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RESEARCH ARTICLE

Assessing the Effect of Monetary Policy on the Competitiveness of Agricultural Enterprises

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Abstract: There are many scientific works the effects of monetary policy on the competitiveness of enterprises. However, no research has yet been conducted on agricultural enterprises. Therefore, the aim of this article is to indicate the effects of monetary policy on the competitiveness of agricultural enterprises. Regression analysis is a suitable econometric method to determine the strength of the effects of monetary policy on competitiveness. In our model, a multiple regression method was used, where interest rates, inflation and exchange rate were defined as exogenous (independent) variables, while revenues of agricultural enterprises were defined as an endogenous (dependent) variable. The findings reveal that the monetary policy significantly affects agricultural competitiveness. Specifically, higher interest rates are shown to have a negative impact on the performance of agricultural enterprises. Economic theory states that higher interest rates have a negative impact on competitiveness, and the results of calculations show that interest rates do have a dominant impact on the agricultural enterprise performance. Monetary policymakers, especially the central bank, should focus on keeping interest rates low in order to increase the availability of operating and investment capital. A market environment with low interest rates could stimulate the introduction of innovations, the implementation of new technologies and the development of robotization in agricultural enterprises. Lower financing costs due to low interest rates could boost business activities and economic growth, which could have a positive impact on the competitiveness of agricultural businesses. The conclusions of our research confirm that in the Czech Republic monetary policy remains a key tool for supporting the development of agricultural enterprises and their competitiveness.

Keywords: Interest rate; Monetary policy; Inflation; Exchange rate; Revenues; Competitiveness; Agricultural enterprises

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1. Introduction

According to economic theory, monetary policy has a significant impact on the competitiveness of agricultural enterprises, both within a specific country and in the global market. Competitiveness, defined as the ability of enterprises to achieve sustained market presence, profitability, and growth in the face of competitive forces, is influenced significantly by factors such as interest rates, inflation, and exchange rates, which are controlled by monetary policy [1]. In this study, the competitiveness of agricultural enterprises was measured through the lens of revenues. Revenues are a direct indicator of market success and provide a quantitative measure that reflects both the ability of these enterprises to sustain operations and their capacity to grow and seize market opportunities under varying economic conditions. The rationale behind using revenues as a benchmark is based on the economic principle that effective responses to monetary policies, reflected in revenue outcomes, signify a higher competitive edge. This includes the ability to adapt to changes in interest rates, manage costs during inflationary periods, and capitalize on favorable exchange rates to maximize profitability [2].

Agriculture is a sector highly dependent on various macroeconomic factors, whose performance and competitive positioning are shaped by these monetary elements. For instance, higher interest rates may increase the financial costs of investment in agriculture, which may limit the development and modernization of the sector. Conversely, lower interest rates can support investment and economic development, enhancing competitiveness in agriculture. Researches have underscored the relationship that tight monetary policies typically increase rural unemployment and reduce agricultural production [2]. Furthermore, fluctuations in exchange rates can have a significant impact on the prices of agricultural products in the world market. Currency devaluation can increase the export competitiveness of agricultural products, while currency appreciation can make exports more difficult and lead to an increase in imports, which can affect domestic agriculture adverselyHigh inflation can increase production and inventory costs, negatively impacting farm profitability. On the other hand, low inflation can support the stability of agricultural product prices and the sustainability of the sector. The restrictive monetary policies in the U.S. have adverse effects on the agricultural sector, such as increased interest rates, reduced agricultural trade and higher prices [1]. There are many scientific works that deal with the effects of monetary policy on the competitiveness of enterprises. However, no research has yet been conducted that focuses on agricultural enterprises. Therefore, the aim of this article is to analyze the effects of monetary policies on the competitiveness of agricultural enterprises.

2. Literature Review

Monetary policy is a set of measures that are used by central banks to control inflation and stabilize the currency through the manipulation of interest rates and the money supply. The reop rate is the interest rate charged by the central bank when providing loans to commercial banks [3]. Commercial banks withdraw loans from the central bank and repay them after a certain period (14 days), during which interest is charged at a certain rate [4]. The reop rate can affect currency stability by affecting the amount of money in circulation. If the reop rate is high, it leads to a decrease in the amount of money in circulation, and thus indirectly leading to the stabilization of the currency [3]. Therefore, the main instrument for regulating the monetary system is the determination of the basic interest rate [4]. Increasing or decreasing the base interest rates can affect the companys' loan cost [3] and thus their business activity and development of sales [5]. Many central banks, such as the European Central Bank and the Czech National Bank, implement inflation targeting, which aims to maintain a stable inflation rate, typically around 2%. This policy helps to stabilize economic expectations and planning, which is crucial for sectors like agriculture where investment decisions are heavily influenced by expected future financial conditions [5]. The relationship between low interest rates and higher inflation is critical, particularly in agriculture. While low interest rates decrease borrowing costs and encourage investment in agricultural technology and infrastructure, they may also lead to higher inflation rates. This inflation can increase the costs of agricultural inputs like feed, fertilizer, and equipment, thereby reducing the net profitability of agricultural operations. Central banks must balance these effects to maintain a stable economic environment conducive to agricultural growth and sustainability [6–7].

The authors state that the effects of the change in monetary policy on the investments of companies in the economy are relatively high, especially in Germany, France [8–9], Italy and Spain [10]. They showed that in each of the four countries, a change in user cost monetary policy was reflected in the use of foreign capital [11]. Foreign capital is affected by interest rates [12]. The

results have shown that the dependence between interest rate levels and entrepreneurial capital appreciation is statistically significant. This has a significant impact on investment [13]. Some researches focused on the analysis of the influence of monetary policy on the investments of companies [12–14]. The authors found that changes in interest rates had a significant effect on firms' investments. If the central bank lowered interest rates, firms would increase their investment to respond . On the contrary, if the central bank raised interest rates, firms would reduce their investments [15]. The authors also investigated the effect of monetary policy on the investments of companies in individual sectors. They found that changes in monetary policy had a stronger effect on the investment of firms in sectors that depend on credit financing [16]. The main sectors that are dependent on foreign capital are telecommunications, energy and mining. Firms in these sectors are more sensitive to changes in monetary policy due to their reliance on foreign investment and debt [17]. The research has confirmed the economic theory about the effects of monetary policy on the investment decisions of companies [18]. Other authors argued that there was only a slight linear relationship between interest rates and investment activity [19]. The author of the article has examined the influence of the monetary policy of the National Bank of Poland on the dynamics and structure of investments in this country. Due to the realist theory of capital, changes in investments were assessed mainly from the perspective of the Austrian school [20]. The research methods used in this study included inference and statistical analysis. The author claimed that "In the years 2006–2013, the Polish economy showed a slightly linear relationship between the reference interest rate and the dynamics of investments" [19]. For these reasons, there would be a need to revise the clear economic assumptions [21] that there was a high degree of dependence between interest rates determined by the Czech National Bank, inflation, the exchange rate of the koruna and the profitability and competitiveness of companies [22]. According to our assumptions, profitability and, in general, the success of companies in the market is much more determined by factors that are not and cannot be in the model, such as the internal organization of companies [23], the willingness of management to implement new technologies, digitization, robotization [24], innovation management and other factors. The quality of human capital, effective fiscal policy, legislation and, of course, the organizational support of companies from the state also certainly influence the success of companies [25]. Monetary policy usually strongly determines the competitiveness of companies [26]. It is an economic assumption, which, however, needs to be subjected to criticism and analysis. If monetary policy ceases to affect the sales of companies [17], it is necessary to look for measures to support competitiveness and effective employment [27]. We need to reassess the unexplored factors that may influence it [28]. These include, for example, tax policy, the competitive environment, technological developments and the development of the labor market [29]. Firms may also consider restructuring their business models, seeking new markets and investing in research and development. However, if this is a long-term trend, the state must intervene through the change of economic policy and market regulation or must intervene in the support of science, research, development, and innovative projects [30].

There has been a wide debate in economic research about the effects of monetary policy on business sales and profitability. Important scientific articles in the last two years, which dealt with the relationship between monetary policy and company sales, corresponded to this. It is a interdisciplinary problem in nature, connecting macroeconomics with a business perspective on competitiveness. The authors paid special attention to the relationship between monetary policy and business investments in relation to setting the real interest rate. Authors in the Czech Republic then focused primarily on the influence of monetary policy on corporate financing [31]. A reduction in interest rates could have a positive effect on the financing of businesses and the increase in their sales in general, and therefore not only in the Czech Republic [32]. In this context, some authors have analyzed the direct effects of monetary policy on the corporate sphere. Companies with strong ties to the banking system are less affected than those without such ties. Some other authors also reached similar opinions and results. In the study Effects of Single Monetary Policy on the Selected Economic and Monetary Union Countries (Case of so Called "PIIGS" Countries [32]), it is stated that monetary policy represents one of the most important policies in any state with an impact on the business sphere. Understanding how monetary policy works and how it affects the real economy is a key to understanding how changes in the setting of monetary instruments, such as raising or lowering interest rates, will affect the real economy and which variables will respond. In this work, the effects of monetary policy shocks in the Czech Republic are analyzed. Stiglitz, J.E. [15] also pursued the same goals and studies the effects of monetary policy. How

monetary factors influence the decisions of firms and their relationship to monetary policy was analyzed by Engel, C. [12] through a general economic model, based on the work of Bernanke [27]. His article *The Effectiveness of Monetary Policy* focused on the analysis of the effectiveness of monetary policy in the US in the period 1985–1995. The author Ben Bernanke has evaluated the effects of changes in monetary policy on economic indicators such as inflation, GDP and unemployment. In the article, the author examined the mechanisms by which monetary policy affects the economy and the relationship between money supply growth and inflation. Other authors stated [33] that the development patterns in the foreign exchange and stock markets, as well as their degree of interconnectedness, especially in connection with the last global financial crisis and the debt crisis of the European Union states, are changing significantly. The authors mainly observe the link between stock market indices and exchange rates in four central and eastern European countries, in the period from 2003 to 2018. The results show that there are significant differences between the four countries. The research also support our contention that one cannot automatically accept general economic assumptions about the relationship between monetary policy and corporate competitiveness. The authors took the concept and theory of the foreign exchange rate (FX rate) as the basis, which is the ratio of two currencies. An exchange rate is the value of one currency expressed in another currency. One of the possible monetary operations carried out by the central bank is also based on this definition. The central bank could influence the relationship between supply and demand in foreign exchange markets in order to influence the development of the home currency market [34]. So, the bank could carry out these operations (exchange rate interventions by directly buying or selling foreign currencies) for home currency. The central bank affected the exchange rate equalization process, which was a model of foreign exchange supply and demand [35]. In the long run, this could be an important factor in the balance of payments. The change in the exchange rate had a retroactive effect on the given balance of payments [36]. Central banks stabilized exchange rates in the long term to prevent so-called volatility, which was monitored and measured through econometric models, mainly ARCH and ARIMA [37]. Financial speculation and operations in capital markets can destabilize international trade. Therefore, modeling and forecasting are part of central banks' exchange rate management. For stabilization, central banks use less robust tools. They used verbal interventions to buy and sell foreign currency for home [38]. And then the value of exchange rates was changed. The reason for this was the volume of foreign exchange holdingswas affected by the interest rate, the development of the price level, and political and economic stability [36]. The home currency might appreciate or depreciate. An appreciation of the home currency would occur when the demand for home currency increases and, other things being equal, the supply of the foreign currency increases [39]. In addition, the authors also dealt with the development of the Czech crown over the past 20 years in the context of the development of commercial banking in the Czech Republic. The authors focused on issues related to monetary policy and the competitiveness of the banking sector in this country. The results showed that the Czech crown has developed stably over the years and that the banking sector has made significant progress in innovation and competitiveness. In the long run, the exchange rate would react to the balance of payments. In the short term, the floating exchange rate would be mainly influenced by financial investments and have volatility. Exchange rates keep the internal economy in balance with external economies based on trade transactions, when we talk about the theory of efficient markets [36].

From this literature review, it is evident that research on the relationship between monetary policy and the competitiveness of enterprises often does not place sufficient emphasis on agricultural enterprises. However, there are several substantial reasons why the impact of monetary policy on agricultural enterprises should be given more consideration. First, agriculture plays a key role in ensuring food security and economic stability in many countries. It can be stated that monetary policy should have a significant impact on food production and price stability in the market, which is of great social and economic significance. Secondly, agricultural enterprises often need funds to invest in land, technology and equipment. Changes in interest rates and the availability of credit can have a material effect on the ability of these businesses to invest and modernize their operations. Thirdly, agriculture is also exposed to external factors such as climatic conditions and global market pressures. Monetary policy can affect currency exchange rates and thus the export and import of agricultural products, which can affect the competitiveness of agricultural enterprises at the international level. Fourthly, agriculture varies from region to region, and therefore the impact of monetary policy on agriculture may be different. Some regions may be more dependent

on credit and subsidies, while others may be more affected by exchange rates and exports. Fifthly, monetary policy can also influence sustainability in agriculture, such as promoting green practices, crop diversification and sustainable land use. These aspects are important for the long-term sustainability of agricultural enterprises and the protection of the environment.

3. Methodology

The theoretical premise is that expansionary monetary policy, which involves lowering interest rates and increasing the amount of money in circulation, can create conditions for capital and credit expansion in businesses. This policy could provide businesses with easier access to finance and thus encourage investment in capital projects. In the context of agricultural enterprises, this monetary expansion could lead to increased productivity, competitiveness and sales. Lower financing costs would support investment in upgrading agricultural technology and infrastructure, which could lead to a more efficient production process and increased productivity. Increased availability of credit could also encourage agricultural enterprises to expand their activities, which could contribute to employment growth in the sector. Higher productivity and employment could then represent benefits for the country's overall economy. At the same time, the improved financial situation of companies could increase their competitiveness in the market. Increased competitiveness could result in increased sales as businesses could better compete and meet a wider range of customers. Thus, in this theoretical framework, expansionary monetary policy can serve as a tool to support the development of agricultural enterprises and their contribution to the economy through increased productivity, employment and competitiveness.

Regression analysis quantifies the relationships between variables and provides an understanding on how changes in the reop rate, inflation and exchange rates can affect the revenues of agricultural enterprises. If any of these coefficients is statistically significant, this will support the alternative hypothesis and indicate that at least one of these variables has a significant effect on the revenues of agricultural enterprises. We decided to use the Ordinary Least Squares (OLS) regression due to its efficiency in estimating the relationships between multiple independent variables and a continuous dependent variable, in this case, the revenues of agricultural enterprises. The choice of OLS is justified by its ability to provide clear, interpretable coefficients that quantify the impact of each monetary policy variable on agricultural competitiveness. The hypothesis assumes that changes in independent variables will be reflected in dependent variables (the revenues of agricultural enterprises). Therefore, it is necessary to formulate the null and the alternative hypothesis. Null hypothesis (H_0): The reop interest rate, the exchange rate of the Czech crown and inflation do not have a significant effect on the sales of agricultural enterprises. Alternative hypothesis (H_1): At least one of the independent variables (reop interest rate, Czech crown exchange rate, and inflation) has a statistically significant effect on the revenues of agricultural enterprises.

The dependent variable used in this study is the revenues of agricultural enterprises, which measures the reward for unpaid work, the returns from land owned by the units, and the returns from the use of capital. This concept approximates the general profit from all agricultural enterprises in the Czech republic before distribution and taxation. It can be specifically derived for the agricultural sector because it is possible to determine the components of cost and revenue interests and rent, which are exclusively tied to agricultural activity. This metric is sourced from the Summary Agricultural Account of the Czech Republic, which provides a comprehensive measure of the financial performance of the agricultural sector. By implementing multiple regression, we can analyze the statistical significance of the coefficients associated with these independent variables. Dependent variable (Y): The revenues of agricultural enterprises (in mil. CZK). Independent variables: X1: reop rate with 1-year lag (Interest rate, in %). X2: Inflation rate (in %, annual change). X3: Exchange rate (Czech crown to euro). X4: Exchange rate (Czech crown to US dollar). A one-year lag for the interest rate was used to account for the delayed effect of monetary policy changes on agricultural operations, allowing time for interest rate adjustments to permeate through the economy and impact agricultural financing and expenditure decisions. Selecting interest rates, inflation, and exchange rates as independent variables is grounded in their established economic relevance to agricultural financing and competitiveness, as discussed in the theoretical framework. These variables represent a regression model where the revenues of agricultural enterprises are assumed to be affected by changes in the repo rate, inflation rate, and exchange rate (both to the euro and the US dollar). The econometric model is used in this form:

$$y_{1t} = \beta_1 * x_{1t} + \beta_2 * x_{2t} + \beta_3 * x_{3t} + \beta_4 * x_{4t} + \beta_5 x_{5t} + \varepsilon_{1t} \quad (1)$$

Y: The revenues of agricultural enter prises (dependent variable).
X_1: Repo rate 1 year lag (independent variable).
X_2: Inflation rate (independent variable).
X_3: Exchange rate of the Czech currency to the Euro (independent variable).
X_4: Exchange rate of the Czech currency to the US dollar (independent variable).
β_0: Intercept (intercept coefficient).
β_1, β_2, β_3, β_4: Coefficients for the respective inde pendent variables.
ε: Error term (captures unobserved factors affecting revenues).

Table 1 contains the initial data used for creating the econometric model to predict the development of the revenues of agricultural enterprises in the Czech Republic. The data for this analysis was collected from the Czech Statistical Office, covering the period from 1999 to 2022. This time frame was selected to capture the long-term effects of monetary policy changes on agricultural revenues, with data vetted for completeness and consistency to ensure the reliability of our regression analysis.

During data collection and analysis the multicollinearity was tested using correlation analysis. The correlation matrix is shown in Table 2. Upon detecting high values between exchange rates we introduced a differenced variable for the exchange rate of the Czech crown to the US dollar. This approach effectively reduces multicollinearity, ensuring that our regression model remains robust and the estimates of the parameters are not biased.

Table 1. Data from the Czech Statistical Office - Baseline data.

Year	Revenues of Agricultural Enterprises (Y) mil. CZK	Repo % (X1)	Inflation % (X2)	CZK/EUR Exchange Rate (X3)	CZK/USD Exchange Rate (X4)
1999	−8080.650118	5.25	2.1	36.882	34.6
2000	−1183.700989	5.25	3.9	35.61	38.59
2001	3056.442569	4.75	4.7	34.083	38.038
2002	−2643.082932	2.75	1.8	30.812	32.736
2003	−2501.997632	2	0.1	31.844	28.227
2004	8547.788973	2.5	2.8	31.904	25.701
2005	7050.756166	2	1.9	29.784	23.947
2006	6834.788053	2.5	2.5	28.343	22.609
2007	10009.00577	3.5	2.8	27.762	20.308
2008	10142.68387	2.25	6.3	24.942	17.035
2009	2840.067811	1	1	26.445	19.057
2010	7645.056592	0.75	1.5	25.29	19.111
2011	17389.13434	0.75	1.9	24.586	17.688
2012	16328.6773	0.05	3.3	25.143	19.583
2013	16155.68948	0.05	1.4	25.974	19.565
2014	23445.35461	0.05	0.4	27.533	20.746
2015	16995.4734	0.05	0.3	27.283	24.6
2016	22474.07667	0.05	0.7	27.033	24.43
2017	19603.41521	0.5	2.5	26.33	23.382
2018	15746.12342	1.75	2.1	25.643	21.735
2019	16047.30399	2	2.8	25.672	22.934
2020	19093.89577	0.25	3.2	26.444	23.196
2021	26335.93	3.75	3.8	25.645	21.682
2022	25582.71	7	15.1	24.565	23.36

Source: Czech Statistical Office. (2024). Agricultural Summary Account. Retrieved from https://www.czso.cz/csu/czso/zemedelstvi_zem and Czech National bank (2024). Retrieved from https://www.cnb.cz/arad/#/cs/home

Table 2. Correlation matrix of the selected variables.

	Revenues of Agricultural Enterprises (Y) mil. CZK	Repo (X1) %	Inflation (X2) %	CZK/EUR Exchange Rate (X3)	CZK/USD Exchange Rate (X4)
Revenues of Agricultural Enterprises (Y) mil. CZK	1				
Repo (X1) %	−0.33152	1			
Inflation (X2) %	0.255602	0.666234	1		
CZK/EUR Exchange Rate (X3)	−0.76463	0.500453	−0.1615	1	
CZK/USD Exchange Rate (X4)	−0.5996	0.57253	0.029966	0.893221	1

Due to the multicollinearity problem, we replaced the exchange rate of the Czech currency to the US dollar for the first difference of this variable. The recalculated data used for the analysis are in Table 3.

4. Results

Higher interest rates usually mean higher financing costs for farms, which can affect their profitability, while lower interest rates can support farms in cheaper financing, which can positively affect their revenues. However, the relationship between interest rates and farm profitability is complex and depends on factors such as market conditions, competition, indebtedness and other economic factors. Therefore, the model needs to be valid enough to estimate the development of agricultural revenues. The regression results are shown in Table 4.

Table 3. Recalculated data used for the model.

Year	Revenues of Agricultural Enterprises (Y) mil. CZK	Repo Lag 1 Year % (X1)	Inflation % (X2)	CZK/EUR Exchange Rate (X3)	Differenced Variable CZK/USD Exchange Rate (X4)
1999	−8080.650118	-	2.1	36.882	-
2000	−1183.700989	5.25	3.9	35.61	3.99
2001	3056.442569	5.25	4.7	34.083	−0.552
2002	−2643.082932	4.75	1.8	30.812	−5.302
2003	−2501.997632	2.75	0.1	31.844	−4.509
2004	8547.788973	2	2.8	31.904	−2.526
2005	7050.756166	2.5	1.9	29.784	−1.754
2006	6834.788053	2	2.5	28.343	−1.338
2007	10009.00577	2.5	2.8	27.762	−2.301
2008	10142.68387	3.5	6.3	24.942	−3.273
2009	2840.067811	2.25	1	26.445	2.022
2010	7645.056592	1	1.5	25.29	0.054
2011	17389.13434	0.75	1.9	24.586	−1.423
2012	16328.6773	0.75	3.3	25.143	1.895
2013	16155.68948	0.05	1.4	25.974	−0.018
2014	23445.35461	0.05	0.4	27.533	1.181
2015	16995.4734	0.05	0.3	27.283	3.854
2016	22474.07667	0.05	0.7	27.033	−0.17
2017	19603.41521	0.05	2.5	26.33	−1.048
2018	15746.12342	0.5	2.1	25.643	−1.647
2019	16047.30399	1.75	2.8	25.672	1.199
2020	19093.89577	2	3.2	26.444	0.262
2021	26335.93167	3.75	3.8	25.645	−1.514
2022	25582.7119	7	15.1	24.565	1.678

Source: Own Calculation

Table 4. Model 1: OLS, using observations 1999–2022.

Dependent variable: Revenues of agricultural enterprises					
	Coefficient	**Std. Error**	**T-ratio**	**P-value**	
Const	12285.3	12338.1	0.9957	0.3326	
Repo Lag 1 Year X1	−5173.84	960.232	−5.388	4.04e−05	***
Inflation X2	1998.66	415.620	4.809	0.0001	***
CZK/EUR Exchange Rate X3	153.321	465.279	0.3295	0.7456	
CZK/USD Exchange Rate X4	235.133	381.066	0.6170	0.5449	

Mean Dependent Var	12391.11	**S.D. Dependent Var**	8810.242
Sum Squared Resid	2.88e+08	**S.E. of Regression**	3997.389
R-squared	0.831567	**Adjusted R-squared**	0.794138
F(4, 18)	22.21687	**P-value(F)**	9.26e−07
Log-likelihood	−220.5648	**Akaike Criterion**	451.1296
Schwarz Criterion	456.8071	**Hannan-Quinn**	452.5575
Rho	0.113890	**Durbin-Watson**	1.764121

Source: Own Calculation

Adjusted R-squared is 0.794138. The F-statistic is 22.21687 with a very low p-value (9.26e-07), suggesting the model is statistically significant overall. The Akaike criterion has a value of 451.1296, and the Hannan-Quinn criterion is 452.5575. The Durbin-Watson statistic value is 1.764121, which suggests that there is no serious autocorrelation problem in the residuals of the model. The mean dependent variable is 12391.11, and the sum of squared residuals is 2.88e+08. The R-squared is 0.831567, and the F-statistic is 22.21687 for 4 and 18 degrees of freedom. The log-likelihood is −220.5648, and the Schwarz criterion has a value of 456.8071.

Estimated form of the econometric model:

$$y_{1t} = 12285.3 - 5173.84 * x_{1t} + 1998.66 * x_{2t} + 153.321 * x_{3t} - 235.133 * x_{4t} + \varepsilon_{1t} \quad (2)$$

The P-value served as a measure for hypothesis testing and was juxtaposed with a predetermined significance level of α = 0.05. The Interpretion of the outcomes of the F-test: Given that the obtained P-value stands at 9.26e-07, falling below the specified significance threshold of α = 0.05, we opt to reject the null hypothesis (H0). Consequently, we assert that the model demonstrates statistical significance at the α = 0.05 significance level. The adjusted R-squared value of our model is 0.794138, suggesting that approximately 79.4138% of the variability in the dependent variable, which in this case are the revenues of agricultural enterprises (Y), is caused by the changes in the independent variables specified within our econometric model. While this outcome is satisfactory and supports the acceptance of the model's fitting, it also indicates that there are other factors affecting agricultural revenues that are not captured by our model. This is a common occurrence in econometric modeling, especially in complex sectors like agriculture where numerous external and internal factors can influence outcomes.

The validation underscores the significance of the estimated parameters from an economic standpoint. The parameters are interpreted as follows: The intercept value is 12,285.3, but it is not statistically significant (p-value = 0.3326), indicating that when all independent variables are zero, the expected revenue is not significantly different from this value in a statistical sense. The positive constant implies that the revenues of agricultural enterprises exhibit a positive trend even when other factors are absent. The coefficient of reop rate is –5,173.84 with a p-value < 0.0001, indicating a highly significant negative relationship. This suggests that a one-percentage-point increase in the repo rate from the previous year is associated with a decrease of approximately 5,174 million CZK in agricultural revenues. The economic interpretation is that higher interest rates from the previous year likely curtail borrowing and investment, negatively impacting revenues. For the variable X_2 (inflation rate), the coefficient of 1,598.66 is statistically significant (p-value = 0.0001). This implies that a one-percentage-point increase in inflation is associated with an increase of approximately 1,599 million CZK in revenues. This could be due to

inflation potentially raising the prices at which agricultural goods are sold, thus increasing revenue. The coefficients for both Exchange Rate CZK/Euro and differenced Exchange Rate CZK/USD are not statistically significant, with values of 153.321 (p-value = 0.7456) and 235.331 (p-value = 0.5449), respectively. This suggests that changes in the exchange rates between the Czech crown and both the euro and the US dollar do not have a discernible or significant impact on the revenues of agricultural enterprises.

The mean revenue of agricultural enterprises, as observed over the period, is 12,391.11 million CZK, with a high standard deviation of 8,810.242 million CZK, indicating a significant variability among enterprises. This variability could stem from differences in enterprise size, agricultural activities, or regional market conditions. The sum of squared residuals stands at 2.88e+08, suggesting that while the regression model captures a significant portion of revenue variability, there remains a substantial amount unexplained, possibly due to omitted variables or other dynamics not included in the model. Additionally, the standard error of regression is 3,997.389 million CZK, indicating that the model's predictions deviate from the actual observed revenues on average. This moderate level of prediction error underscores the complexities and challenges in accurately modeling agricultural revenues.

As the analysis of the regression model's initial outputs concludes, it is imperative to proceed with testing the assumptions and underlying the residuals to validate the model's integrity and robustness. Initially, the examination will focus on heteroskedasticity to ascertain whether the variance of the residuals remains constant across different levels of the independent variables. Addressing heteroskedasticity is vital as its presence can lead to inefficient estimators and compromise the reliability of statistical inferences. The White test is a statistical method designed to detect heteroskedasticity without requiring a specific alternative hypothesis regarding the pattern of heteroskedasticity. This test operates by estimating a secondary regression of the squared residuals from the original model against the original model's independent variables and their squares and cross-product. The formulation of the White test for heteroskedasticity involves regressing the squared residuals of the original regression model on the independent variables, including their squares and cross-product, and then computing the R-squared value from this regression. The test statistic is then calculated by multiplying this R-squared value by the sample size, which approximately follows a chi-square distribution with degrees of freedom equal to the number of regressors used in the test model. The significant result from the White test would indicate the rejection of the null hypothesis, which posits the absence of heteroskedasticity, thereby suggesting that the variance of the residuals is not constant. The results of the White's test of the model used are shown in Table 5.

The results from the White test for heteroskedasticity indicate an unadjusted R-squared of 0.426456 and a test statistic (TR^2) of 9.808497, which corresponds to a chi-square distribution with 14 degrees of freedom. The associated p-value of 0.776046 significantly exceeds significance level 0.05, leading to the non-rejection of the null hypothesis of no heteroskedasticity. This suggests that there is no evidence of heteroskedasticity in the model, implying that the variance of the residuals does not systematically depend on the values of the independent variables. Therefore, the standard errors of the regression coefficients are likely reliable, supporting the validity of inferences based on these estimates and affirming the efficiency of the usual OLS estimators without the need for corrective measures such as weighted least squares or robust standard errors.

The Breusch-Godfrey test is used to assess autocorrelation in the residuals of a regression model. The null hypothesis of the test is that there is no autocorrelation of any order up to a specified lag. The test operates by regressing the residuals from the original regression on the initial regressors and a specified number of their lagged residuals. The test statistic, derived from the R-squared of this auxiliary regression, follows a chi-square distribution, and a significant result leads to the rejection of the null hypothesis, indicating the presence of autocorrelation. This method provides a robust mechanism for identifying autocorrelation, ensuring that the conclusions drawn from regression analysis are based on appropriately specified models. The results of the autocorrelation test are shown in Table 6.

The results from the Breusch-Godfrey test for autocorrelation in the regression model using data from 2000 to 2022 indicate no significant autocorrelation in the residuals. The coefficients of the lagged variables are not statistically significant, as evidenced by high p-values (ranging from 0.9144 to 0.9810), suggesting these factors do not significantly predict the current residuals when past residuals are considered. The coefficient for the lagged residual itself is also not significant with a p-value of 0.6300. Furthermore, the unadjusted R-squared value of 0.013960 is very low, indicating a weak power of the model to explain for the residual

Table 5. White's test for heteroskedasticity.

OLS, using observations 2000-2023 (T = 23)				
Dependent variable: uhat^2				
	coefficient	**std. error**	**t-ratio**	**p-value**
const	1.08792e+09	1.21250e+09	0.8972	0.3958
Repolag1yearX1_1	1.02250e+08	1.27686e+08	0.8008	0.4464
InflationX2	2.90966e+07	6.97337e+07	0.4173	0.6875
CZKEURexchangera~	−8.69309e+07	9.16549e+07	−0.9485	0.3707
d_CZKUSDexchange~	−2.50271e+07	4.95438e+07	−0.5052	0.6271
sq_Repolag1yea~_1	4.41582e+06	5.80790e+06	0.7603	0.4689
X2_X3	−5.17426e+06	6.22345e+06	−0.8314	0.4299
X2_X4	−3.69493e+06	4.98949e+06	−0.7405	0.4801
X2_X5	−3.66309e+06	4.84642e+06	−0.7558	0.4714
sq_InflationX2	693323	1.52647e+06	0.4542	0.6618
X3_X4	−1.11490e+06	2.56511e+06	−0.4346	0.6753
X3_X5	797938	2.30764e+06	0.3458	0.7384
sq_CZKEURexchang~	1.75859e+06	1.74105e+06	1.010	0.3420
X4_X5	1.15657e+06	2.03857e+06	0.5673 0.5860	
sq_d_CZKUSDexcha~	−3.35904e+06	2.24870e+06	−1.494	0.1736
Unadjusted R-squared	= 0.426456			
Test statistic: TR^2 : TR^2 = 9.808497,				
with p-value = P(Chi-square(14) > 9.808497) = 0.776046				

Source: Own Calculation in Gretl software

Table 6. Breusch-Godfrey test for first-order autocorrelation.

OLS, using observations 2000-2022 (T = 23)				
Dependent variable: uhat				
	coefficient	**std. error**	**t-ratio**	**p-value**
const	378.499	12630.4	0.02997	0.9764
Repolag1yearX1_1	34.1529	983.617	0.03472	0.9727
InflationX2	−47.5336	435.587	−0.1091	0.9144
CZKEURexchangera~	−11.4928	475.992	−0.02415	0.9810
d_CZKUSDexchange~	−10.0193	389.902	−0.02570	0.9798
uhat_1	0.123732	0.252211	0.4906	0.6300
Unadjusted R-squared = 0.013960				
Test statistic: LMF = 0.240676, with p-value = P(F(1.17) > 0.240676) = 0.63				
Alternative statistic: TR^2 = 0.321075, with p-value = P(Chi-square (1) > 0.321075) = 0.571				
Ljung-Box Q' = 0.332691, with p-value= P(Chi-square(1) > 0.332691) = 0.564				

Source: Own Calculation

variation. The LMF test statistic of 0.240676 with a p-value of 0.63, along with other diagnostic statistics such as TR^2 and Ljung-Box Q', both of which also show p-values well above conventional significance levels (0.571 and 0.564, respectively), show the absence of first-order or higher autocorrelation in the model residuals. This outcome confirms that the residuals from the model are independent across observations, validating a key assumption of the OLS regression.

Based on the comprehensive evaluation conducted through diagnostic tests, the regression model shows its robustness with no significant violations of key as-

sumptions. No significant issue is found in the tests for heteroskedasticity and autocorrelation, indicating that the residuals have constant variance and are independent across observations. The lack of heteroskedasticity and autocorrelation suggests that the standard errors derived from the model are reliable, and the parameter estimates are efficient. Moreover, the adjusted R-squared, although not capturing all the variability in the dependent variable, still provide a reasonable explanation of the variability of the included variables. Overall, the model can withstand scrutiny on fundamental econometric grounds, making it a valid tool for inference about the effects of the independent variables on the dependent variable in the context of this study.

5. Discussion

Integrating the regression model findings with specific details from the literature review deepens our understanding on how monetary policy impacts agricultural enterprises, drawing on theoretical insights and empirical data to offer a nuanced picture. The significant negative relationship between repo rates and agricultural revenues, as indicated by a p-value less than 0.0001 for the repo rate coefficient, aligns with literature assertions [1,4] that higher interest rates will elevate financing costs, consequently dampening investments and economic activities within sectors like agriculture. This is particularly evident in our findings, where higher rates in the previous year have a discernible dampening effect on agricultural revenues. The positive relationship between inflation and agricultural revenues in our model supports discussions from the literature that low interest rates, while reducing borrowing costs, can lead to higher inflation, potentially increasing the revenues of agricultural enterprises by enabling higher pricing of agricultural products [5,6]. This phenomenon underscores the dual nature of inflation's impact, beneficial in terms of revenue generation but potentially harmful if escalated costs are not managed [5]. Exchange rates, however, did not show significant effects on agricultural revenues in our model, which could be explored further in the context of existing literature. Studies have shown [34,35] that exchange rates impact agricultural competitiveness at an international level, yet our findings suggest that this impact may not be direct or significant for all enterprises, possibly due to varying degrees of market exposure or effective risk management strategies employed within the sector. This observation calls for a deeper investigation into specific market conditions and enterprise characteristics that could influence this relationship.

In sum, our empirical findings resonate with established economic theories and previous research results, illustrating how monetary policies influence agricultural economics. They reveal the complexity of these relationships and the necessity for policies that not only aim for macroeconomic stability but also consider sector-specific dynamics to support sustainable growth. This integration of empirical data with literature insights not only validates our model but also enriches the discourse on monetary policy's role in agricultural and broader economic contexts.

6. Conclusions

This study investigates the impact of monetary policy on the competitiveness of agricultural enterprises, underscores several critical interactions between monetary variables and agricultural performance. Drawing on both the empirical findings from the regression analysis and the theoretical insights discussed in the literature review, we can assert that monetary policy exerts a significant influence on the agricultural sector. Firstly, the empirical evidence from our model, which highlights a strong negative correlation between higher repo rates and agricultural revenues, aligns with the theoretical discussions that suggest higher interest rates increase the financial burden on agricultural operations, thus curtailing investments and, consequently, dampening the sector's competitiveness. This finding is particularly resonant with the broader economic principles that tight monetary policies, while stabilizing the currency, can adversely affect sectors like agriculture that are sensitive to capital costs.

Additionally, the positive relationship observed between inflation and agricultural revenues reflects the complexity of inflation's effects. While inflation can escalate the costs of agricultural inputs, it also has the potential to increase the revenues of agricultural enterprises by allowing higher prices for agricultural products. This dual effect underscores the nuanced role inflation plays in the agricultural sector, necessitating a balanced approach in monetary policymaking to harness benefits while mitigating adverse impacts. However, this study did not find significant effects from exchange rates on agricultural revenues, suggesting that this area may require further exploration to fully understand the nuances of how these factors impact the sector. While this study provides a robust examination of the relationships between monetary policy and agricultural competitiveness, it is important to acknowledge its limitations. First, the absence of

significant findings regarding exchange rates might be due to the limited scope of the data or the complexity of exchange rate impacts that this study was unable to capture fully. The agricultural sector's response to exchange rate fluctuations might be influenced by variables not included in our model, such as specific export or import dependencies, which were not explored in depth. Secondly, the study's reliance on revenue as a sole indicator of competitiveness might not capture other essential aspects of agricultural success, such as market share, technological adoption, and sustainability practices. Future studies could benefit from including a broader set of indicators to provide a more comprehensive analysis of competitiveness. Thirdly, while the regression model accounts for several key variables, there may be other unobserved factors affecting the outcomes, such as policy changes, regional economic conditions, and climatic factors, which could introduce bias or variance into the results. The study's findings are based on the assumption that the chosen variables adequately represent the dynamics of the agricultural sector, which might not always hold true.

This study provides a comprehensive analysis of how monetary policies influence agricultural competitiveness. By integrating empirical data with theoretical perspectives, it offers a clear depiction of the complex dynamics within the agricultural sector influenced by monetary variables. While there are limitations and areas requiring further research, the findings significantly contribute to the economic literature and can serve as a critical tool for evidence-based policymaking aimed at enhancing the performance and sustainability of the agricultural sector.

Author Contributions

Mansoor Maitah: Conceptualization, Methodology, Data curation, Writing-original draft. Rober Koželský: Methodology, Resources, Supervision, Writing- review & editing. Eva Cvik: Methodology, Data curation. Daniel Toth: Conceptualization, Methodology. Emil Flegel: Supervision, Funding acquisition. Ali Sindi: Methodology, Data curation. Ondřej Zelenka: Conceptualization, Methodology.

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Data Availability

The data is available upon request from the corresponding author.

Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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