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Monetary Conditions and Firm Performance in Czech Agriculture: Evidence from Firm-Level Panel Data

Mansoor Maitah , Michaela Urbanová , Karel Malec , Karel Tomšík

Department of Economics, Faculty of Economics and Management, Czech University of Life Sciences Prague, Czech Republic

Abstract

The aim of this paper is to examine how monetary conditions are associated with firm performance in the Czech agricultural sector. Using a balanced panel of 167 firms observed over the effective estimation period 2016-2024, the paper estimates static firm fixed-effects models for three complementary outcomes: return on equity (ROE), year-on-year log sales growth and cash flow to assets. The objective is to assess whether tighter monetary conditions were linked to weaker profitability, slower expansion and lower internal financing capacity in the broad agricultural economy. The results indicate that higher interest rates are associated with lower ROE, weaker sales growth and lower cash flow to assets, while higher real rates are negatively associated with ROE and internal liquidity. Exchange-rate appreciation is positively associated with sales growth and cash-flow capacity, which suggests that, in this sector, the imported-input cost channel may dominate the conventional export-price competitiveness channel.

Keywords

Monetary policy, interest rate, exchange rate, firm performance, agriculture, Czech Republic.

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Introduction

Monetary policy affects firms through several interconnected channels. Changes in policy rates alter the cost of external finance and the opportunity cost of internal funds; they also interact with bank balance sheets, risk-taking incentives, expectations and asset prices. In the canonical transmission literature, firm outcomes respond not only through the traditional interest-rate channel but also through credit frictions and balance-sheet amplification (Bernanke, 2022; Borio and Zhu, 2012). These mechanisms are unlikely to be uniform across firms. Theory and evidence suggest that balance-sheet strength, dependence on external finance, collateral, firm size and sectoral business models condition how the same macroeconomic impulse is transmitted into profitability and growth (Bruno and Shin, 2015). This heterogeneity is central for an agricultural-economics perspective because sectoral composition affects both financing structures and exposure to input-cost shocks.

In small open economies, the exchange-rate channel adds another layer of heterogeneity. Exchange-rate movements reshape the relative price of exports and imported inputs, and the net firm-level effect depends on invoicing, import intensity, pricing power, productivity and the composition of revenues and costs (Galí and Monacelli, 2005; Campa and Goldberg, 2005; Berman et al., 2012; Amiti et al., 2014; Aman et al., 2022). For some firms, appreciation weakens external competitiveness; for others, it lowers the cost of imported energy, feed, fertilisers, machinery and intermediate inputs. This ambiguity is exactly why sector-specific evidence matters.

Agriculture provides a particularly informative setting for studying such heterogeneity. Firms in this broad sector combine biological production cycles, weather exposure, uneven bargaining power, seasonal working-capital needs and sensitivity to transport, fuel and imported inputs, which makes their margins and liquidity sensitive to both input-cost and financing shocks (Pokrivčák and Tóth, 2022; Khafagy and Vigani, 2023; Ölkers and Musshoff, 2024). In addition, the capital structure of agricultural firms is shaped by land, buildings, machinery, biological assets and inventories that are asset-heavy, sector-specific

and often imperfectly liquid. These assets can support collateralised borrowing, but they also create high fixed costs, long investment horizons and exposure to valuation changes, making leverage and the cost of debt central to profitability and financial resilience (Pokharel et al., 2019; Toušek et al., 2025). As a result, interest-rate increases may affect agricultural firms not only through the price of new credit, but also through refinancing conditions, working-capital pressure and the opportunity cost of maintaining liquidity buffers (Yeager and Barnard, 2014; Ölkers and Musshoff, 2024).

Existing agricultural finance research supports this concern. Evidence from the United States shows that financial stress in agricultural cooperatives is closely linked to low profitability, leverage and the interest-rate environment (Pokharel et al., 2019). Farm-management case research similarly indicates that liquidity buffers become more valuable when net farm incomes weaken and interest rates rise (Yeager and Barnard, 2014). Recent Czech evidence also suggests that leverage and the cost of debt remain central drivers of financial outcomes in agricultural firms once balance-sheet composition and biological assets are taken into account (Toušek et al., 2025).

The Czech Republic is an especially relevant case because the estimation period 2016-2024 combines years of near-zero interest rates, pandemic disruption, the aftermath of the Czech National Bank (CNB) exchange-rate commitment, the energy shock and a rapid tightening cycle. Czech macroeconomic research has documented important changes in the domestic transmission mechanism and the balance-sheet implications of exchange-rate policy, while price studies show that pass-through remains an important feature of the small open economy environment (Brůna, 2010; Franta et al., 2014; Hájek and Horváth, 2016; Franta et al., 2022). Yet firm-level sector evidence for the broad agricultural economy remains scarce. A further motivation is conceptual. In this paper, competitiveness is treated as a multidimensional firm concept rather than as a single trade indicator. This is why the analysis considers profitability, expansion and internally generated funds simultaneously; taken together, these outcomes capture whether firms can maintain accounting profitability, grow and finance adaptation under changing macroeconomic conditions. At the same time, because they are accounting-based measures, they have to be interpreted with the caution emphasised in the earnings-quality literature (Dechow et al., 2010).

The objective of this paper is to examine how monetary conditions are associated with three complementary dimensions of firm performance in the Czech NACE section A - agriculture, forestry and fishing: profitability, sales growth and internal liquidity. The paper uses a balanced panel of 167 firms observed over the effective estimation period 2016-2024 and estimates static firm fixed-effects models for ROE, year-on-year log sales growth and the cash flow to assets ratio. The focus on this sector reflects both the substantive relevance of the sector and the need to retain a sample large enough for credible sector-level inference.

The contribution of the paper is threefold. First, it provides sector-specific evidence for Czech agriculture within a firm-level panel framework. Second, it brings together the interest rate, exchange rate and real interest rate perspectives within one sector-specific design. Third, it connects macroeconomic financial transmission to firm-level outcomes that matter directly for resilience and competitiveness in the agricultural economy.

Literature review

Monetary transmission from macro policy to firm outcomes

The broader macroeconomic literature treats monetary policy as a central determinant of aggregate demand, inflation and financing conditions, but the firm-level route of transmission is increasingly understood as a macro-financial process rather than a single mechanical interest-rate effect. In the New Keynesian tradition, policy influences output and prices through intertemporal substitution, expectations management and the credibility of the nominal anchor (Carlin and Soskice, 2015; Mishkin, 2022). Central banking research then adds institutional design, communication and credibility as key elements of the transmission environment (Blinder et al., 2008; Bernanke, 2022).

A related insight of the post-crisis literature is that the financial cycle modifies the strength of transmission and may generate outcomes that cannot be understood from the policy rate alone. When leverage, liquidity and balance-sheet valuations move strongly, monetary policy can affect risk appetite and external finance premia in ways that alter firm outcomes even before standard investment responses fully materialise (Borio and Zhu, 2012; Borio, 2014; Bruno and Shin, 2015). This broader perspective is especially useful for reading the examined period, which includes both accommodative conditions and a sharp tightening phase.

Interest-rate and credit channel

The interest-rate and credit channel is the most direct benchmark for the present analysis. Bernanke (2022) shows how monetary tightening affects credit conditions through banks and the cost of finance. This logic is extended by emphasising agency costs, borrower balance sheets and the financial accelerator. In this framework, weaker net worth raises the external finance premium, reducing investment and amplifying the real effects of shocks.

At the firm level, the empirical implications are clear: firms that are more dependent on external finance, hold weaker collateral, or face tighter liquidity constraints should react more strongly to monetary tightening. This logic is reinforced by the financing-constraints literature and by evidence on small-firm cyclicality and bank-lending transmission. Recession and credit-crunch evidence further suggests that the effect of tighter conditions is not limited to investment, but can also compress profitability, working capital and survival margins (Claessens et al., 2008; Bianchi, 2011).

Exchange-rate channel in a small open economy

For a small open economy, the exchange rate is not a side issue but a core transmission channel. The classic open-economy framework predicts that monetary policy affects output partly through the exchange rate and trade competitiveness. Later models formalise how exchange-rate movements enter domestic demand, pricing and inflation dynamics in an economy with incomplete pass-through and sectoral heterogeneity (Galí and Monacelli, 2005; Campa and Goldberg, 2005).

The firm-level trade literature makes this channel more nuanced. Exchange-rate movements do not affect all firms alike because exporters, importers and two-way traders differ in market structure, mark-ups, import intensity and productivity. More productive firms may absorb part of the shock in margins; input-intensive firms may benefit from appreciation even if export competitiveness weakens; and heterogeneous-firm selection can reshape sector aggregates (Berman et al., 2012; Amiti et al., 2014). This matters for section A because agricultural, forestry and fishing firms often combine domestic production with imported inputs and equipment.

Internal finance, liquidity and resilience in agriculture

A complementary strand of literature links monetary conditions to internal finance and resilience. Cash flow, retained earnings and liquidity buffers can determine whether firms are able to maintain investment, working capital and adaptation expenditures during periods of tighter financing conditions. This perspective is closely connected to the financial accelerator, but it also highlights the role of self-financing and balance-sheet resilience in day-to-day business operation (Dechow et al., 2010).

This issue is particularly relevant in agriculture and related sectors. Agri-food firms often face financing gaps despite being economically viable, because investments are lumpy, collateral can be imperfect, and project horizons may be long relative to loan structures (Pokrivčák and Tóth, 2022). Recent evidence links external finance to agricultural productivity growth (Khafagy and Vigani, 2023) and shows that agricultural loan demand responds to interest rates, macroeconomic conditions and agricultural cycles (Ölkers and Musshoff, 2024). Cooperative studies also underline that low profitability, leverage and high interest rates can jointly create financial stress, while liquidity management may be crucial for repayment capacity under adverse scenarios (Pokharel et al., 2019; Yeager and Barnard, 2014).

Agricultural firms, profitability and balance-sheet composition

The agricultural-finance literature also points to the importance of firm structure. Recent Czech evidence suggests that the cost of debt in agricultural firms depends strongly on leverage, while profitability is shaped by balance-sheet composition and asset tangibility (Toušek et al., 2025). Related studies in agricultural and agri-food industries show that profitability depends on working capital, asset structure, capital intensity and financial development, all of which can affect how macroeconomic tightening translates into firm outcomes (Setianto et al., 2022; Beyer and Hinke, 2020; Mijic and Jaksic, 2017). In agriculture, this transmission is likely to be shaped by a distinctive asset base: land-related assets, machinery, biological assets and inventories make balance sheets comparatively asset-intensive, while the liquidity of these assets may be limited in periods of stress. The same asset structure can improve collateral capacity in normal times but can also make profitability and refinancing more sensitive to interest-rate changes when debt service costs rise.

These insights reinforce the relevance of using more than one dependent variable. Profitability alone may miss whether a macroeconomic shock works

primarily through accounting profitability, revenue growth or the internal generation of funds; because these three dimensions need not move together, a single ratio can understate firm-level exposure. A multidimensional outcome set is therefore useful when the objective is to connect macro-financial tightening to firm resilience rather than to a single accounting ratio.

Czech evidence and the research gap

The Czech literature provides an important macro background, but it leaves a sector-level micro gap. Brůna (2010) discusses liquidity management and monetary-policy implementation in the Czech banking environment. Franta et al. (2014) examine changes in the Czech monetary transmission mechanism, while Hájek and Horváth (2016) show that exchange-rate pass-through remains relevant in the Czech Republic. Franta et al. (2022) further demonstrate that the legacy of exchange-rate policy has material balance-sheet implications in a small open economy. Together, these studies confirm that monetary conditions matter in the Czech setting, but they do not directly show how such conditions are reflected in firm-level agricultural outcomes.

What is still missing in the literature is sector-specific firm-level evidence for the broad agricultural economy in the Czech Republic. Existing work either stays at the macro level, focuses on prices and pass-through, or analyses agricultural firms through different accounting questions rather than through the lens of monetary transmission. The present paper addresses this gap by bringing a Czech agricultural sector panel into a fixed-effects framework that jointly tests rate, exchange-rate and real-rate conditions against profitability, sales growth and cash-flow capacity.

Materials and methods

Data sources and sample construction

The empirical analysis combines firm-level accounting data from Orbis with annual macroeconomic indicators from the Czech Statistical Office and the Czech National Bank databases. The underlying firm panel covers 2015-2024 and is constructed as a balanced panel of Czech-resident firms. Because sales growth and exchange-rate changes are measured in year-on-year differences, the effective estimation period in the static specifications runs from 2016 to 2024. The sector sample used in this paper consists of 167 firms classified under CZ-NACE Section A, corresponding to NACE Rev. 2 Section A: Agriculture, forestry and fishing, including divisions 01-03.

Constructing the dataset as a balanced panel improves the consistency of the longitudinal analysis by ensuring that each firm is observed across the full study period. This restriction is analytically useful, but it also narrows the empirical coverage of the sample. In particular, it excludes firms with interrupted reporting records, firms entering the sector during the period, and firms exiting before the end of the examined period. As a consequence, the sample is likely to over-represent firms with greater organisational stability and more regular reporting practices. The balanced-panel structure should therefore be understood as a deliberate methodological trade-off: it strengthens comparability over time, but it does not constitute a complete census of all firms operating in the sector in each year.

Model specification

Firm performance is captured by three dependent variables. The first is return on equity (ROE), used as an equity-scaled measure of accounting profitability. The second is year-on-year log sales growth, defined as the change in the natural logarithm of operating revenue and used to capture expansion in market activity. The third is cash flow to assets, defined as operating cash flow relative to total assets and used to proxy internal financing capacity and operational resilience. This outcome set reflects a multidimensional view of competitiveness at the firm level rather than a single export-based measure. Because all three outcomes are accounting-based, they are interpreted with caution and not as comprehensive measures of welfare or technical efficiency.

The key macroeconomic variables are the year-end CNB two-week repo rate, the annual log change in the CNB nominal effective exchange-rate index (NEER), and the real policy rate defined as the repo rate minus annual CPI inflation. The exchange-rate variable is multiplied by 100, so a positive value corresponds to an appreciation of the koruna. Additional controls include annual CPI inflation, year-on-year growth of the M2 broad-money aggregate, the Czech Statistical Office business/economic-sentiment confidence indicator, and firm size measured by the logarithm of total assets. In the real-rate specification, the real rate replaces the separate nominal-rate and inflation terms to avoid double counting.

The use of ROE rather than a ROA-based profitability measure deserves comment, because interest rates affect firm performance partly through financial leverage and the cost of debt. By construction, ROE is sensitive to capital structure: for a given level of operating performance, higher

leverage mechanically raises ROE in favourable years and depresses it when financing costs rise. This mechanical sensitivity is precisely why the coefficient is not interpreted as a pure operating-profitability effect. ROE is retained because it is widely reported in the agricultural-finance literature and because the equity-holder perspective is relevant when monetary tightening works through leverage, refinancing and the cost of debt. At the same time, ROE is complemented by cash flow to assets, which is asset-scaled and less directly affected by equity scaling, and the consistency of signs across these outcomes is treated as evidence that the results are not driven solely by the mechanical leverage component of ROE. A fuller ROA/leverage comparison is left for future work because consistently reported operating-profit and liability items are not available in the present extract.

Firm performance is modelled with a static firm fixed-effects specification. For firm *i* in year *t*, each outcome is related to a single monetary variable and a vector of controls according to:

$$y_{it} = \alpha_i + \beta\, MP_t + \gamma' X_{it} + \varepsilon_{it} \qquad (1)$$

where y_{it} denotes the relevant firm outcome, α_i captures unobserved time-invariant firm heterogeneity, MP_t denotes the selected monetary variable, X_{it} contains the macroeconomic controls and the firm-size control, β is the coefficient of interest, and ε_{it} is the idiosyncratic error term. Standard errors are clustered at the firm level, and the significance of the monetary coefficients is cross-checked with Driscoll-Kraay standard errors that are robust to heteroskedasticity, serial correlation and cross-sectional dependence.

For each of the three dependent variables, equation (1) is estimated in three separate versions that differ only in the monetary variable MP_t: (a) a repo-rate model, in which MP_t is the CNB two-week repo rate; (b) a real-rate model, in which MP_t is the real repo rate (the repo rate minus CPI inflation), with the separate inflation control omitted to avoid double counting; and (c) an exchange-rate model, in which MP_t is the annual log change in the nominal effective exchange rate. This design yields nine estimated equations in total (three outcomes × three monetary variables). The three monetary variables are treated as complementary rather than competing: the repo rate captures nominal financing pressure, the real rate captures monetary tightness net of inflation, and the exchange rate captures external input-cost and competitiveness conditions.

The coefficients are interpreted with deliberate caution. Because the monetary variables are common to all firms in a given year, the coefficient β is identified only from variation over time across a relatively short horizon. The estimates should therefore be read as conditional within-firm associations that are consistent with standard transmission mechanisms, not as structural causal multipliers; the identification concerns this raises are discussed in detail in the Limitations subsection.

Table 1 summarises the construction and interpretation of all variables used in the estimations, grouped into dependent

Group	Variable	Construction / definition	Interpretation
Dependent	ROE	ROE (%); Orbis ratio defined as profit/loss before tax divided by book equity; winsorised at the 1st and 99th percentiles	Profitability (equity-scaled; sensitive to leverage)
	Δln Sales	Δln Sales = ln(operating revenuet) - ln(operating revenuet-1); winsorised at the 1st and 99th percentiles	Firm expansion / turnover dynamics
	CF/Assets	CF/Assets = operating cash flow, measured as net income plus depreciation and amortisation, divided by total assets; winsorised at the 1st and 99thpercentiles	Internal financing capacity and operational resilience (asset-scaled)
Monetary	Repo rate	Year-end value of the CNB two-week repo rate, in percent	Nominal monetary-policy stance
	Real repo rate	Real repo rate = year-end CNB two-week repo rate minus annual CPI inflation, in percentage points	Real monetary tightness
	Δln NEER	100 × [ln(NEERt) - ln(NEERt-1)], based on the CNB nominal effective exchange-rate index; positive values denote koruna appreciation	Exchange-rate / imported-input cost and competitiveness conditions
Controls	CPI inflation	Annual average CPI inflation rate, in percent, from the Czech Statistical Office	Price environment
	M2 growth	Year-on-year growth of the M2 broad-money aggregate, in percent	Macro-financial environment
	Business confidence	Annual average of the Czech Statistical Office business/economic-sentiment confidence indicator	Expectations / demand environment
	ln Assets	Natural logarithm of total assets from Orbis	Firm-size control

Source: Own processing

Table 1: Variable construction and interpretation.

variables, the main monetary (explanatory) variables, and control variables. The set of outcomes deliberately combines a profitability indicator, a growth indicator and an internal-finance indicator, so that the empirical results can speak to several dimensions of firm resilience at once rather than to a single accounting ratio.

Sample composition and descriptive statistics

An important descriptive feature of the sample is that this section is agriculture-dominant even though the paper keeps the formal section-A label throughout. More than 92% of firms and observations come from NACE division 01, while division 02 represents a smaller forestry-and-logging segment and division 03 is only marginally represented. This composition justifies two statements at once: first, the broad sectoral label remains factually correct; second, the results are likely to reflect the economics of agriculture much more than the economics of fishing.

The sample is also informative about firm size. Using the size classification in the underlying dataset, 152 of the 167 firms (91.0%) are small, 15 (9.0%) are medium-sized and none are large, so the panel is dominated by small and medium-sized enterprises. Size dispersion is nonetheless considerable: the logarithm of total assets has a mean of 15.09 and ranges from 12.02 to 18.26 (Table 3), so even within a predominantly small-firm sample the largest balance sheets are several hundred times larger than the smallest. Information on financial leverage is not available in a sufficiently consistent form in the current data extract, which contains turnover, cash-flow information, total assets and profitability indicators but does not include reliable liability items across the full balanced panel. The role of indebtedness is therefore noted as a limitation and a priority for future data collection rather than quantified here.

Given the accounting nature of the data, key ratio variables are winsorised at the 1st and 99th percentiles. This is especially important for ROE because accounting profitability can become mechanically volatile when equity is low. Winsorisation does not solve all measurement problems, but it reduces the influence of extreme observations without removing the within-sample variation that the fixed-effects design needs. The descriptive statistics confirm that the resulting sample still exhibits substantial dispersion, especially in profitability and sales growth.

Because the fixed-effects estimator exploits only within-firm variation, Table 4 decomposes

NACE division	Firms	Firm share (%)	Observations	Obs. share (%)
01 Agriculture	154	92.2	1386	92.2
02 Forestry and logging	12	7.2	108	7.2
03 Fishing and aquaculture	1	0.6	9	0.6

Source: Own processing based on the section A estimation sample

Table 2: Composition of the section A sample by NACE division.

Variable	N	Mean	Std. dev.	Min	Median	Max
ROE, winsorised	1503	7.843	18.763	-220.105	6.736	111.973
Δln Sales, winsorised	1502	0.073	0.330	-0.773	0.042	2.969
CF/Assets, winsorised	1503	0.107	0.079	-0.489	0.098	0.584
ln Assets	1503	15.093	1.012	12.021	15.055	18.255
Repo rate	1503	2.894	2.509	0.050	2.000	7.000
CPI inflation	1503	4.811	4.518	0.700	2.800	15.100
M2 growth	1503	7.414	1.620	4.964	7.013	10.671
Business confidence	1503	98.743	5.699	88.903	96.527	106.436
Δln NEER	1503	1.207	2.578	-2.357	0.482	6.322
Real repo rate	1503	-1.917	2.680	-8.100	-0.800	1.600

Source: Own processing based on Orbis and CZSO data

Table 3: Descriptive statistics of the sample.

Variable	Overall SD	Between-firm SD	Within-firm SD	Within share (%)
ROE	18.763	11.141	15.097	64.7
Δln Sales	0.330	0.102	0.314	90.5
CF/Assets	0.079	0.055	0.056	50.9

Source: Own processing based on the estimation sample

Table 4: Within-firm variation in the dependent variables.

the dispersion of each dependent variable into a between-firm and a within-firm component. The within-firm component dominates for all three outcomes, accounting for about 65% of the total variance of ROE, 91% for sales growth and 51% for cash flow to assets. This is informative for interpreting the modest within R^2 reported below: the limited explanatory power does not stem from a lack of within-firm variation—there is substantial year-to-year movement within firms—but rather from the limited explanatory reach of macroeconomic regressors that are common to all firms in a given year.

Annual macroeconomic context

The macroeconomic environment changed sharply over the estimation period. The annual values in Table 5 show three distinct phases: a low-rate period in 2016–2020, an abrupt tightening and inflation episode in 2021–2023, and the return to a positive real repo rate in 2024. This chronology matters for interpretation because the estimated firm-level coefficients combine these different regimes into one within-sample relationship (Figure 1).

Model selection, diagnostic tests and inference

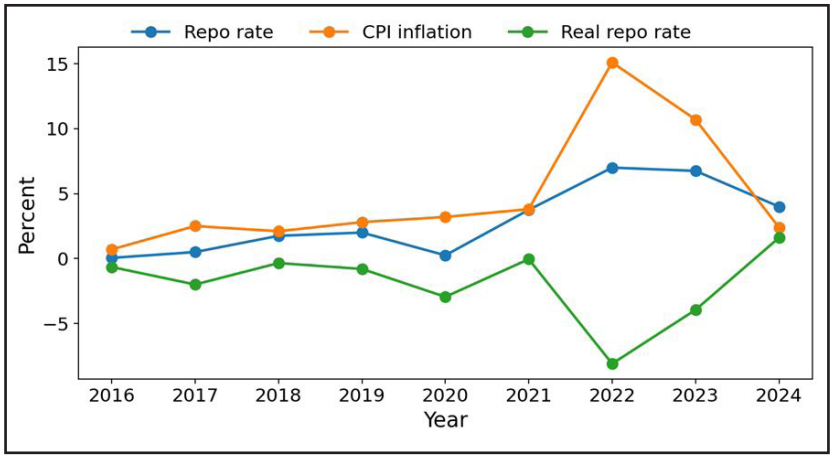
The baseline estimator is the firm fixed-effects model. This choice is motivated primarily by the research question, which focuses on within-firm associations after removing time-invariant heterogeneity in the business model, accounting practice and risk profile. Fixed and random effects were compared using Hausman tests for all nine baseline equations. The evidence is mixed: the null of no systematic FE–RE difference is rejected only in the real-rate sales-growth equation ($p = 0.016$), while the remaining equations do not reject the null. Because the FE and RE monetary coefficients are quantitatively very similar and because FE remains consistent under possible correlation between firm-specific heterogeneity and the regressors, FE is retained as the conservative baseline estimator.

Residual diagnostics were then performed for the FE equations. Wooldridge tests do not

Year	Repo rate	CPI inflation	Real repo rate	M2 growth	Business confidence	Δln NEER
2016	0.05	0.70	-0.65	6.57	103.90	0.48
2017	0.50	2.50	-2.00	8.58	105.13	6.32
2018	1.75	2.10	-0.35	5.64	106.44	-0.28
2019	2.00	2.80	-0.80	7.01	102.83	0.80
2020	0.25	3.20	-2.95	10.67	88.90	-1.13
2021	3.75	3.80	-0.05	6.99	96.53	3.03
2022	7.00	15.10	-8.10	4.96	95.99	3.99
2023	6.75	10.70	-3.95	8.58	93.21	-0.01
2024	4.00	2.40	1.60	7.73	95.75	-2.36

Source: Own processing based on CNB and CZSO indicators assigned to firm-year observations

Table 5: Annual macroeconomic context in the estimation period.



Source: Own processing based on annual CNB and CZSO data

Figure 1: Czech monetary environment in 2016–2024.

indicate first-order serial correlation in the ROE equations ($p \approx 0.40$), but they do indicate serial correlation in the sales-growth and cash-flow equations ($p < 0.001$). Modified Wald tests reject homoskedasticity in all nine equations ($p < 0.001$). Pesaran CD statistics additionally point to cross-sectional dependence in most specifications, which is unsurprising because the key macroeconomic variables are common within each year. The main tables therefore report firm-clustered robust standard errors, and the statistical significance of the main monetary coefficients is cross-checked using Driscoll–Kraay standard errors robust to heteroskedasticity, serial correlation and cross-sectional dependence. The main tables (Table 6 and Table 7) therefore report firm-clustered robust standard errors.

Results and discussion

Table 7 and Figure 2 summarize the main monetary coefficients for the three outcomes. The overall pattern is coherent across specifications: tighter monetary conditions are associated with weaker firm outcomes in section A. The clearest result is the nominal interest-rate channel. A one-percentage-point increase in the CNB repo rate is associated with a decline in ROE of about 1.69 percentage points, an approximately 4.2% decline in the level of sales and a decline in cash flow to assets of about 0.0077, which equals roughly 7.2% of the sample mean of 0.107. Relative to the descriptive means reported above, these are economically meaningful associations rather than merely statistically significant signs. Because the monetary variables vary only over time, these estimates cannot fully separate the effect of monetary conditions from other macroeconomic developments that co-moved over the period, such as inflation, energy prices and the broader business cycle; the patterns below are therefore described as associations and are revisited in the Limitations subsection.

Diagnostic and robustness checks support the substantive reading of Table 7. When inference is re-estimated with Driscoll–Kraay standard errors robust to heteroskedasticity, serial correlation and cross-sectional dependence, the repo-rate coefficients remain negative and statistically

Outcome	Specification	Hausman p	Wooldridge p	Wald p
ROE	Exchange-rate	1.000	0.399	<0.001
ROE	Repo-rate	0.911	0.406	<0.001
ROE	Real-rate	0.999	0.403	<0.001
Δln Sales	Exchange-rate	0.105	<0.001	<0.001
Δln Sales	Repo-rate	0.863	<0.001	<0.001
Δln Sales	Real-rate	0.016	<0.001	<0.001
CF/Assets	Exchange-rate	0.824	<0.001	<0.001
CF/Assets	Repo-rate	1.000	<0.001	<0.001
CF/Assets	Real-rate	0.806	<0.001	<0.001

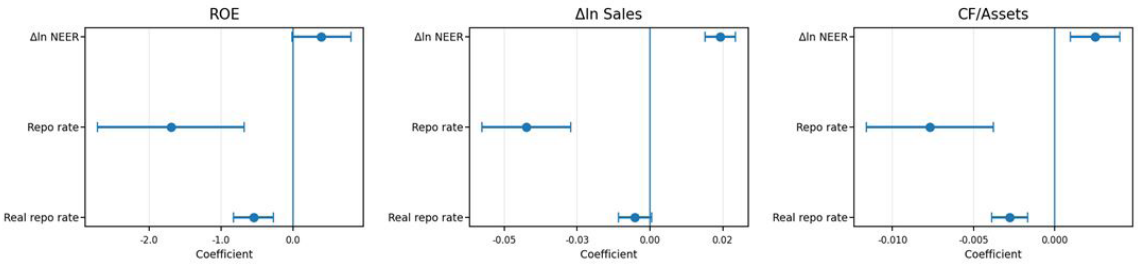
Note: Hausman compares fixed and random effects; Wooldridge tests first-order serial correlation; modified Wald tests groupwise heteroskedasticity
Source: Own processing

Table 6: Model selection and diagnostic tests.

Monetary variable	Specification	ROE	Δln Sales	CF/Assets
Δln NEER	Exchange-rate	0.3978* (0.2095) within R^2 = 0.010	0.0241*** (0.0027) within R^2 = 0.071	0.0025*** (0.0008) within R^2 = 0.025
Repo rate	Repo-rate	-1.6933*** (0.5200) within R^2 = 0.021	-0.0424*** (0.0077) within R^2 = 0.069	-0.0077*** (0.0020) within R^2 = 0.038
Real repo rate	Real-rate	-0.5465*** (0.1402) within R^2 = 0.013	-0.0051* (0.0029) within R^2 = 0.049	-0.0028*** (0.0006) within R^2 = 0.027
Observations		1503	1502	1503
Firms		167	167	167

Notes: Coefficients shown with firm-clustered robust standard errors in parentheses; *, ** and *** denote significance at the 10%, 5% and 1% levels. Within R^2, the number of observations and the number of firms are reported in the lower panel
Source: Own processing.

Table 7: Main fixed-effects estimates for monetary variables.



Source: Own processing

Figure 2: Main monetary coefficients with 95% confidence intervals.

significant for ROE, sales growth and cash flow to assets. The real-rate coefficients remain negative and significant for ROE and cash flow to assets, while the sales-growth effect becomes weaker. In the exchange-rate specification, the positive coefficients for sales growth and cash flow to assets remain significant, whereas the positive ROE coefficient becomes statistically weak. This pattern indicates that the main conclusions are not an artefact of one particular error structure.

The profitability result is economically meaningful. The sample mean of winsorised ROE is 7.84%, so the repo-rate coefficient corresponds to a sizeable fraction of average profitability. This does not imply that every firm loses profitability mechanically when the policy rate rises. Rather, it indicates that within the observed macroeconomic environment, years with tighter nominal monetary conditions were years in which the same firms tended to exhibit lower accounting profitability. For a sector that often operates with limited profitability buffers and considerable working-capital needs, such a relationship is entirely plausible.

The sales-growth equation points to a similarly clear pattern. Because the dependent variable is defined as a log-difference, the repo-rate coefficient of -0.0424 should be interpreted as a change in the level of sales rather than as a coefficient in ordinary percentage points. In this specification, a one-percentage-point increase in the repo rate is associated with about a 4.2% decline in sales using the log approximation. Relative to an average winsorised sales-growth rate of 0.073, the estimated association is not trivial. It suggests that monetary tightening matters not only through financing costs but also through the expansion channel, either because credit becomes more expensive, because customers weaken demand, or because cost pressure constrains the ability of firms to maintain volumes and pricing.

The exchange-rate specification delivers a more selective but highly informative result. A one-unit increase in the exchange-rate variable-interpretable approximately as a 1% appreciation because the variable is scaled as 100 x Δln(NEER) is associated with higher sales growth and higher cash flow to assets. Because the sales-growth outcome is a log-difference, the estimated coefficient of 0.0241 corresponds to about a 2.4% increase in sales. The cash-flow coefficient of 0.0025 represents about 2.3% of the sample mean CF/Assets ratio of 0.107. The coefficient on ROE is positive as well, but only marginally significant. Taken together, this pattern is consistent with a sector in which the cost-of-imported-inputs channel was quantitatively important during the analysed period. A standard export-competitiveness story would predict that appreciation weakens domestic producers by making their output relatively more expensive abroad. Yet many firms in this sector also depend on imported inputs, machinery, fuel, fertilisers, chemicals and feed. If imported-input costs respond more quickly or more strongly than export revenues, appreciation can improve operating conditions even when it does not uniformly improve bottom-line profitability. The present estimates are consistent with such a mechanism. They suggest that currency exposure in the agricultural sector should not be viewed only through export competitiveness, but also through the domestic-currency cost of imported production inputs.

The real-rate specification provides a separate reading of monetary tightness after inflation is netted out. A one-percentage-point increase in the real policy rate is associated with a decline in ROE of about 0.55 percentage points and a decline in cash flow to assets of about 0.0028, which represents roughly 2.6% of the sample mean CF/Assets ratio of 0.107. The sales-growth coefficient of -0.0051 corresponds to an approximately 0.5% decline in sales when

converted from the log-difference specification. This pattern confirms the nominal-rate result in a more conservative form: the relationship is not only a feature of high nominal rates, but also of tighter real monetary conditions once inflation dynamics are taken into account.

Cash flow to assets deserves special attention because it is the outcome most directly linked to internal resilience. The mean of the winsorised ratio is about 0.107, so the repo-rate coefficient of -0.0077 corresponds to a weakening equal to roughly 7.2% of average internal funding capacity in the sample. The real-rate coefficient of -0.0028 points in the same direction and represents about 2.6% of the same mean. In practice, this matters because internally generated funds help finance working capital, maintenance investment, adaptation and short-term liquidity needs. In sectors exposed to weather risk, biological cycles or volatile input prices, lower internal funding can be an important transmission margin even when firms do not undertake large balance-sheet expansions.

The control variables provide additional context. In the exchange-rate specification, CPI inflation, M2 growth and business confidence are all negatively associated with sales growth, suggesting that the exchange-rate result is not simply picking up a generic macro boom. In the repo-rate specification, CPI inflation enters positively in the ROE and cash-flow equations, which is plausible in a period when nominal price increases may have temporarily supported revenues in some firms even as tighter policy worked in the opposite direction. The confidence indicator is generally weak or negative in these short-horizon regressions, which again reinforces the need for cautious interpretation when macro variables move together over a limited number of years.

A useful way to read the three specifications jointly is to think in terms of complementary rather than competing channels. The repo-rate model captures nominal financing pressure, the exchange-rate model captures external cost conditions, and the real-rate model captures monetary tightness after accounting for inflation. The fact that the signs are broadly consistent across profitability, growth and cash-flow outcomes strengthens the case that the results reflect a genuine sectoral pattern rather than a random correlation attached to one isolated dependent variable.

Reading across the three monetary variables reinforces this picture in a systematic way. For profitability, the repo-rate, real-rate and exchange-rate specifications imply, respectively, a decline of about 1.69 percentage points of ROE per one-percentage-point increase in the nominal rate, a decline of about 0.55 percentage points per one-point increase in the real rate, and a small positive but only marginally significant association with appreciation. For sales growth, the same ordering holds when coefficients are converted from log differences into approximate percentage changes in sales levels: the repo-rate coefficient (-0.0424) implies about a 4.2% decline in sales, the real-rate coefficient (-0.0051) implies about a 0.5% decline, and the appreciation coefficient (0.0241) implies about a 2.4% increase. For cash flow to assets, the repo-rate, real-rate and exchange-rate coefficients correspond, respectively, to about -7.2%, -2.6% and +2.3% of the sample mean CF/Assets ratio of 0.107. The real-rate column thus consistently confirms the nominal-rate results once inflation is netted out, while being quantitatively smaller, which is what one would expect when a single composite tightness measure replaces the separate nominal-rate and inflation terms.

Relation to previous literature

The negative repo-rate and real-rate coefficients align well with the rate and credit-channel literature. In the standard transmission view, tighter policy raises financing costs and weakens borrower balance sheets; with agency frictions, this also widens the external finance premium and amplifies the real effect of the shock (Kashyap and Stein, 2000). The present results do not identify exogenous policy shocks, but the sign pattern is consistent with this mechanism: tighter monetary conditions are associated with lower profitability and weaker internal financing capacity in this sector.

The exchange-rate result also fits the open-economy firm literature once input-cost exposure is taken seriously. A standard export story would predict that appreciation harms sales, yet incomplete pass-through and import-intensive production can reverse this effect when cheaper imported inputs and capital goods support margins and demand conditions (Campa and Goldberg, 2005; Amiti et al., 2014; Aman et al., 2022). For the agricultural sector, where production often combines domestic raw production with imported machinery, feed, fertilisers, fuel and other tradable inputs, the positive association between appreciation, sales growth and cash-flow capacity is therefore economically plausible.

Finally, the cash-flow results speak directly to the agricultural-finance literature. They resonate

with work showing financing gaps in agri-food sectors, the importance of leverage and the cost of debt in agricultural firms, and the stabilising role of liquidity when financial conditions become less favourable (Pokrivčák and Tóth, 2022; Khafagy and Vigani, 2023; Toušek et al., 2025; Yeager and Barnard, 2014). In this sense, the article contributes not only to monetary-transmission research but also to the literature on farm and agri-food resilience under changing macro-financial regimes.

The appendix tables report the full regression output for transparency. They show that the main message does not depend on suppressing inconvenient control coefficients. At the same time, the supplementary tables also make clear why the paper avoids causal language. The within R^2 values are modest, the time dimension is short, and the macro variables are common within each year. These are normal features of a sector-level accounting panel, but they set clear limits on what the design can identify. The paper therefore contributes primarily by documenting a robust empirical pattern: the agricultural sector appears systematically exposed to tighter monetary conditions, and the exchange-rate channel in this sector appears to be shaped importantly by input-cost considerations.

From a practical point of view, the results have implications for both firms and policy monitoring. For firms, they underline the importance of working-capital management, maturity management and active monitoring of interest-rate and exchange-rate exposure. For policy analysis, they suggest that aggregate monetary tightening can redistribute pressure across sectors in ways that are not visible in headline macro indicators alone. Even if the central bank targets price stability at the aggregate level, the real-economy burden of tightening may be concentrated in sectors whose margins, financing structure and import dependence make them especially sensitive to changing monetary conditions.

Managerial and policy implications

A useful implication of the results is that monetary transmission into the agricultural sector should be thought of as a risk-management problem as much as a macroeconomic one. When rates rise sharply, the effect is not limited to the accounting cost of debt. Tighter policy can alter customer demand, inventory financing, maintenance planning and the timing of investment. For managers, this means that interest-rate exposure should be monitored together with working-capital discipline and liquidity buffers rather than being treated as a narrow treasury issue.

The exchange-rate results point to a similar broadening of perspective. For many firms in the agricultural sector, the currency channel is not only about export revenues but also about the domestic cost of imported inputs. This implies that exchange-rate management should be linked to procurement strategy, budgeting and margin monitoring. In years of appreciation, the gain may arrive more through cheaper inputs and improved cash generation than through visibly stronger accounting profitability. That distinction is economically important because it changes where managers should look for early warning signals.

For policy monitoring, the findings suggest that a central bank or a macroprudential authority can benefit from watching sectoral firm indicators alongside aggregate macro variables. The Czech National Bank sets policy for the economy as a whole, but the real-economy burden of tightening is unlikely to be evenly distributed. This sector may react through profitability, liquidity and internal cash generation before this becomes obvious in aggregate business statistics. Even without claiming causal identification, firm-level sector evidence can therefore serve as a useful complement to standard macro monitoring.

Limitations of the empirical design

Several features of the design limit what the estimates can identify and should be kept in mind when reading the results. First, the key explanatory variables- the repo rate, the real rate and the exchange-rate change are macroeconomic and therefore common to all firms within each year. Identification consequently rests entirely on variation over a relatively short period (2016-2024), which makes it difficult to separate the influence of monetary conditions from other macroeconomic developments that co-moved over the same window, including inflation dynamics, energy-price shocks and broader business-cycle fluctuations. Second, the policy rate is itself endogenous to macroeconomic conditions: it responds to inflation and activity, so the estimated coefficients may partly capture these broader dynamics rather than the isolated effect of monetary policy. For both reasons, the relationships are interpreted as conditional associations rather than as causal policy multipliers, and a full two-way fixed-effects baseline is infeasible because year effects would absorb the common monetary regressors in this single-section design.

Third, although the specification includes several macroeconomic controls, it remains relatively parsimonious given the complexity of the factors that shape firm performance in agriculture. Some potentially relevant time-varying factors—notably input and energy prices, weather and other sector-specific shocks—are not fully captured and may be correlated with both monetary conditions and firm outcomes. Fourth, the balanced-panel construction, while strengthening longitudinal comparability, may bias the sample toward more stable and more formalised firms and under-represent entrants and exiters, so the estimates are most representative of established firms. Finally, the outcome variables are accounting-based and therefore subject to the measurement and earnings-quality caveats discussed earlier. These limitations do not overturn the central finding: a coherent, robust association between tighter monetary conditions and weaker firm outcomes—but they delimit its interpretation and point to natural extensions, such as linking outcomes to firm-level exposure measures (leverage, debt maturity or trade intensity) that would help move from association toward identification.

Conclusion

This paper examined how monetary conditions were associated with firm performance in the Czech agricultural sector, that is, agriculture, forestry and fishing, during 2016–2024. Using a balanced firm-level panel and static fixed-effects models, it showed a consistent pattern: tighter monetary conditions were associated with lower profitability, slower sales growth and weaker internal financing capacity. The nominal repo rate produced the clearest and most uniform negative pattern across the three dependent variables. The real-rate specification reinforced the interpretation that tighter real monetary conditions constrained profitability and cash generation. Exchange-rate appreciation, by contrast, was positively associated with sales growth and cash flow to assets.

The findings suggest that the broad agricultural economy should not be viewed as insulated from monetary conditions. On the contrary, the sector appears materially exposed to both financing costs and exchange-rate-induced changes in input prices. This matters for managers because internal liquidity, refinancing discipline and currency-aware cost planning become more important during tightening episodes. It also matters for policy discussion because aggregate monetary indicators may hide a non-trivial redistribution of financial stress across sectors.

The paper remains cautious about interpretation. The macroeconomic variables are common across firms within each year and the time dimension is short, so the coefficients should be read as conditional associations rather than as causal policy multipliers. The balanced-panel design may also bias the sample toward more stable firms. Even with these limitations, however, the evidence is informative. It indicates that this sector was among the parts of the Czech economy in which monetary tightening was visible at the level of firm accounting outcomes. That is already a useful result for agricultural economics, for corporate risk management, and for future research that aims to connect monetary transmission more directly to firm-level exposure measures such as leverage, maturity structure or trade intensity. Because the key monetary regressors are common within year, a full two-way fixed-effects baseline would absorb the monetary variables themselves in this single-section design; robustness is therefore based on model diagnostics and alternative inference rather than on a year-fixed-effects baseline.

Corresponding author:
Ing. Michaela Urbanová
Department of Economics, Faculty of Economics and Management
Czech University of Life Sciences Prague
Kamýcká 129, 165 00 Prague 6 - Suchdol, Czech Republic
Email: urbanovam@pef.czu.cz

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Appendix: Supplementary regression output

The following Tables A1 - A4 report the full coefficients for the three baseline specifications. They are included for transparency and to show how the main monetary coefficients sit within the broader set of controls.

Variable	ROE	Δln Sales	CF/Assets
Δln NEER	0.3978* (0.2095)	0.0241*** (0.0027)	0.0025*** (0.0008)
CPI inflation	-0.0259 (0.1696)	-0.0147*** (0.0028)	-0.0002 (0.0006)
M2 growth	-0.7275* (0.4228)	-0.0579*** (0.0073)	-0.0036** (0.0017)
Business confidence	-0.0567 (0.1634)	-0.0114*** (0.0024)	-0.0007 (0.0006)
ln(Assets)	-1.8920 (3.3187)	-0.1333** (0.0675)	-0.0218 (0.0167)
Observations	1503	1502	1503
Firms	167	167	167
Within R^2	0.010	0.071	0.025

Note: Coefficients shown with firm-clustered robust standard errors in parentheses
Source: Own processing

Table A1: Exchange-rate specification – full coefficients.

Variable	ROE	Δln Sales	CF/Assets
Repo rate	-1.6933*** (0.5200)	-0.0424*** (0.0077)	-0.0077*** (0.0020)
CPI inflation	0.7163*** (0.1621)	0.0106*** (0.0030)	0.0035*** (0.0007)
M2 growth	-1.2114*** (0.4444)	-0.0591*** (0.0085)	-0.0053*** (0.0016)
Business confidence	-0.0711 (0.1124)	-0.0059*** (0.0021)	-0.0005 (0.0004)
ln(Assets)	1.1747 (3.9485)	-0.0656 (0.0719)	-0.0083 (0.0194)
Observations	1503	1502	1503
Firms	167	167	167
Within R^2	0.021	0.069	0.038

Note: Coefficients shown with firm-clustered robust standard errors in parentheses
Source: Own processing

Table A2: Repo-rate specification – full coefficients.

Variable	ROE	Δln Sales	CF/Assets
Real repo rate	-0.5465*** (0.1402)	-0.0051* (0.0029)	-0.0028*** (0.0006)
M2 growth	-0.3020 (0.2949)	-0.0295*** (0.0058)	-0.0014 (0.0014)
Business confidence	0.1704 (0.1257)	0.0020 (0.0021)	0.0006 (0.0006)
ln(Assets)	-1.5234 (3.2701)	-0.1532** (0.0669)	-0.0198 (0.0164)
Observations	1503	1502	1503
Firms	167	167	167
Within R^2	0.013	0.049	0.027

Note: Coefficients shown with firm-clustered robust standard errors in parentheses
Source: Own processing

Table A3: Real-rate specification – full coefficients.

Year	Mean ROE	Mean Δln Sales	Mean CF/Assets	Repo rate	Real repo rate	Δln NEER
2016	9.059	0.301	0.116	0.050	-0.650	0.482
2017	8.690	0.096	0.112	0.500	-2.000	6.322
2018	9.728	0.052	0.111	1.750	-0.350	-0.275
2019	7.785	0.021	0.106	2.000	-0.800	0.804
2020	8.032	-0.013	0.108	0.250	-2.950	-1.129
2021	7.200	0.137	0.107	3.750	-0.050	3.035
2022	11.763	0.155	0.124	7.000	-8.100	3.991
2023	4.228	-0.059	0.091	6.750	-3.950	-0.009
2024	4.108	-0.030	0.085	4.000	1.600	-2.357

Source: Own processing

Table A4: Annual sample means of firm outcomes and monetary variables.

The annual means in Table A4 are not used for identification, but they provide an intuitive bridge between the macroeconomic chronology and the firm-level outcomes. They show, for example, that profitability and internal cash-flow capacity were visibly weaker at the end of the sample than in the earlier low-rate years, while sales growth also turned negative in 2023–2024.