

AGRICULTURAL GROWTH AND DISPOSABLE INCOME GROWTH IN UZBEKISTAN: EVIDENCE FROM REGIONAL PANEL DATA

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Abstract: This study examines the impact of agricultural growth on disposable income growth across 13 regions of Uzbekistan over the period 2011–2024 using balanced panel data comprising 182 observations. The empirical analysis applies panel data estimation techniques, including fixed-effects, random-effects, and Driscoll–Kraay estimators, to account for heteroskedasticity, serial correlation, cross-sectional dependence, and common time effects. The results reveal a positive and statistically significant relationship between agricultural growth and disposable income growth. The preferred specification indicates that a one percentage-point increase in agricultural output growth is associated with an approximately 0.31 percentage-point increase in regional disposable income growth. In addition, the inclusion of year fixed effects substantially improved the explanatory power of the model, highlighting the important role of nationwide macroeconomic conditions in shaping regional income dynamics during the study period. Overall, the findings suggest that agricultural development remains an important contributor to regional income growth and rural welfare in Uzbekistan.

Keywords: agricultural growth, disposable income growth, panel data analysis, Driscoll–Kraay estimator, regional development, Uzbekistan

1. Introduction

Agriculture plays an important role in the economic development of many developing and transition economies by contributing to employment, household income, food security, and rural welfare. In economies where a substantial share of the population depends on agriculture, changes in agricultural output may significantly affect economic conditions and living standards, particularly in rural areas.

In Uzbekistan, agriculture remains one of the key sectors of the economy despite ongoing economic diversification and structural reforms. The sector continues to account for a considerable share of regional employment and economic activity, especially outside major urban centers. Since the beginning of economic liberalization reforms after 2017, Uzbekistan has experienced important macroeconomic and structural changes that affected both agricultural production and household income across regions. At the same time, differences in regional income growth remain an important policy concern.

Previous empirical studies generally suggest that agricultural growth positively affects household income and rural welfare in developing economies. However, empirical evidence focusing specifically on the regional relationship between agricultural growth and disposable income growth in Uzbekistan remains limited. Existing studies mainly examine agricultural reforms, productivity, or rural development at the national level, while relatively few studies apply panel econometric techniques to examine regional income growth. Therefore, this study investigates the relationship between agricultural growth and disposable income growth across the regions of Uzbekistan during 2011–2024 using panel data analysis. The study applies fixed-effects,

random-effects, and Driscoll–Kraay estimation techniques to account for regional heterogeneity, cross-sectional dependence, and common time effects.

The study contributes to the literature by providing regional-level empirical evidence on the agriculture–income relationship in Uzbekistan using robust panel estimation methods. In addition, the study highlights the importance of nationwide economic conditions in shaping income growth across regions during the study period.

2. Literature Review

The relationship between agricultural growth and income dynamics has long been discussed in development economics. Lewis (1954) and Johnston and Mellor (1961) argued that agricultural development supports economic growth by increasing employment, rural income, and productivity in developing economies. Empirical studies generally identify a positive relationship between agricultural growth and household income. Datt and Ravallion (1998) found that agricultural productivity growth improved rural household incomes in India, while Christiaensen, Demery, and Kuhl (2011) showed that agricultural growth contributes significantly to income growth and poverty reduction in developing economies. Haggblade, Hazell, and Reardon (2007) also emphasized that agricultural expansion stimulates non-farm economic activities through sectoral linkages. In transition and post-Soviet economies, agricultural reforms have also been associated with improvements in rural welfare. Lerman (2008) and Spoor and Visser (2004) showed that agricultural restructuring and farm reforms in Central Asia contributed positively to household income and agricultural productivity.

Several studies additionally highlight the importance of accounting for econometric issues such as heteroskedasticity, serial correlation, and cross-sectional dependence in panel data analysis. Driscoll and Kraay (1998) proposed a robust estimation approach that remains consistent under such conditions. Despite the growing literature on agriculture-led development, empirical evidence on the relationship between agricultural growth and disposable income growth across the regions of Uzbekistan remains limited. Therefore, this study contributes to the literature by examining this relationship using regional panel data while accounting for regional heterogeneity, common time effects, and cross-sectional dependence.

3. Methodology

This study investigates the impact of agricultural growth on disposable income growth across the regions of Uzbekistan using panel data analysis. The dataset consists of annual observations for 13 regions covering the period 2011–2024, forming a strongly balanced panel with 182 observations. The data were obtained from the National Statistics Committee of the Republic of Uzbekistan. Tashkent City was excluded from the analysis because the agricultural growth indicator was equal to zero throughout the entire study period, making it structurally different from agriculturally active regions. The study uses two main variables, and their descriptions and measurement units are presented in Table 1.

Variable	Description	Unit
Y	Real growth rates of disposable total income of the population (by region)	Percent (%)
X	Growth rates of the total volume of agricultural, forestry and fisheries products (services)	Percent (%)

Table 1. Description of Variables

The empirical model is specified as follows: $Y_{it} = \alpha + \beta X_{it} + \mu_i + \lambda_t + \varepsilon_{it}$ where Y_{it} denotes the disposable income growth rate in region i during year t ; X_{it} represents agricultural growth; μ_i captures unobserved regional-specific effects; λ_t represents time-specific effects, and ε_{it} is the error term.

The empirical analysis began with descriptive statistics, correlation analysis, and graphical analysis to examine regional trends and the relationship between the variables. The stationarity properties of the variables were tested using the Levin–Lin–Chu (LLC) panel unit root test, and the results confirmed that both variables are stationary at levels. To estimate the relationship between agricultural growth and income growth, both fixed-effects (FE) and random-effects (RE) models were estimated. The Hausman specification test was applied to determine the appropriate estimator under standard panel assumptions. Although the Hausman test supported the random-effects estimator, Pesaran's cross-sectional dependence test revealed significant cross-sectional dependence among regions, indicating the presence of common macroeconomic shocks and interregional linkages during the study period.

Therefore, the final specification was estimated using the fixed-effects estimator with Driscoll–Kraay robust standard errors and year dummy variables. This approach provides consistent standard errors in the presence of heteroskedasticity, serial correlation, and cross-sectional dependence, while year fixed effects control for common time-specific shocks affecting all regions simultaneously. As an additional robustness check, dynamic panel estimations using the Arellano–Bond and System GMM approaches were also performed to assess the potential endogeneity between agricultural growth and income growth.

4. Results

4.1 Descriptive and Preliminary Analysis

The average growth rate of disposable income of the population (Y) was 10.69%, while the average growth rate of agricultural, forestry, and fisheries production (X) was 4.4% during the study period, as reported in Table 2. The standard deviation of disposable income growth was more than twice as large as that of agricultural growth, indicating that income growth was considerably more volatile across regions and over time. In addition, both variables recorded negative minimum values, reflecting periods of economic contraction in certain regions.

Variable	Obs	Mean	Std. Dev.	Min	Max
Y	182	10.69	7.59	-3.4	42.0
X	182	4.40	3.05	-7.1	18.9

Table 2. Descriptive Statistics

As shown in Table 3, the correlation coefficient between agricultural growth and disposable income growth was positive and statistically significant ($r=0.2076$, $p<0.01$). However, the relatively weak magnitude of the correlation suggests that agricultural growth explains only a limited share of regional income dynamics, while broader macroeconomic factors may also influence income growth.

Variables	Y	X
Y	1.0000	
X	0.2076	1.0000

Table 3. Correlation Matrix

Figure 1 illustrates the relationship between agricultural growth and disposable income growth. The fitted regression line demonstrates a positive association between the variables, although the wide dispersion of observations indicates that the relationship is moderate rather than strong.

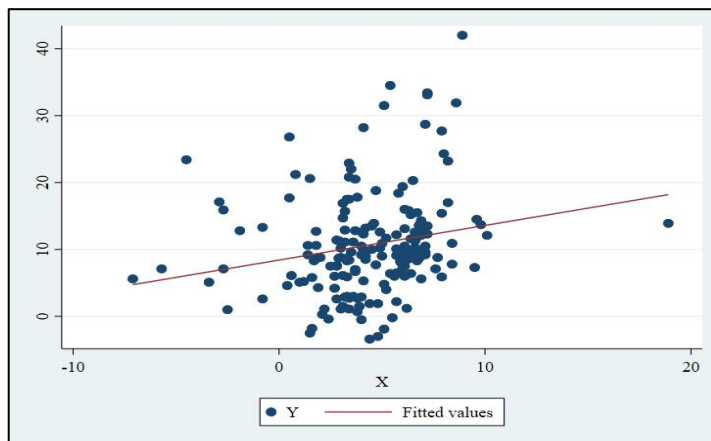


Figure 1. Relationship Between Agricultural Growth and Disposable Income Growth.

As shown in Figure 2, the regional trends of disposable income growth and agricultural growth exhibited synchronized movements and common turning points during the study period. This pattern suggests that regional economies were affected by common macroeconomic conditions and nationwide economic shocks, providing preliminary support for the inclusion of time fixed effects and robust estimation techniques in the econometric analysis.

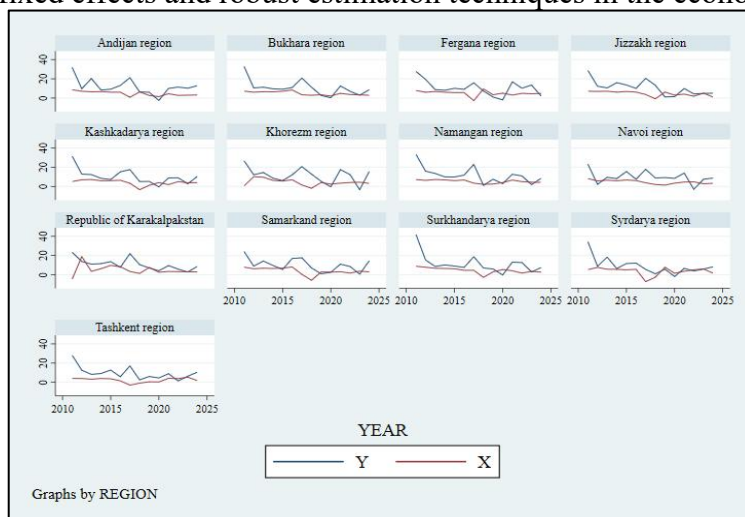


Figure 2. Regional Trends in Agricultural Growth and Disposable Income Growth.

4.2 Panel Unit Root Analysis

The stationarity properties of the variables were examined using the Levin–Lin–Chu (LLC) panel unit root test. The results are reported in Table 4.

Variable	Adjusted statistic	t-	p-value	Result
Y	-3.3392		0.0004	Stationary
X	-3.6107		0.0002	Stationary

Table 4. LLC Panel Unit Root Test Results

The results indicate that both variables are stationary at levels, as the adjusted t-statistics for Y and X were equal to -3.3392 and -3.6107, respectively, with p-values below 0.01. Therefore, the null hypothesis of unit roots is rejected, confirming that the variables do not contain unit roots and can be used in level form for panel regression analysis.

4.3 Regression Analysis

To estimate the relationship between agricultural growth and disposable income growth, fixed-effects and random-effects models were estimated. The regression results are presented in Table 5.

Variables	Fixed Effects	Random Effects	Fixed Effects with Year Fixed Effects	Driscoll–Kraay Fixed Effects with Year Fixed Effects
(X)	0.5078***	0.5174***	0.3118**	0.3118**
Std. Error	(0.1929)	(0.1817)	(0.1300)	(0.1357)
R ²	0.0396	0.0431	0.7862	0.7862
Observations	182	182	182	182

Table 5. Panel Regression Results

Note: *** and ** indicate significance at the 1% and 5% levels, respectively.

The fixed-effects and random-effects estimations both indicate a positive and statistically significant relationship between agricultural growth and disposable income growth. In the fixed-effects model, a one percentage-point increase in agricultural growth was associated with an approximately 0.51 percentage-point increase in disposable income growth. Similar results were obtained from the random-effects model, where the coefficient of agricultural growth was 0.5174.

The Hausman specification test produced a p-value of 0.8823, suggesting that the random-effects estimator was preferable under standard panel assumptions. Nevertheless, Pesaran's cross-sectional dependence test revealed significant cross-sectional dependence among regions ($p=0.0108$), indicating that regional economies were simultaneously affected by common macroeconomic conditions and nationwide economic shocks during the study period. To address this issue, the final specification was estimated using fixed effects with Driscoll–Kraay robust standard errors and year fixed effects. The coefficient of agricultural growth remained positive and statistically significant, although its magnitude decreased to 0.3118 after controlling for common time effects and cross-sectional dependence. This result suggests that agricultural growth continued to contribute positively to disposable income growth under a more robust estimation framework.

As an additional robustness check, dynamic panel estimations were performed using the Arellano–Bond and System GMM approaches. The System GMM estimation also produced a positive and statistically significant coefficient for agricultural growth ($\beta=0.2194$, $p=0.037$), supporting the stability of the main findings. In addition, the Arellano–Bond test indicated no evidence of second-order serial correlation ($p=0.474$). However, given the relatively small number of regional units and the large number of instruments, these results should be interpreted cautiously.

The inclusion of year fixed effects substantially increased the explanatory power of the model, with the within R² increasing from 0.0396 in the baseline fixed-effects model to 0.7862 in the final specification. This finding indicates that nationwide macroeconomic conditions and common economic shocks played a major role in explaining regional income dynamics during the study period.

5. Discussion

The empirical results reveal a positive and statistically significant effect of agricultural growth on disposable income growth across the regions of Uzbekistan during 2011–2024. The preferred specification, estimated using fixed effects with Driscoll–Kraay robust standard errors and year fixed effects, indicates that a one percentage-point increase in agricultural growth was associated with an approximately 0.31 percentage-point increase in disposable income growth.

The findings are consistent with previous studies emphasizing the importance of agriculture for household income and rural welfare in developing and transition economies (Datt & Ravallion, 1998; Christiaensen et al., 2011). The results also support earlier evidence from Central Asia and post-Soviet economies, where agricultural reforms and productivity improvements contributed positively to rural incomes (Lerman, 2008; Spoor & Visser, 2004). However, the moderate magnitude of the estimated coefficient suggests that agricultural growth was not the only factor influencing income growth across regions during the study period. This may reflect the increasing importance of industrial and service sectors within Uzbekistan's ongoing economic diversification process. The reduction in the estimated coefficient from approximately 0.51 in the baseline fixed-effects model to 0.31 in the final specification indicates that nationwide economic conditions strongly influenced regional income growth. Economic reforms, inflationary pressures, external shocks, and the COVID-19 pandemic affected both agricultural output and household income across regions. Nevertheless, the coefficient remained statistically significant after controlling for these common time effects. The robustness checks additionally supported the stability of the main findings, as the System GMM estimation also produced a positive and statistically significant coefficient for agricultural growth. However, these results should be interpreted cautiously due to the relatively small number of regional units and the large number of instruments.

The findings suggest that policies aimed at improving agricultural productivity and output may contribute positively to household income growth, particularly in rural regions. At the same time, the strong role of nationwide economic conditions highlights the importance of macroeconomic stability for sustainable regional development.

Several limitations should be acknowledged. First, the analysis includes only one explanatory variable due to limitations in the availability of consistent regional data for the study period. As a result, the model does not account for other potential determinants of regional income growth. Second, the study cannot fully address the potential endogeneity between agricultural growth and income growth. Therefore, the estimated relationship should be interpreted with caution. Future research could incorporate additional control variables, apply dynamic panel estimation techniques, and examine spatial spillover effects across regions.

6. Conclusion

This study examined the relationship between agricultural growth and disposable income growth across the regions of Uzbekistan during 2011–2024 using panel data analysis. The empirical evidence revealed a positive and statistically significant relationship between the two variables. The preferred model indicated that agricultural growth contributed positively to disposable income growth across regions during the study period. The analysis also demonstrated the important role of nationwide macroeconomic conditions in shaping regional income growth. The inclusion of year fixed effects and the presence of cross-sectional dependence showed that common economic shocks and national economic changes affected both agricultural output and household income across regions. Overall, the study suggests that agricultural development remains an important component of regional economic growth and rural welfare in Uzbekistan. At the same time, the results highlight the importance of broader macroeconomic stability and economic diversification for sustainable income growth across regions. Therefore, strengthening agricultural productivity together with maintaining macroeconomic stability may contribute to more balanced and sustainable regional development in Uzbekistan.

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