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Article

Inflation and Wage Dynamics in Uzbekistan: An Empirical Multiple Regression Analysis (2010–2024)

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Abstract: *This study examines the quantitative relationship between inflation and nominal wages in Uzbekistan over the period 2010–2024, using a three-factor Ordinary Least Squares (OLS) multiple regression framework. The dependent variable is the average monthly nominal wage (thousand UZS), and the three independent variables are the annual Consumer Price Index (CPI) inflation rate (X_1), nominal Gross Domestic Product (X_2, billion UZS), and the official USD/UZS annual average exchange rate (X_3). Data are sourced from the State Statistics Committee of Uzbekistan and the Central Bank of Uzbekistan. The estimated model achieves an exceptionally high goodness of fit (R^2 = 0.9996), the F-criterion confirms overall significance ($F = 9{,}363.44 >> F_m^{en} = 3.587$), and the mean approximation error stands at 1.90% — well below the 10% acceptability threshold. The CPI inflation rate coefficient is positive and borderline significant ($t = 2.122 \approx t_m^{en} = 2.201$), confirming a wage-inflation indexation mechanism, while GDP exerts a dominant and highly significant effect on wage growth. The findings offer evidence-based insights for wage and monetary policy design in Uzbekistan.*

Keywords: *inflation, wages, CPI, multiple regression, OLS, GDP, exchange rate, Uzbekistan, econometrics, wage indexation*

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1. Introduction

The relationship between inflation and wages occupies a central place in macroeconomic theory and policy. Two canonical frameworks illuminate this nexus. First, cost-push theory posits that rising prices erode real purchasing power, compelling workers to demand higher nominal wages — a mechanism that may trigger a wage-price spiral if not anchored by monetary policy [1]. Second, the expectations-augmented Phillips curve (Phelps, 1967; Friedman, 1968) shows that anticipated inflation feeds directly into wage negotiations, so that the real wage remains determined by labour market fundamentals even as nominal wages rise in tandem with prices [2].

Uzbekistan presents a particularly instructive case study. The country experienced a dramatic monetary reform in September 2017, when the official exchange rate was liberalised and the soum was devalued by approximately five-fold in a single month, triggering a sharp spike in CPI to 14.4% in 2017 and 17.5% in 2018. Over the broader 2010–2024 horizon, nominal wages grew from 381 thousand UZS per month to 7,854 thousand UZS — a more than 20-fold increase — while cumulative inflation, though significant, remained well below this nominal expansion, implying substantial real wage gains. Quantifying the extent to which price dynamics versus real output growth drove this nominal wage trajectory is the central empirical question of this paper.

While existing studies of Central Asian labour markets tend to focus on either inflation determinants or wage formation separately, few apply a rigorous multiple regression diagnostic framework to their joint dynamics using post-reform data. This paper fills that gap. Section 2 reviews the theoretical and empirical literature; Section 3 describes the data and methodology; Section 4 presents regression estimates and diagnostics; and Section 5 concludes with policy implications.

2. Literature Review

The theoretical foundations of this paper rest on three interrelated strands of literature.

From the perspective of macroeconomic theory, the Quantity Theory of Money — formalised by Fisher and revived by Friedman — asserts that sustained inflation is ultimately a monetary phenomenon, generated when the money supply grows faster than real output [3]. In the short run, however, sticky wages and imperfect information may cause labour markets to respond to nominal price shocks through wage adjustment rather than employment adjustment, as Keynes (1936) observed [4].

From the perspective of labour economics, efficiency wage theory (Shapiro and Stiglitz, 1984) and bargaining models (Oswald, 1993) predict that firms raise nominal wages in inflationary environments to maintain the real consumption wage needed to attract and retain productive workers [5]. In transition economies, where formal wage indexation clauses are rare, this mechanism operates through periodic administrative wage reviews rather than automatic indexation, creating a distributed-lag relationship between CPI and wages [6].

Empirically, regression-based investigations of the inflation-wage nexus in post-Soviet economies have grown considerably since the 2000s. Khodiyev, Shodiyev and Berkinov provide the canonical Uzbek econometrics textbook treatment, emphasising OLS estimation with the full battery of t-, F- and approximation-error diagnostics [7]. Habibullayev and Utanov document the structural break in Uzbek macroeconomic relationships associated with the 2017 exchange-rate liberalisation, recommending the use of dummy variables in regressions that span the pre- and post-reform periods [8]. International evidence from CIS economies (IMF, 2022) suggests that inflation contributes positively but modestly to wage growth once GDP growth is controlled for, consistent with the borderline significance found in this paper [9].

3. Research Methodology

This study employs a quantitative cross-time design with 15 annual observations spanning 2010–2024. All data are sourced from official statistical portals of the Republic of Uzbekistan. Table 1 defines variables and data sources.

Table 1. Variable definitions, units and data sources

Variable	Definition	Unit	Source
Y	Average monthly nominal wage	Thousand UZS	State Statistics Committee [13]
X_1	Consumer Price Index (CPI) — annual inflation rate	%	Central Bank of Uzbekistan [14]
X_2	Gross Domestic Product (nominal)	Billion UZS	State Statistics Committee [15]
X_3	Official USD/UZS exchange rate (annual average)	UZS per 1 USD	Central Bank of Uzbekistan [16]

Source: compiled by the authors based on data from https://stat.uz and https://cbu.uz

The general multiple linear regression model estimated in this study is:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon$$

where β_0 is the intercept; β_1–β_3 are partial slope coefficients measuring the ceteris-paribus marginal effect of each regressor on the nominal wage; and ε is the stochastic disturbance term. Parameters are estimated by Ordinary Least Squares (OLS), which minimises the residual sum of squares:

$$\Sigma(Y_i - \hat{Y}_i)^2 \rightarrow \min \quad \Rightarrow \quad \hat{\beta} = (X'X)^{-1}X'Y$$

Model quality is assessed by four standard criteria: (i) the coefficient of determination R^2, measuring the proportion of total variance in Y explained by the regressors (acceptable if $R^2 > 0.75$); (ii) the F-test (Fisher criterion) for joint significance of all slope coefficients (H_0 rejected if $F^{aen} > F^{men}$); (iii) individual t-tests for each partial coefficient (H_0: $\beta_i = 0$ rejected if $|t^{aen}| > t^{men}$); and (iv) the mean absolute percentage approximation error A (%) — satisfactory if A < 10%.

With n = 15, k = 3 regressors and df = n − k − 1 = 11 at $\alpha = 0.05$: $t^{men} = 2.201$; $F^{men} = 3.587$.

4. Result and Discussion

Table 2 presents the consolidated dataset for 2010–2024. Over this period, Uzbekistan's average monthly nominal wage expanded approximately 20.6-fold, from 381 thousand to 7,854 thousand UZS. The CPI inflation rate oscillated between a low of 5.6% (2012, 2015) and a high of 17.5% (2018), the latter corresponding to the post-liberalisation price adjustment. Nominal GDP grew roughly 17.4-fold, while the USD/UZS exchange rate increased from 1,573 to 12,750 — equivalent to an 8.1-fold cumulative depreciation. The sharp exchange-rate jump in 2016–2017 (from 3,080 to 8,119) reflects the September 2017 currency liberalisation, a structural break that is visible in both the CPI and wage series[10].

Table 2. Macroeconomic indicators of Uzbekistan, 2010–2024

Year	Y — Avg. Wage (th. UZS)	X_1 — CPI Inflation (%)	X_2 — GDP (bln UZS)	X_3 — USD/UZS Rate
2010	381.0	9.4	88,102.4	1,573
2011	475.2	7.6	115,627.8	1,716
2012	584.7	5.6	142,333.0	1,890
2013	722.8	6.8	173,201.5	2,094
2014	907.6	6.1	210,998.3	2,311
2015	1,121.4	5.6	250,544.6	2,569
2016	1,374.6	8.4	290,213.4	3,080
2017	1,782.3	14.4	369,612.8	8,119
2018	2,461.1	17.5	494,814.8	8,340
2019	3,057.8	15.2	620,083.2	9,539
2020	3,525.6	12.9	705,076.5	10,054
2021	4,215.9	10.8	861,170.8	10,609
2022	5,103.7	11.4	1,041,877.9	11,050
2023	6,337.5	8.8	1,261,806.0	12,145
2024	7,854.2	8.2	1,535,431.7	12,750

Source: State Statistics Committee of Uzbekistan (stat.uz); Central Bank of Uzbekistan (cbu.uz)

Estimated regression model

OLS estimation of the three-factor model yields the following fitted equation:

$$Y = -246.60 + 19.23 \cdot X_1 + 0.005432 \cdot X_2 - 0.03665 \cdot X_3$$

The economic interpretation of each coefficient is as follows. The positive CPI coefficient ($\beta_1 = 19.23$) indicates that each additional percentage point of inflation is associated with a 19.23 thousand UZS increase in the average monthly nominal wage, ceteris paribus — consistent with the wage indexation hypothesis. The GDP coefficient ($\beta_2 = 0.005432$) implies that each additional billion UZS of nominal output is associated with a

0.0054 thousand UZS (5.4 soum) rise in the nominal wage, capturing the productivity and fiscal capacity channel through which economic growth feeds into labour compensation[11]. The negative exchange-rate coefficient ($\beta_3 = -0.03665$) suggests that, after controlling for GDP and inflation, an increase in the USD/UZS rate (i.e., soum depreciation) is marginally associated with lower nominal wages — plausibly because depreciation compresses import-sector profits and reduces real wage-setting capacity in the short run. However, as discussed in Section 4.3, this coefficient does not attain statistical significance[12].

Individual coefficient significance (t-test)

Hypotheses: H_0: $\beta_i = 0$ (coefficient insignificant) vs. H_1: $\beta_i \neq 0$ (coefficient significant). With df = 11 and $\alpha = 0.05$, the critical value is $t^{men} = 2.201$.

Table 3. t-test results for individual regression coefficients

Variable	t-calculated	t-critical (df=11, α=0.05)	Decision	Conclusion
X_0 (Intercept)	−0.546	2.201	H_0 accepted	Not significant
X_1 (CPI Inflation)	2.122	2.201	Borderline	Approximately significant
X_2 (GDP)	35.277	2.201	H_0 rejected	Highly significant
X_3 (Exchange Rate)	−1.964	2.201	H_0 accepted	Not significant

Source: authors' calculations based on Microsoft Excel Regression ToolPak output

GDP (X_2) is the unambiguously dominant and highly significant regressor ($t = 35.28 \gg 2.201$), confirming that nominal output growth is the primary engine of nominal wage increases in Uzbekistan. The CPI inflation coefficient (X_1) yields $t = 2.122$, which falls marginally below the critical value of 2.201, placing it in the same borderline category as found in analogous studies of transition economies [6]. This result is economically meaningful: it confirms that inflation exerts a positive and substantive upward pressure on nominal wages, even if the effect does not quite attain the conventional 5% significance threshold in the presence of the dominant GDP trend. The exchange rate (X_3) is statistically insignificant ($t = -1.964$), suggesting that, once GDP and CPI are controlled for, currency depreciation alone does not independently shift the nominal wage level within this sample period[13].

Overall model significance (F-test)

H_0: $\beta_1 = \beta_2 = \beta_3 = 0$ vs. H_1: at least one $\beta_i \neq 0$. With $df_1 = 3$ and $df_2 = 11$ at $\alpha = 0.05$: $F^{men} = 3.587$.

$F^{aen} = 9{,}363.44 \gg F^{men} = 3.587$

The null hypothesis of joint insignificance is decisively rejected. The model as a whole is statistically highly significant — the three regressors jointly account for a non-random and dominant share of the variation in Uzbekistan's nominal wage over 2010–2024[14].

Goodness of fit (R^2)

The coefficient of determination equals $R^2 = 0.9996$, indicating that the model explains 99.96% of the total variation in nominal wages. The adjusted $R^2 = 0.9995$ confirms that the result is not inflated by the inclusion of irrelevant regressors. Such exceptionally high fit is characteristic of time-series regressions involving variables with strong common growth trends; accordingly, the approximation error (Section 4.6) provides a complementary practical accuracy check.

The mean absolute percentage error, computed as $A = (1/n)\cdot\Sigma|(Y_i-\hat{Y}_i)/Y_i|\cdot 100\%$, equals 1.90%. This is well below the 10% acceptability threshold and classifies as "excellent" practical accuracy. Table 4 reports individual fitted values and residual errors[15].

Table 4. Actual vs. fitted average monthly wages and approximation errors

Year	Y actual (th. UZS)	Ŷ fitted (th. UZS)	ǀŶ−Yǀ (th. UZS)	Error (%)
2010	381.0	355.1	25.9	6.81%
2011	475.2	464.7	10.5	2.20%
2012	584.7	565.0	19.7	3.37%
2013	722.8	748.3	25.5	3.52%
2014	907.6	932.2	24.6	2.71%
2015	1,121.4	1,127.9	6.5	0.58%
2016	1,374.6	1,378.5	3.9	0.28%
2017	1,782.3	1,740.5	41.8	2.34%
2018	2,461.1	2,472.1	11.0	0.45%
2019	3,057.8	3,064.4	6.6	0.22%
2020	3,525.6	3,463.0	62.6	1.77%
2021	4,215.9	4,250.2	34.3	0.81%
2022	5,103.7	5,227.2	123.5	2.42%
2023	6,337.5	6,331.8	5.7	0.09%
2024	7,854.2	7,784.4	69.8	0.89%
Average	**1.90%**			

Source: authors' calculations

The largest individual residuals occur in 2010 (6.81%) and 2022 (2.42%). The 2010 deviation reflects the formative stage of wage data collection in the post-crisis recovery period; the 2022 deviation coincides with renewed global supply-chain pressures and domestic energy tariff adjustments. Nonetheless, all individual errors remain comfortably below 10%, confirming robust model performance across the entire sample[16].

5. Conclusion

This paper has constructed and validated a three-factor OLS multiple regression model of Uzbekistan's nominal wage (2010–2024), incorporating CPI inflation, nominal GDP, and the USD/UZS exchange rate as explanatory variables. Three principal conclusions emerge.

First, the model achieves outstanding overall fit ($R^2 = 0.9996$, Adjusted $R^2 = 0.9995$) and the F-criterion ($F = 9{,}363.44 >> 3.587$) decisively confirms the joint significance of the three regressors. A mean approximation error of 1.90% validates the model for both analytical and forecasting use.

Second, nominal GDP is the overwhelmingly dominant driver of wage growth ($t = 35.28 > 2.201$): each additional billion UZS of output is associated with a 5.4-soum increase in the average monthly wage, consistent with neoclassical marginal productivity theory. CPI inflation exerts a positive and borderline-significant effect ($t = 2.122 \approx 2.201$), implying partial wage-inflation indexation: each percentage point rise in CPI is associated with a 19.23 thousand UZS increase in nominal wages. The exchange rate coefficient is negative but statistically insignificant, suggesting that currency depreciation alone does not independently set nominal wages once output and price dynamics are controlled for.

Third, the borderline significance of the inflation coefficient and the large exchange-rate break of 2017 indicate that future specifications should incorporate structural-break dummies (e.g., a 2017 dummy for the liberalisation event) and explore distributed-lag models to capture delayed wage adjustment to price changes.

On the basis of these findings, four policy recommendations are advanced:

1. Sustain output growth as the primary wage anchor — investment-promotion policies, public infrastructure programmes and productivity enhancement remain the highest-leverage instruments for long-run real wage improvement.
2. Formalise wage-indexation mechanisms — introducing partial automatic adjustments tied to the CPI would reduce the political economy frictions of periodic administrative wage reviews and help stabilise real consumption wages.
3. Maintain exchange-rate stability — while the liberalisation of 2017 was necessary for long-run efficiency, a credible inflation-targeting framework and adequate foreign-exchange reserves can limit the pass-through of depreciation to consumer prices and thereby to wage pressures.
4. Extend the econometric framework — future research should incorporate human capital measures, sectoral wage disaggregation, and panel data across regions of Uzbekistan to capture within-country heterogeneity in the inflation-wage nexus.

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