DOI: 10.22620/agrisci.2025.45.013

Agricultural production in Bulgaria: the financial impact of credit, subsidies, and interest rates

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Abstract

The present study analyses the impact of external bank financing on agricultural production in Bulgaria from 2000-2022. The main objective of this research is to assess the role of external funding in the development of the agricultural sector in the Republic of Bulgaria by examining the influence of bank lending on Bulgarian agricultural production, evaluating the impact of subsidies on the formation of the value of Bulgarian agricultural production, and investigating the significance of interest rates for Bulgarian agricultural production. For this study, three hypotheses have been formulated to be subsequently tested and discussed. A multiple regression analysis has been employed to identify the relationship between agricultural production, lending, sector subsidies, and interest rate levels. The study is based on Eurostat, FAOSTAT, and the Bulgarian National Bank (BNB) data. The results show that the three indicators examined are strongly related to agricultural production and explain a significant part of its dynamics. It has been found that agricultural lending and the interest rates at which farmers have access to financing exert a strong positive influence on the growth of agricultural production. At the same time, subsidies have a negative effect. As a result, the article recommends expanding financial instruments for agricultural credit, improving lending conditions, lowering interest rates for investment loans in the agricultural sector, reviewing subsidy distribution mechanisms, and channeling financing towards areas that enhance productivity and sustainability in agriculture.
Keywords: agricultural production, credit, subsidies, interest rate

INTRODUCTION

In modern society, the role of agriculture in ensuring food security for the population is indisputable. In Bulgaria, the sector is one of the most complex and dynamic, requiring continuous policy adjustments and state support. The specific working conditions, the seasonal nature of agricultural activities, and the irregular and delayed financial inflows for farmers necessitate a different approach of financing their activities. The lack of official funding sources and the reliance on informal ones can often lead to excessively high costs for farmers and inefficiencies in their operations. Various factors contribute to securing external sources of funding, but some of the most significant ones are agricultural loans, the interest rates at which they are available, and state support through subsidies. The synergy and alignment between loans, interest rates, and subsidies can guarantee higher productivity and sustainability in agriculture.

Several studies (Danso-Abbeam et al., 2016; Makate et al., 2019; Moahid & Maharjan, 2020) have demonstrated a positive relationship between agricultural credit and productivity. At the same time, some circumstances hinder farmers from taking out loans (Ibe & Obilor, 2013), as they fear taking on such risks. Most of these studies (Şimşir, 2012; Udoka et al., 2016; Wasif et al., 2020) indicate the existence of a positive correlation between bank lending, government spending on agriculture, and its productivity, while also establishing a negative relationship with interest rate levels. Accessible credit not only enables farmers to invest in their activities but also enhances their efficiency

(Moahid et al., 2021; Moahid & Maharjan, 2020; Sekyi et al., 2020; Seven & Tumen, 2020; Truong et al., 2020). The optimal combination of credit with state support in the form of subsidies creates a synergistic effect, further contributing to increased productivity. This highlights the importance of an integrated approach to financing agricultural producers (Yang Q. et al., 2023; Yang T. et al., 2023). Providing subsidies can compensate for these shortcomings and stimulate production in cases where the credit market is underdeveloped and inefficient (Garrone et al., 2019; Xin et al., 2024). However, the impact of subsidies is not always positive. Some studies have shown that excessive government subsidies can distort the market and lead to inefficient resource allocation (Rizov et al., 2013; Sarma & Rahman, 2020). Farmers may cease investing in innovation and efficiency improvements when subsidies encourage dependency on state support, causing them to rely primarily on continued government assistance (Garrone et al., 2019; Li et al., 2022; Skreli et al., 2015). Therefore, the effectiveness of financial instruments such as loans and subsidies largely depends on the operational environment in which they are applied.

The main objective of this study is to assess the role of external financing in developing the agricultural sector in the Republic of Bulgaria. Specifically, to:

i. Analyze the impact of bank lending on Bulgarian agricultural production.

ii. Evaluate the effect of subsidies on the formation of the value of Bulgarian agricultural production.

iii. Examine the significance of interest rates for Bulgarian agricultural production.

The formulated research hypotheses to be tested in the course of the study are:

i. H01 – Bank lending does not significantly impact Bulgarian agricultural production.

ii. H02 – Subsidies have no significant impact on Bulgarian agricultural production.

iii. H03 – Interest rate levels have no significant impact on Bulgarian agricultural production.

MATERIALS AND METHODS

The article employs descriptive and analytical methods for data processing and analysis. The first category includes historical method and chronological analysis, comparative and content analysis, as well as graphical methods. The analytical methods encompass inductive and deductive methods, quantitative dependency analysis, and critical analysis. Correlation and multiple regression analysis have been applied to establish cause-and-effect relationships and dependencies and test the hypotheses. The study is based on data from Bulgaria, covering 22 years from 2000 to 2022. The objective is to determine which factors influence the value of agricultural output. The selected indicators include the output of the agricultural 'industry' as the dependent variable and credit to agriculture, forestry and fishing, subsidies on products output of the agricultural 'industry,' and interest rate as independent variables.

Data from Eurostat is used for the Output of the agricultural 'industry,' measured in a million euros as Production value at the basic price. The total agricultural output is a key indicator for assessing the productivity and significance of the sector. It includes all agricultural goods produced in a given year, valued at the price received by the producer, excluding taxes.

Regarding the Credit to Agriculture, Forestry and Fishing indicators, data from FAOSTAT in million euros has been used. This is also an important indicator, reflecting the sector’s access to financing, which is crucial for its efficiency and development. A higher credit value indicates easier access for the agricultural sector to external funding for further growth. An increase in credit value suggests more investments, greater mechanisation, and modern

technologies, which, in turn, enhance sector productivity. Conversely, lower credit values indicate insufficient support, including government support, indicating a need for policy changes and additional subsidies. Therefore, the Credit to Agriculture, Forestry and Fishing indicators significantly influence the agricultural sector's development, mechanisation, and competitiveness.

Regarding the subsidies for product output of the agricultural 'industry' indicator, data from Eurostat for million euros has also been used. Its impact can be traced in the years following 2007 when Bulgaria joined the EU and became a beneficiary of EU subsidies. These subsidies play a key role in assessing the state's support for the sector's development. The higher their value, the stronger the influence of subsidies on agriculture. They help reduce production costs, making agricultural products more competitive. Additionally, subsidies contribute to the sector's sustainability by encouraging various environmental practices.

The Interest rate indicator is the third independent variable, based on data from the Bulgarian National Bank (BNB). It is measured as interest rates and volumes on new business loans, excluding overdrafts, for non-financial enterprises, categorised by the initial interest rate fixation period. This indicator reflects the average interest rate at which banks grant loans. It influences agricultural producers' decision to use external financing sources. The higher the interest rate, the more difficult and expensive it is for farmers to access credit. On the other hand, higher subsidy allocations for the sector reduce the need for external financing through loans.

Based on these criteria, the functional specification of the research model is as follows:

AGROUT = f (CAFF, SAGRP, INTR)

Where:

- AGROUT - Output of the agricultural 'industry', measured in million euros as Production value at basic price
- CAFF - Credit to Agriculture, Forestry, and Fishing, measured in million euros
- SAGRP - Subsidies on products Output of the agricultural 'industry', measured in million euros
- INTR - Interest rates on loans for the non-financial enterprises sector

To estimate the model above, the following regression equation can be formulated:

$$AGROUT = a_0 + a_1CAFF + a_2SAGRP + a_3INTR$$

Where:

- AGROUT – Dependent variable
- CAFF, SAGRP, INTR – Independent variables
- a_0 – Intercept of the model
- a_1, a_2, a_3 – Parameters of the regression equation

Theoretical expectations regarding the sign of the regression parameters are as follows:

- $a_1 > 0 \rightarrow$ A positive relationship between credit to agriculture and agricultural output
- $a_2 > 0 \rightarrow$ A positive relationship between subsidies and agricultural output
- $a_3 < 0 \rightarrow$ A negative relationship between interest rates and agricultural output

RESULTS AND DISCUSSION

The role of bank lending can be assessed using the Agricultural Orientation Index, whose data for Bulgaria and the EU-27 can be observed in Figure 1. This index is calculated as the ratio of agricultural loans to GDP. Values below 1 indicate that the sector receives fewer loans than its economic contribution would justify. A clear trend is observed: In Bulgaria, the index has remained below 1 for the past 22 years, except for three years from 2017 to 2019, when it exceeded 1. In comparison, in EU countries, the value has been consistently above 1.5. This characterised Bulgaria's agricultural sector as insufficiently financed.

Figure 1 also tracks the share of agricultural loans as a percentage of total loans in Bulgaria and the EU-27. In Bulgaria, the

volume of loans allocated to the sector hovers around 2%, below the European average. Only in the last four years of the analysed period has Bulgaria gradually aligned with the other European countries, reaching values of approximately 3.5%. These trends justify the need for further analysis of such a relationship.

The trends in the development of the indicators Output of the agricultural 'industry', measured in million euros as Production value at basic price, and Credit to Agriculture, Forestry, and Fishing, measured in million euros, can be observed in Figure 2.

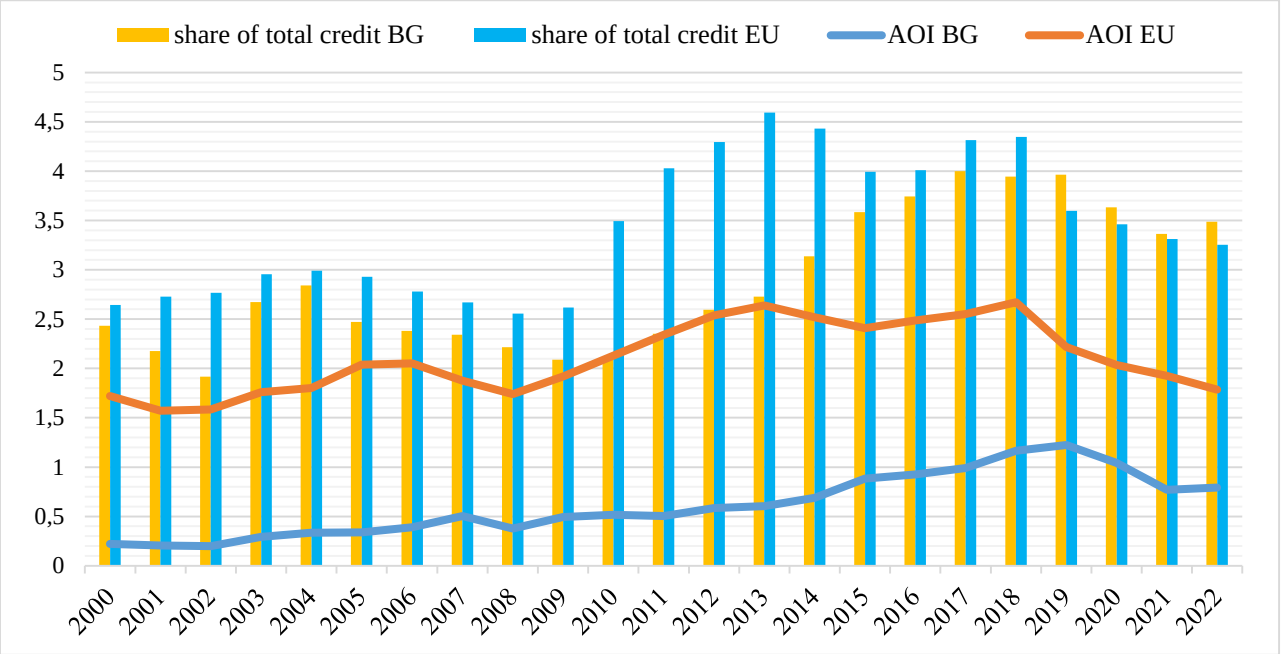

Figure 1 Agricultural Orientation Index and Share of Agricultural Credit in Total Credit in Bulgaria and EU-27, 2000-2022

Source: Faostat

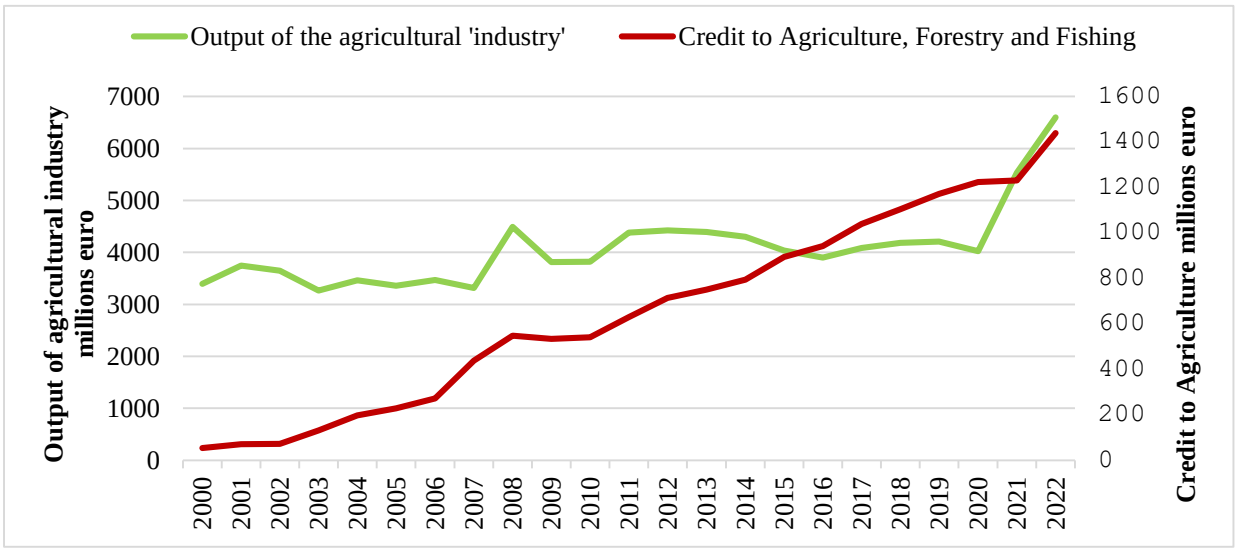

Figure 2 Output of the agricultural 'industry' and Credit to Agriculture, Forestry and Fishing in Bulgaria million euro, 2000-2022

Source: Eurostat, Faostat

Agricultural production in Bulgaria has shown an upward trend over the past two decades. Starting at €3,397 million in the initial year, with some declines, particularly in 2003, 2005, and 2007, production gradually increased to €6,596 million by the end. There were also significant fluctuations, especially between 2007 and 2012. After that, production remained relatively stable until 2021, when a sharp increase occurred. Regarding credit financing, there has been continuous growth throughout the analysed period, indicating increasing financial support for the sector. It started at €54.35 million at the beginning of the period and reached €1,438.94 million by the end. In most years, the dynamics of the two indicators coincide, suggesting a potential relationship between them. This relationship will be further analysed using correlation and regression analysis. However, there are periods, such as 2008–2010, where agricultural output declined despite increasing credit availability. This suggests that other factors influence production, which will be examined further with multiple regression analysis.

Figure 3 illustrates the dynamics of subsidies, which are a key factor affecting agricultural production. Their values can only be tracked from the year Bulgaria accessed the EU when the country became a beneficiary of subsidy programs.

The value of agricultural subsidies started at €59.13 million. Over five years, until 2012, they doubled to €120.25 million. In 2015, they peaked at €213.05 million, after which their dynamics showed only minor changes, stabilising at €129.76 million by the end of the period.

The trend of the two indicators suggests that an increase in subsidies does not automatically lead to higher agricultural production. Other factors, such as investments, credit availability, interest rates, and inefficiencies in subsidy utilisation, may also play a role.

Figure 4 allows us to track the dynamics of interest rates, a key indicator influencing access to external financing.

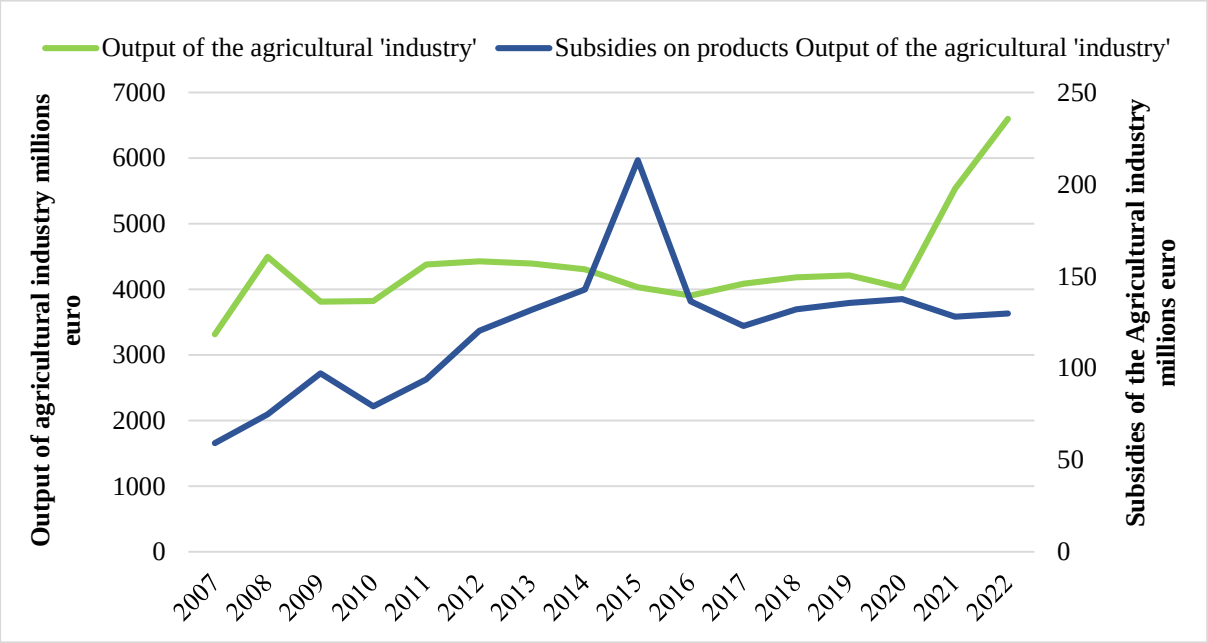

Figure 3 Output of the agricultural 'industry' and Subsidies of the Agricultural industry in Bulgaria million euro, 2007-2022
Source: Eurostat

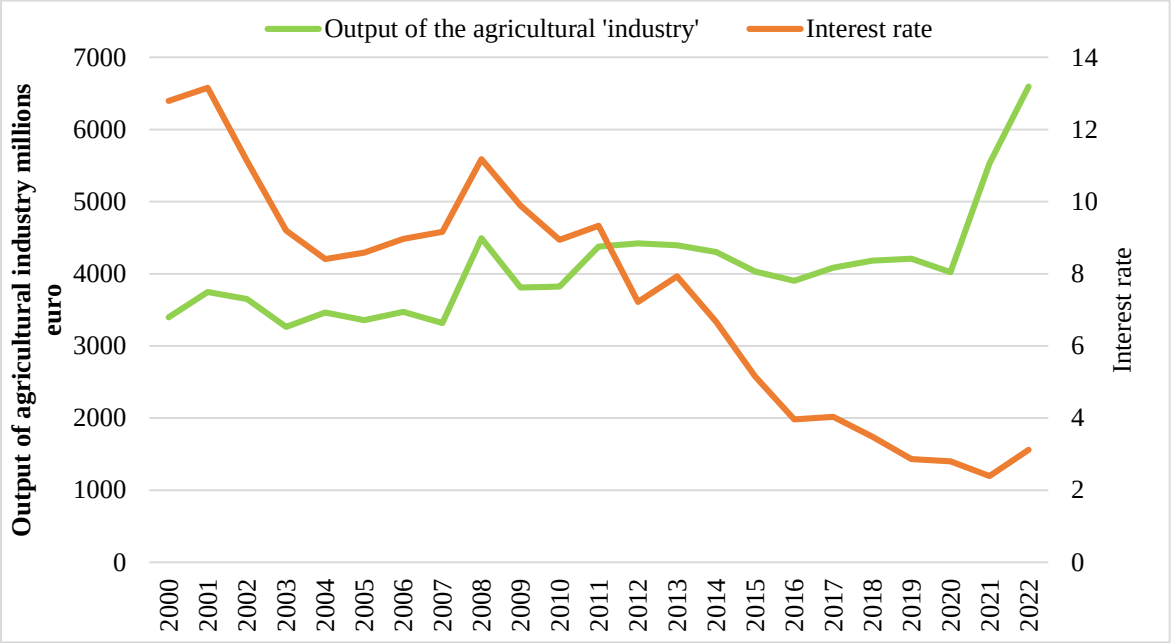

Figure .4 Output of the agricultural 'industry' and Interest rate in Bulgaria, 2000-2022
Source: Eurostat, BNB

Table 1. The empirical result of the regression

dependant variable AGROUT	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	630.2375	851.3256	0.7403	0.4682	-1151.60	2412.08
CAFF	3.6491	0.7262	5.0246	0.0001	2.1291	5.1691
SAGRP	-6.2884	2.9517	-2.1305	0.0464	-12.4663	-0.1105
INTR	215.5107	69.2159	3.1136	0.0057	70.6403	360.3812
Multiple R	0.8462	R Square	0.7161	Adjusted R Square		0.6713

Source: authors` calculation

There is a clear downward trend in interest rates in Bulgaria, reaching record-low levels in recent years. Starting at 12.79% at the beginning of the period, interest rates gradually declined to 9.6% in 2007. In 2008, there was a temporary increase to 11.18%, but after that, the downward trend remained consistent, reaching the lowest point in 2021 at 2.39% and slightly increasing to 3.12% in 2022. Lower interest rates facilitate access to credit, enabling agricultural producers to invest in their businesses and enhance their competitiveness.

To further analyse these indicators, and in accordance with the research methodology outline earlier, we conducted a multiple regression analysis to examine their relationship.

Multiple regression analysis of the output of the agricultural 'industry' in Bulgaria

As a result of the analysis, based on the research methodology, the following regression equation is obtained:

AGROUT=630.2375+3.6491CAFF–
6.2884SAGRP+215.5107INTR

The empirical results are presented in Table 1.

The multiple correlation coefficient of 0.8462 indicates a strong positive correlation between the dependent variable (agricultural

production) and the independent variables (credit, subsidies, and interest rates). The coefficient of determination (R^2) of 0.7161 means that the variation in the selected independent variables explains 71.61% of the variation in agricultural production. The Adjusted R^2 value of 0.6713, which accounts for the number of variables and sample size, suggests that the model is well-specified with minimal unnecessary variables. The high F-value (15.98) and the very low Significance F-value (1.99E-05) indicate that the model is statistically significant, meaning that at least one independent variable significantly affects the dependent variable. The intercept, which represents agricultural production when all independent variables are zero, is 630.24. However, it is not statistically significant ($p > 0.05$), implying that the baseline level of agricultural production without external factors is not meaningful.

The regression coefficient for Credit to Agriculture, Forestry, and Fishing is positive, which aligns with the theoretical expectation for the sign of the coefficient. The result suggests that an increase in agricultural credit by one unit leads to a rise in agricultural production by 3.65 units. This finding is statistically significant, as indicated by its *p*-value of 0.0001. This result supports the idea that access to financing facilitates investment in agriculture. Consequently, the null hypothesis formulated earlier, namely:

H01 – Bank lending has no significant impact on Bulgarian agricultural production

is rejected in favour of the alternative hypothesis.

Therefore, we can conclude that bank lending in Bulgaria significantly impacts agricultural production. The positive effect of this influence becomes evident when loans are used for investment in land, mechanisation, new crop varieties, precision agriculture, and sustainable environmental practices rather than merely covering operational expenses. These investments create favourable conditions for farmers to manage better the seasonal nature of their business and working capital. Additionally, government support is essential, particularly for small-scale producers. Thus, credit is a powerful mechanism for generating growth in agriculture. Still, its effectiveness depends on how it is utilised – to avoid triggering a debt crisis and over-reliance on external financing.

Contrary to the initial theoretical assumption, the regression coefficient for subsidies is negative. This indicates that an increase in subsidies by one unit corresponds to a decrease in agricultural output by 6.29. This result is statistically significant ($p = 0.0464$), suggesting that higher subsidies do not necessarily lead to increased agricultural production.

Several possible explanations require further investigation:

- Inefficient use – farmers might use subsidies for non-productive activities, such as covering operational costs rather than investing in growth;
- Dependence on subsidies – farmers may rely on direct payments instead of investing in innovation, reducing their motivation to modernise;
- Crowding out private investments – farmers who depend excessively on subsidies reduce their investments, slowing production growth;
- Market distortions – subsidies might encourage the production of unprofitable crops or restrict overall output;
- Subsidies as compensation rather than growth stimulus – if subsidies are primarily granted during crises (e.g., droughts or price drops), their increase could be linked to weak economic conditions rather than sector growth;
- Institutional inefficiencies – bureaucracy, delayed payments, or corruption could reduce the real impact of subsidies on production.

Given the low *p*-value, we have grounds to reject the null hypothesis formulated earlier, namely:

H02 – Subsidies have no significant impact on Bulgarian agricultural production

and accept the alternative hypothesis. Therefore, subsidies have a significant impact on Bulgarian agricultural production.

The regression coefficient for interest rates is positive, which contradicts the initial assumption that higher interest rates lead to lower investments and, thus, lower production. The model shows that a 1-unit increase in the interest rate corresponds to the rise in agricultural output by 215.51 units. This result is statistically significant ($p = 0.0057$).

Thus, we reject the third hypothesis:

H03 – Interest rate levels have no significant impact on Bulgarian agricultural production

and accept the alternative hypothesis that interest rates significantly influence Bulgarian agricultural production.

Conventional economic logic suggests that higher interest rates lead to lower investments and, consequently, reduced production. However, this pattern does not hold in Bulgaria due to the country's specific conditions and interest rate dynamics. Bulgaria has traditionally maintained higher interest rates than other European countries. The business environment in the country has adapted to these conditions, meaning that higher interest rates have not necessarily discouraged investment. The alignment of Bulgarian interest rates with global and European levels began after 2018. This process has led to record-low interest rates in recent years, the full effects of which are yet to be observed. Throughout the observed period, there are years of significant economic expansion. Higher revenues in the agricultural sector enabled farmers to invest more despite higher borrowing costs. In addition, the impact of subsidisation should be taken into account, which provides at least some producers with access to financing at a lower cost, partially offsetting the impact of high market rates.

The t-statistics of regression coefficients indicate that credits and interest rates are strongly significant variables with a high impact on agricultural production. Subsidies are also statistically significant, although their effect is comparatively weaker. We can observe the confidence intervals for the estimated regression coefficients from the data in Table 1. The confidence interval of Credit to Agriculture, Forestry, and Fishing ranges from 2.1291 to 5.1691, excluding zero, confirming its significant effect. We can be 95% confident that an increase in credit by one unit leads to an increase in production between 2.13 and 5.17 units. The confidence interval of subsidies ranges from -12.4663 to -0.1105, excluding zero, confirming its significant negative impact. We can conclude with 95% certainty that an increase in subsidies leads to a decrease in agricultural production between 0.11 and 12.47 units. The confidence interval for the impact of interest rates ranges from 70.64 to 360.38, excluding zero, confirming a significant positive relationship. Higher interest rates are associated with increased agricultural production, accounting for 70.64 and 360.38 units.

This regression model provides valuable insights but can be further refined by incorporating additional relevant independent variables.

CONCLUSIONS

Based on the results of the conducted analysis, including the dynamics of the listed indicators and the regression findings on the impact of credits, subsidies, and interest rates in Bulgaria, several conclusions can be drawn. Agricultural production in Bulgaria has shown an upward trend over the past two decades. Both agricultural crediting and subsidies have increased throughout the analysed period, indicating growing financial support for the

sector. Interest rates have followed a downward trend, facilitating access to external financing. The positive and statistically significant regression coefficient of agricultural credit indicates that increased crediting results in higher agricultural production. The negative and statistically significant regression coefficient of subsidies suggests that their increase results in lower agricultural production, which is primarily linked to inefficiencies in their utilisation. The positive and statistically significant regression coefficient of interest rates shows that as interest rates rise, agricultural production also increases, possibly due to higher investments in the sector.

Based on the conclusions, some recommendations also can be made. Financial instruments for agricultural loans can be expanded, ensuring better credit conditions, including more extended repayment periods and lower interest rates for investment loans in the agricultural sector. High interest rates may restrict farmers' investment activity; therefore, approaches to reducing interest rates on agricultural loans should be considered, such as government support or subsidies. Introducing preferential interest rates for loans used for investments in sustainable and innovative agricultural practices, as well as "green" loans that promote sustainable farming and reduce the environmental footprint of agricultural production.

Revisiting subsidy allocation mechanisms and directing funding toward areas that enhance productivity and sustainability. Linking subsidies to specific production outcomes or sustainable resource management practices ensures effective utilisation.

These conclusions and measures highlight the need for improved financing in Bulgaria's agricultural sector, effective subsidy management, and lower interest rates. Such steps will enable farmers to increase their production and enhance the sustainability of agriculture in the country.

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