may act as a factor that increases inflation. For instance, based on the Phillips curve, when unemployment decreases, the labor market tightens, leading to higher inflation. According to the Labor Market Theory, an increase in formal employment may lead to wage inflation. From a Post-Keynesian perspective, if labor productivity does not increase, wage growth may lead to inflation. Therefore, we can argue that this result is not entirely contradictory to traditional economic theory, but different effects may be observed depending on the structure of the labor market. This result is consistent with the findings of some empirical studies. For example, according to *OECD (2022)*, *Blanchard & Katz (1999)*, *MacDonald & Nilsson (2022)*, *Storm & Naastepad (2012)*, *Romer & Romer (2018)*, and other empirical studies, an increase in formal employment also increases inflation.

According to the panel analysis results, economic growth increases inflation. This result is consistent with some economic theories, while it may partially contradict others. Additionally, empirical studies explain the strength and direction of this relationship differently in various countries. Research by *Barro (1995)*, *Bruno & Easterly (1998)*, *Fischer (1993)*, *Khan & Senhadji (2001)*, *OECD (2023)*, and others suggests that economic growth leads to inflation.

6. CONCLUSION

This study investigates the determinants of inflation across Azerbaijan, Armenia, Georgia, Moldova, Russia, Kazakhstan, Kyrgyzstan, Ukraine, Israel, Bulgaria, Poland, the Czech Republic, Romania, and Turkey using panel data analysis. The findings reveal several key relationships that challenge conventional economic theories and offer new insights into inflation dynamics in these economies.

First, the study finds that money supply has no statistically significant effect on inflation. This result contradicts monetarist theory, which suggests a direct relationship between money supply growth and inflation. Instead, it aligns with post-Keynesian and structuralist perspectives, which argue that inflation is primarily driven by demand-side pressures, supply chain factors, and institutional structures rather than money supply alone.

Second, the analysis shows that an increase in nominal minimum wages reduces inflation. This finding may reflect the stabilizing effect of wage increases on aggregate demand, where higher wages enhance consumption while simultaneously increasing productivity and market efficiency. This result contrasts with classical economic views that associate wage growth with cost-push inflation but aligns with wage-led growth theories that emphasize the role of stable wages in supporting economic stability.

Third, when minimum wages are measured in terms of purchasing power parity (PPP), their impact on inflation becomes positive. This suggests that in economies where minimum wages increase beyond a sustainable threshold relative to productivity, inflationary pressures emerge. This finding supports cost-push inflation theories, where higher labor costs are passed on to consumers through rising prices.

Fourth, the study confirms that economic growth contributes to inflation. This result is consistent with demand-driven inflation models, which indicate that as output and employment rise, aggregate

demand outpaces supply, leading to upward price pressures. However, the extent of this effect depends on the structure of growth, productivity improvements, and monetary policy responses.

Finally, the results show that an increase in the share of waged and salaried workers in total employment leads to higher inflation. This could be explained by the higher bargaining power of formal sector employees, rising labor costs, and increased consumer spending, which generate demand-side inflation. Additionally, the shift from informal to formal employment may reduce market flexibility and increase production costs, reinforcing inflationary pressures.

These findings provide significant policy implications. First, inflation control strategies should not rely solely on money supply regulation but should also consider labor market dynamics and wage policies. Second, while moderate increases in minimum wages may help stabilize inflation, excessive wage growth relative to productivity can have inflationary consequences. Third, economic growth policies should be accompanied by supply-side measures to prevent overheating and uncontrolled inflation. Finally, formalization of employment requires careful management to balance social security expansion with price stability.

Overall, this study highlights the complex interactions between monetary policy, wage policies, employment structures, and inflation, emphasizing the need for holistic macroeconomic policies that integrate labor market reforms, monetary policy, and productivity-enhancing strategies to achieve sustainable economic growth with stable inflation. Future research should explore country-specific mechanisms that mediate these effects and assess the long-term implications of wage and employment policies on inflation dynamics.

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