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# FINANCIAL PERFORMANCE IN THE CROP PRODUCTION SECTOR IN THE ERA OF DIGITAL TRANSFORMATION

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***Abstract***

*This paper analyses the financial performance of crop production enterprises related to the costs associated with their innovation activity. We aim to determine influencing factors related to the digital transformation process, on the one hand, and on the other, explore the change in the economic performance of enterprises. For this purpose, we trace out enterprises' intangible assets and financial performance indicators. The study is based on a sample of enterprises, classified according to whether they disclose intangible assets in balance sheets. We use panel data collected on financial results, income, expenses, liabilities, and assets for five years. Both the Probit model and Fixed effects model are applied in an attempt to deepen the analysis. The results show that enterprises spend a negligibly small share of their revenue on innovation activities.Larger and more innovative crop farms with higher labour productivity have better financial performance. However, we found out that the higher value of return on assets does not affect enterprises' innovation decisions.*

***Key words*****:** *innovation activity, profitability, digitalization, Probit, agriculture*

## INTRODUCTION

The era of digitization and changes in the Common Agricultural Policy (CAP) have led to dynamic changes in agriculture in Europe, particularly in Bulgaria, as a member of the European Union. The new CAP 2023-2027 continues its policy of funding farmers to deliver public goods, mainly linked to the conservation of natural resources and the protection of the environment, while at the same time increasing productivity. In addition, it is planned to focus efforts on providing safe food at affordable prices for EU citizens and ensuring a fair standard of living for farmers.

The restructuring processes are related to the application of new digital technologies and digital innovations in agricultural enterprises' production processes and management. Accelerating the digitalization process in agriculture at the national level would help to optimize the production process, increase yields and farmers' income, achieve sustainability and food safety, and increase the competitiveness of Bulgarian agriculture and Bulgarian production on the single European market (MAF, 2019) [10]. Digitization of operations and new digital technologies changes the results in agriculture, turning it into a more efficient and sustainable economic activity (Lorenzo et al., 2020) [9]and creating new opportunities for business and developing new business models (Nikolov et al., 2022) [13].

In the economic literature, innovation has been considered an essential element of strategic business planning and a key factor in creating competitive advantages, improving the ability to fight competitors, adapting to the changing environment, and achieving intelligent, sustainable growth and a better standard of living.

European countries recognize innovation as an important element of the economic policy for the formation of successful national economies, and the stimulation of innovation activity has become an important tool. OECD (2015) [15] states in its research that countries with a high standard of living are characterized by high innovation of production and labor productivity.

According to the data published in the European Innovation Scoreboard (EIS, 2023) [4] for 2023, Bulgaria belongs to the group of emerging innovators with an innovation

performance rating of 46.7% of the EU average. Productivity is below average for emerging innovators (up to 54%), with performance improving (4.4% growth) but at a slower pace than the European Union (8.5%). Hence, the difference in the results of Bulgaria compared to the EU is continue increasing. Our country is also lagging behind the stated target of reaching 70% of the EU average level of innovation and moving from the group of "emerging" to "moderate" innovators. The Innovation Strategy for Smart Specialization (ISIS) [18] 2021-2027 adopts a new grouping of member states according to their innovation performance compared to the EU average. The countries are divided into four groups: innovation leaders – over 125%; strong innovators – between 100% and 125%; moderate innovators – between 70% and 100%; emerging innovators – below 70%.

The data show that in 2023 Bulgaria's performance exceeds the 70% rate of average European levels in six dimensions: digitalization (in the part of broadband access), use of information technologies (in the part of employed ICT specialists), innovators (in the part of product innovators ( SMEs), intellectual assets (in the trademark and industrial design applications part), sales impact (in the knowledge-intensive services export part) and environmental sustainability (in the environment-related technologies part). The country's performance in terms of public financing of innovations is particularly weak. The indicator “expenditure on R&D as a relative share of GDP” for 2022 maintains a low value of 0.75%, which is extremely insufficient and even represents a decrease compared to the share of funds provided for 2021. The performance is also relatively weak in terms of lifelong learning, resource productivity, innovation costs per employee, and the number of enterprises providing ICT training.

Compared to 2022, there has been a significant increase in the number of innovative collaborating SMEs, business process innovators, and product innovators, but at the same time, there has been a sharp decline in the number of doctoral candidates, a reduction in R&D spending in public and private sectors, as well as technologies related to the environment and the export of medium and high technology products.

The data show that enterprises are reducing their investment activity in terms of the creation and implementation of new products. At the same time, studies show that enterprises are willing to implement innovations as well as to make small improvements (Galev et al., 2015) [5].

One of the main strategic goals of the CAP, set in the new program period 2023-2027, is the stimulation and sharing of knowledge, innovation, and digitalization, as well as promoting their use.

Agriculture should use and apply new and innovative technologies to meet the growing challenges of the digital age and create and capture value. Hence, a number of questions arise regarding the impact of digitization and related business models on the financial performance of enterprises. Including how the digitization of operations and management processes will affect the financial and economic results of agricultural enterprises, their viability, and competitiveness.

In the literature, there is a lot of evidence for the positive impact of digitization on the profitability and competitiveness of enterprises. Balzer & Vojtková (2023) [2] recognize investments in new digital technologies and software expertise as key factors to make the sector more flexible and adaptable to changing market conditions. In their research, the authors also find that digitally mature firms in the market spend up to three times more on intangible assets than the industry average, which translates into higher levels of overall profitability, competitiveness, and improved firm performance compared to non-digital participants. A number of authors such as Gupta et al. (2017), Nguyen-Anha et al. (2022), Rizaev & Kadirov (2022), Zhaiet al. (2022), Klerkx & Rose, (2020) [6, 14, 17, 19, 8], found the positive relationship between investment in intangible assets and firm performance.

Although we are at the beginning of the digitalization era, there are studies in the literature that suggest an ambiguous

relationship between the digitalization of processes and financial results. Masuda &Whang (2021) [11] investigate whether digitization will lead to higher profitability of enterprises. The authors prove that such dependence is found for enterprises with high variable costs and accelerated depreciation. Only in this case does digitization favor profitability. In their study of the cost effects of digitization, Ebhote&Nwanna (2020) [3] find that digitization does not have a statistically significant effect on return on equity. Anderton et al. (2023) [1] analyzed the data of 2,390,805 enterprises operating in the EU and concluded that the costs of digitization do not in every case increase productivity and should not be considered as a one-size-fits-all approach.

The current study attempts to explore the dynamics of costs related to the innovation activity of plant-growing enterprises and their impact on financial performance. In order to achieve the goal, on the one hand, we research the factors related to the digital transformation process, and on the other, search for a related change in the economic results of the enterprises. An attempt has been made to trace the relationship between the cost of intangible assets of enterprises in the crop sector as an indicator of innovation and selected financial performance indicators.

## MATERIALS AND METHODS

To investigate and analyze the costs of innovation activity, the study is based on a sample of agrarian enterprises operating in the section "Crop production, animal husbandry, and hunting; auxiliary activities', part of sector A "Agriculture, forestry and fisheries", according to the NACE Rev.2 Statistical Classification of Economic Activities [12]. The sample covers panel data containing financial information from the balance sheets of an average of 71 medium and large plant-growing enterprises in the Republic of Bulgaria. The time span of the study covers the period from 2017 to 2021.

We apply a Probit regression model to further investigate the relationship between the probability of crop farms investing in digital innovation and the achieved profitability and innovation activity. We track the factors that determine the propensity of plant-growing enterprises to seek and implement innovative solutions in their activities. To distinguish between innovative and non-innovative enterprises and to assess the relationship between the propensity to digitize and the selected financial performance indicators, we introduce a dichotomous dependent variable, Yi, defined as follows:

$$Y_i = \begin{cases} 1, if\ Y^* digitalization \\ 0, if\ Y^* no\ digitalization \end{cases}$$

where: Yi takes two values –the presence or absence of intangible assets (digitalization) and Y* is the latent variable that indicates the propensity of crop farms to invest and introduce new digital innovations in their activity.

The applied Probit model has the following form:

$$P(Y = 1|ROA_{it}, Labour\_Prod_{it}, Solvency_{it}, logTA_{it}) = P(\beta_0 + \beta_1 ROA_{it} + \beta_2 Labour\_Prod_{it} + \beta_3 Solvency_{it} + \beta_4 logTA_{it} + \epsilon_{it} > 0) = \Phi(\beta_0 + \beta_1 ROA_{it} + \beta_2 Labour\_Prod_{it} + \beta_3 Solvency_{it} + \beta_4 logTA_{it})$$

where: $Y$ is the propensity of crop farm i to invest in digital innovation i year t;

The betas, $\beta s$ are the coefficients to be estimated, and the X is a vector of independent variables – return on assets (ROA), labour productivity (Labour_Prod), solvency and farm size (LnTA) of the *i*-thcrop farm.

To assess the significance of the relationships between innovation costs and financial results, a regression model with fixed effects is applied with a dependent variable – the economic profitability (ROA), we assess a sample of plant-growing enterprises showing intangible assets in their balance sheets. We use a fixed-effects model, widely used in the literature for analyzing and estimating dependencies in panel data. The model also allows the consideration of the individual characteristics of enterprises (factors not

included as variables in the model, i.e.,the presence of unobserved heterogeneity). For the purpose of the analysis, we present ROA as a function of the following factors: investment costs in the long-term of intangible assets, the intensity of intangible assets, labour productivity, capital structure, and size of enterprises. The above-selected factors are among the most commonly used ones in the economic literature, a precise summary of which can be found in the publications of Kamruzzaman (2019), Pandey & Diaz (2019), Zhaiet al. (2022) [7, 16, 19].

The applied fixed effects model has the following form:

$$ROA_{it} = \alpha_0 + \beta_1 digit_{it} + \beta_2 RD\_int_{it} + \beta_3 Laboour\_Prod_{it} + \beta_4 Solvency_{it} + \beta_5 logTA_{it} + \epsilon_{it}$$

*Description of the variables in the models applied in the study:*

*Investment costs in long-term intangible assets* (*digit*) – we use this indicator to define the innovative activity of enterprises. We classify enterprises into two groups – innovation-active and innovation-inactive enterprises, depending on the disclosure of R&D costs and costs of concessions, patents, trademarks, and software products. We conditionally accept the costs of investment in intangible assets as a measure of innovation costs or costs related to innovation activity. On this basis, we analyze the size, structure, and dynamics of innovation costs.

*Return on assets (ROA)* – a proven indicator in economic literature, measuring economic results and efficiency of enterprises' assets. It is also suitable for use in comparative analyses.

*One-year lag of the return on assets (lagROA)* – we introduce a lagged value of return on assets in order to trace the existence of a relationship between the return in the previous year and the propensity of crop farms to invest in digital innovation. The lag variable will show us whether enterprises that generated higher returns in previous periods have higher innovation activity.

*Intensity of intangible assets (RD_int)* – the indicator is calculated as a ratio of incurred costs for intangible assets and the net sales. The obtained value shows us the relative share of innovation costs from the revenues generated in the current year.

*Labour productivity (Labour_Prod)* – a ratio of net sales revenue per employee; in order to track both the differences in the productivity of innovative enterprises and the presence of an impact on their profitability.

*Solvency*–we set an indicator of the ability of enterprises to meet their long-term obligations in view of the relatively high rate of financial bankruptcy in the agricultural sector. We use the ratio of total liabilities to total assets of the enterprises.

*Size of the enterprises (logTA)* – to define the enterprises' size we calculate the natural logarithm of the book value of total assets.

Table 1 shows the descriptive characteristics of the variables used in the models.

Table 1. Descriptive statistics of the variables used in the models, N=356, n = 115

| Variable | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|
| digit | | | | |
| overall | .427 | .495 | 0 | 1 |
| between | | .462 | 0 | 1 |
| within | | .201 | -.373 | 1.23 |
| ROA | | | | |
| overall | .070 | .087 | 0 | .776 |
| between | | .099 | 0 | .776 |
| within | | .045 | -.135 | .275 |
| lagROA | | | | |
| overall | .070 | .087 | 0 | .776 |
| between | | .082 | 0 | .472 |
| within | | .059 | -.313 | .453 |
| RD_int | | | | |
| overall | .006 | .029 | 0 | .300 |
| between | | .021 | 0 | .149 |
| within | | .015 | -.139 | .158 |
| Labour_Prod | | | | |
| overall | 125.7 | 191.3 | .819 | 2099 |
| between | | 234.3 | .819 | 1906.5 |
| within | | 82.9 | -818.7 | 1070.1 |
| Solvency | | | | |
| overall | .373 | .293 | .004 | 1.54 |
| between | | .291 | .006 | 1.35 |
| within | | .074 | .021 | .725 |
| logTA | | | | |
| overall | 9.482 | 1.10 | 5.12 | 12.44 |
| between | | 1.17 | 5.12 | 12.06 |
| within | | .128 | 8.98 | 9.97 |

Source: Own calculations.

For all variables, we observe a greater deviation from their average values between enterprises (between variation), compared to the deviation of one enterprise by years (within variation). The average return on assets (ROA) in our sample is 7%, with a variation of 10% between firms. We observe a very low value of the ratio of innovation expenses to sales revenue – enterprises spend an average of 0.6% of their costs on investments in innovation activity. Significantly higher between-group deviation is evident in labour productivity. The average income of one employee is BGN 126,000 with a standard deviation of BGN 191 thousand. The data show good financial stability with an average solvency ratio of 37%. As a positive result, we can consider the low within-group deviation of 7%.

## RESULTS AND DISCUSSIONS

The panel data from the sample covers all the necessary financial information of balance sheet data for the financial result, income, expenses, liabilities, and assets of plant-growing enterprises in the Republic of Bulgaria. We consider 5-year period. Only medium-sized and large enterprises are included in the analysis.

For 2021, the total number of enterprises analyzed is 69, which is 10% less than in 2017 (77). The enterprises operating in the branches "Growing of cereals (except rice), leguminous crops and oil seeds" (code 0111), "Growing of vegetables and melons, roots and tubers" (code 0113), "Growing of other non-perennial crops" (code 0119), "Growing of grapes" (code 0121), "Growing of pome fruits and stone fruits" (code 0124), "Growing of other tree and bush fruits and nuts" (code 0125), "Growing of other perennial crops' (code 0129) and 'Plant propagation' (code 0130) (Table 2).

The predominant part of them works in the branches "Growing of cereals (except rice), leguminous crops and oil seeds" - 70% and "Growing of vegetables and melons, roots and tubers" - 15%.

Table 2. Number of enterprises, distributed according to their economic activity, 2017-2021

| Year | NACE Ref. 2 code | | | Total |
|---|---|---|---|---|
| | 0111 | 0113 | Others 0119-0130 | |
| 2017 | 56 | 13 | 8 | 77 |
| 2018 | 50 | 9 | 10 | 69 |
| 2019 | 51 | 11 | 11 | 73 |
| 2020 | 46 | 10 | 12 | 68 |
| 2021 | 47 | 9 | 13 | 69 |
| Total | 250 | 52 | 54 | 356 |

Source: Own calculations.

The data analysis shows an average relative share of 43% of the innovation-active farms in the sample, making expenditures for concessions, patents, trademarks, and software products related to digitalization.

Figure 1 clearly shows that R&D expenses occupy an extremely low share in the structure of intangible assets, from 1.49% in 2017 to 2.13% in 2021. R&D expenditures reached a share of 4.95% in 2018, due to an increase of BGN 45 thousand (an increase of 563%) compared to the previous year. In the following years, a negative dynamic in their size was observed. In 2017 - 2020, the intangible assets were predominately occupied by the costs of concessions, patents, licenses, trademarks, and software, which formed 90.69% in 2017. At the same time, in 2021 we see a significant decrease of 83%.

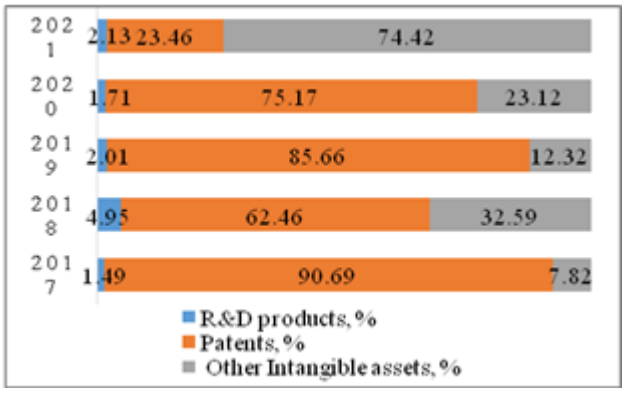


Fig. 1. Structure of costs for intangible assets for 2017-2021

Source: Own design.

Considering the costs for concessions, patents, licenses, trademarks, and software, their extremely low amount is striking. The average value of the expenses for the period is 0.525

thousand BGN and 15.728 thousand BGN, respectively (Table 3). We can highlight 2019 and 2020 with average costs significantly exceeding those for the relative year. The erratic dynamics in their size are not surprising given the significant between and within deviation.

Table 3. Descriptive statistics of costs for R&Dand expenditure for concessions, patents, licenses, trademarks, and software, 2017-2021

| Year | R&D products, BGN 000' | | Concessions, patents, licenses, trademarks, software, BGN 000' | | Freq. |
|---|---|---|---|---|---|
| | Mean | Std. Dev. | Mean | Std. Dev. | |
| 2017 | .1039 | .661 | 6.325 | 16.393 | **77** |
| 2018 | .768 | 5.791 | 9.696 | 22.834 | **69** |
| 2019 | .685 | 5.390 | 29.137 | 142.652 | **73** |
| 2020 | .662 | 5.216 | 29.029 | 142.472 | **68** |
| 2021 | .449 | 3.496 | 4.957 | 13.367 | **69** |
| Total | **.525** | **4.466** | **15.728** | **90.940** | **356** |

Source: Own calculations.

Only 3.5% of the analyzed enterprises (Table 4) disclose R&D expenditure for the period. Total2.25% of the enterprises spent up to BGN 10 thousand; by 2020, almost 1% spent up to BGN 50 thousand, and in 2021, only one enterprise spent up to BGN 30 thousand.

Table 4. Number of enterprises as per the presence of R&D expenditure

| R&D products, BGN | Year | | | | | Total |
|---|---|---|---|---|---|---|
| | **2017** | **2018** | **2019** | **2020** | **2021** | |
| 0 | 75 | 66 | 70 | 66 | 67 | **344** |
| up to 10,000 | 2 | 2 | 2 | 1 | 1 | **8** |
| up to 30,000 | 0 | 0 | 0 | 0 | 1 | **1** |
| up to 50,000 | 0 | 1 | 1 | 1 | 0 | **3** |
| **Total** | **77** | **69** | **73** | **68** | **69** | **356** |

Source: Own calculations.

Analyzing the disclosed innovation costs of the enterprises, it is noticeable that a high share of farms does not carry out innovation costs – an average of 61% for the considered period (Table 5). On average, 23% of the enterprises (17 of them) carry out innovation costs up to BGN 10,000, nearly 11% (8 enterprises) – up to BGN 50,000, 3.65% - up to BGN 100,000, and only 1,4% - over BGN 100 thousand (2 companies for 2019-2020).

Table 5. Number of enterprises as per the presence of concessions, patents, licenses, trademarks and software

| Concessions, patents, licenses, trademarks, software, BGN | Year | | | | | Total |
|---|---|---|---|---|---|---|
| | **2017** | **2018** | **2019** | **2020** | **2021** | |
| 0 | 46 | 43 | 44 | 41 | 43 | **217** |
| up to 10,000 | 19 | 14 | 17 | 15 | 17 | **82** |
| up to 50,000 | 9 | 7 | 7 | 8 | 8 | **39** |
| up to 100,000 | 3 | 4 | 3 | 2 | 1 | **13** |
| more than 100,000 | 0 | 1 | 2 | 2 | 0 | **5** |
| **Total** | **77** | **69** | **73** | **68** | **69** | **356** |

Source: Own calculations.

***Results of applied regression models***

Table 6. Results of the Probit analysis

| digit | Coef. | Std. Err. | z | P>z | [95% Conf.Interval] | |
|---|---|---|---|---|---|---|
| ROA | -.740 | 2.795 | -0.26 | 0.791 | -6.22 | 4.74 |
| labour_ prod | -.013** | .005 | -2.70 | 0.007 | -.02 | -.004 |
| solvency | 2.64* | 1.27 | 2.07 | 0.038 | .14 | 5.13 |
| logTA | 1.76** | .577 | 3.06 | 0.002 | .63 | 2.90 |
| _cons | -17.08*** | 5.07 | -3.37 | 0.001 | -27.01 | -7.14 |
| /lnsig2u | 2.857 | .432 | | | 2.01 | 3.70 |
| sigma_u | 4.17 | .902 | | | 2.73 | 6.37 |
| rho | .946 | .022 | | | .882 | .98 |

legend: * p<.05; ** p<.01; *** p<.001
Source: Own calculations.

The results from the Probit model (Table 6)show a negative but statistically insignificant relationship between ROA and the probability of enterprises carrying out innovation costs. A higher value of ROA does not affect enterprises' innovation decisions. Additional tests were performed on the influence of lagged ROA values over three years, again showing no lagged ROA effect.
We prove statistically significant relationship between labour productivity, solvency, and farm size. One potential explanation for the negative relationship between earnings per employee and the propensity for innovation activity is the perception of innovation as a development driver. Enterprises with higher productivity are less likely to carry out innovation activities, while those with lower labour productivity are more likely to increase

the revenue per employee by implementing digital solutions. The results also reveal that long-term solvent and larger enterprises are more likely to become innovatively active.

When applying the regression model, we want to account for the firm-specific characteristics. For this reason, we perform a Hausman test in order to choose between fixed and random effects models. The results show that the p-value is less than 0.05, and we can reject the null hypothesis and should use the fixed effects model.

Results of Fixed effects model (Table 7)show that there is no significant relationship between the ROA and innovation costs.

Table 7. Results of the Fixed effects model

| ROA | Coef. | Std.Err. | t | P>t | [95% Conf. Interval] | |
|---|---|---|---|---|---|---|
| digit | -.012 | .014 | -0.86 | 0.391 | -.039 | .015 |
| RD_int | .339* | .190 | 1.79 | 0.075 | -.035 | .711 |
| labour_ prod | .00006* | .00003 | 1.74 | 0.083 | -7.75 | .0001 |
| solvency | -.169*** | .040 | -4.21 | 0.000 | -.249 | -.090 |
| logTA | .049** | .023 | 2.11 | 0.036 | .0039 | .095 |
| _cons | -.337 | .225 | -1.50 | 0.135 | -.78 | .105 |
| sigma_u | .119 | | | | | |
| sigma_e | .052 | | | | | |
| rho | .841 | (fraction of variance due to u_i) | | | | |

legend: * p<.1; ** p<.05; *** p<.01
Source: Own calculations.

Results cannot explicitly explain better ROA of the innovative crop farms with their innovation activity. All other variables are statistically significant (although at different levels of significance). ROA is positively related to the labour productivity, R&D intensity and size of the crop farms. That means the larger and innovative crop farm with increasing sales per employee, have better financial performance. The negative relationship between solvency and ROA could be explain with greater liabilities of the bigger crop farm.

## CONCLUSIONS

Concessions, patents, licenses, trademarks, and software dominate the crop farm's intangible assets. R&D expenses occupy an extremely low share of them – the highest share for the 5-year period is 4.95% (2018). The total amount of the expense is also negligibly small – up to 50,000 BGN. The predominantly share of crop farms does not invest in innovation activities (61%).The results clearly show that crop farms prefer to implement existing innovative solutions and do not invest in developing new and innovative products.

Furthermore, related to crop farms that are innovatively active, investments in intangible assets do not appear to be determinants of better financial performance, although larger, financially sound, and insolvent enterprises have better returns. Finally, the results also reveal that long-term solvent and larger enterprises are more likely to become innovatively active.

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