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tel. 22 593 55 20
e-mail: wydawnictwo@sggw.edu.pl
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EFFECTS OF THE NEW TAXATION SYSTEM ON RURAL HOUSEHOLDS IN ALBANIA

Albana Gjoni✉, Etleva Muça

Agricultural University of Tirana, Albania

ABSTRACT

Aim: The tax system is a key pillar of the conceptual framework for the design and implementation of economic policies in Albania. This system, being constantly subject to changes and reforms, sometimes uncoordinated or without follow-up, in certain cases contains contradictory or unclear provisions that do not provide accurate decisions on certain transactions or situations. Changes in tax law provisions and enforcement regulations have recently resulted in unintentional errors by Albanian taxpayers, which are reflected in most cases in small businesses or rural households. The situation is more complicated in rural areas since only 10–12% of the total number of farms are equipped with a Tax Identification Number (NIPT). The main objective of this study is to assess the effects of changing tax rates on the personal income of farmers. **Methodology:** To carry out this study, the descriptive study research method was used, and primary data were collected through 100 interviews with farmers, and also secondary data were statistically performed as well as analysed with the aim of making conclusions. **Results:** Findings show that the new income tax rate has changed many times in a decade, and this change has not positively helped farmers. **Conclusions:** Tax rates have changed irregularly and without a well-studied long-term policy. This must be improved quickly so as not to discourage farmers from following through with their activity and business in Albania.

Keywords: tax system, household, farmer, Albania
JEL codes: D18, E62, H21

INTRODUCTION

The tax system in Albania consists of a package of laws, articles, and tax instructions that aim to oblige, orient and instruct all local tax entities to report properly and to settle tax obligations to the state. The main types of taxes in Albania are: Value-added tax (VAT); Corporate tax (CT); Employment income tax (EIT); Personal income tax (PIT); Excise (ET), and Local Taxes (LT). All tax rates, as well as contribution rates for social and health insurance, have been constantly subject to successive changes, often without a follow-up and without coherence concerning the economic and social developments of the country, which have become a constant object of study in order to identify weaknesses in national policies aimed at increasing the performance of farms in Albania [Fortuzi et al. 2021]. Nowadays, taxation systems tend to be based on the main taxation principles, and what is more important, tax policymakers tend to create taxation systems that are clear, simple, and fit with the country's economy and business trends. Also, more and more taxation

Albana Gjoni https://orcid.org/0000-0001-7875-0387; Etleva Muça https://orcid.org/0000-0002-6524-8467
✉agjoni@ubt.edu.al

systems are becoming similar because of economic globalisation, which creates facilities for people and multinationals.

The Albanian Tax System contains several violations of the basic tax principles (such as the equity principle). Similar taxpayers in similar circumstances are taxed with different tax rates from 0–23%. For similar income levels, an individual may be taxed 13–23% for employment income or at a rate of 0% or 5% on profits for business income (if registered as an independent entrepreneur/freelancer).

The Albanian Tax System, in some cases, contains loopholes and contradictory or unclear provisions giving no exact rulings on certain transactions or situations and increases the uncertainty in tax treatment. The contradictory provisions, with no clear technical rulings, create differences in interpreting the rules, and "mistakes" considered as such by tax audit inspectors (during tax audits) may lead to additional tax dues, interest, and penalties for the taxpayers.

Many changes have been made in the tax law provisions, with many new regulations introduced and new procedures implemented – often not associated with adequate guidance – producing consequently unintentional mistakes by taxpayers and different implementation standards by the tax inspectors.

The new tax system did not include the farmers, and they did not benefit anything from VAT due to the self-billing of their goods from collecting companies.

Taxation evolution is divided in Albania into four main periods:

1. Ottoman empire;
2. Albanian independence;
3. Communist regime;
4. Free trade economy.

The Albanian tax system has its beginnings in the very early years, but the most well-known and documented period is the period of the Ottoman conquest [Mateli 2018]. The rules followed in Albania were according to Ottoman Empire rules. The period from 1912 to 1925 is considered full of political and social turmoil, including World War I, during which Albania was a battlefield of foreign armies, and laws were almost inexistent [Fejzaj and Gjoni 2021]. Some of the main features of this tax system were:

- tax revenues were based on taxation on the income generated by the agricultural and livestock economy;
- direct taxes were the main revenue in the total tax revenues;
- tax collection was done by collecting other goods of the same value;
- the tax burden fell on the peasantry;
- the administration of tax collection was done through entrepreneurship.

In this period, the main pillars of Albanian state income were the direct taxes inherited from the previous system and directly affected the product or the revenues of the producers at the time of their production and creation. The inherited taxes were [Gjoni et al. 2021]:

- Tenth;
- Xhelepi;
- Vergija, the tax on buildings and land;
- Patent tax, profit tax on the rich;
- Tax on products from forests and quarries;
- Customs fees.

At that period, all the taxes were related to agricultural production since Albania was considered an agrarian country. At this point, for example, *xhelep* was a tax calculated as a fixed income for each livestock (about 1/10 of livestock product) [Pano 2012]. The tax policy of the Albanian state during 1945–1990 relied on the principles of Marxist ideas about taxes [Gjoni et al. 2022], for whom only the concept of a surplus in the economy was important. During the communist economic system, the state budget revenues were divided into the following types of income:

- incomes from state-owned enterprises;
- income from cooperatives;
- private property incomes;
- incomes from the population.

These revenues were realised through two types of taxation:

1. Turnover tax (state-centralised net income);
2. Profit surplus (enterprise net income).

Immediately after the Second World War, the Albanian communist government, through the adoption of the tax legislation system, required a change of the budget revenue structure. This change favours the state sector and imposes a lot of taxes on the private

sector. After the disappearance of private property in 1976, the existing tax structure changed in favour of the state's economic income [Gjoni et al. 20215]. With the adoption of the New Constitution in 1976, the objective of the disappearance of private property was achieved through the tax system. The Albanian government, through the tax policy, proclaimed that Albania was the only country in the world without taxes. But Albanians paid taxes, which were "camouflaged" in the centralised prices of goods and services supplied by the state and cooperative economy [Çela and Gjoni 2021]. The same situation appeared in other socialist countries during the same period, which didn't classify the income from public enterprises as profit taxes, but only as a reduction of state surplus products [Çela et al. 2021]. The political, economic and social changes that existed in Albania after 1990 created the need for a complete review of policies and practices in the field of budget and revenues, with the main part coming from tax revenues. Under this logic, the conditions required the creation and implementation of a new fiscal policy [Wilczynski 1977]. Parallel to the development of the new tax legislation in the 1990s, almost all small and medium-sized enterprises were privatised, and the agricultural land was fragmented and given to the existing farmers (former employees of agricultural cooperatives and farms and, in some cases, to previous owners. The results of this fast privatisation, not coordinated and based on clear economic policies, led to "a limited economy" with a large number of small owners, mainly in the trade and services industry. The Law on Tax Procedures in December 1998 would again be an important step in the taxation system in Albania, as it sanctions in a clear and meaningful manner the rights and obligations of the tax administration and taxpayers on the basic principles of taxation, based on their ability to pay taxes [Muça and Kazazi 2021].

The tax system in Albania

Tax legislation has been amended and transformed, and with all this dynamic of change, we can identify the taxes that are applied in Albania:

1. National taxes and duties:
   - Income Taxes;
   - Social Security Taxes;
   - Value Added Tax (VAT);
   - Excise Tax;
   - Other National Taxes and Fees;
   - Customs Duties.
2. Local taxes and fees:
   - The Local Tax on small businesses;
   - The Property Tax;
   - The Hotel Tax;
   - Tax for the impact on infrastructure;
   - The tax on the alienation of immovable properties;
   - Other local taxes and tariffs (including temporary taxes approved by the Municipality Council).
3. Tax procedures:
   - Principles of administration of taxes, organisation and structure of the tax administration.
4. Tax authorities:
   - National taxes. National taxes and duties are administered by the Central (National) Tax Authorities, where the General Taxation Department (GTD) and 15 Regional (branch) Directorates (including the Regional Directorate of Large Taxpayers) are included [Brunschot et al. 2021];
   - Customs duties. Customs duties and VAT on imported goods are administered by the General Customs Department;
   - Local taxes that are administered by tax offices of the local governments (in Municipalities and Communes);
   - Tax policies. The Tax Policy Directorate creates tax policies and drafting of laws and regulations in the Ministry of Finance in cooperation with the General Tax Department and other stakeholders [Brunschot et al. 2021]. The Ministry of Finance proposes draft tax laws to the Council of Ministers (Government) and to the Assembly of Albania (Parliament).
5. International tax treaties:
   - International agreements and treaties (conventions) for the avoidance of double taxation.

The above-mentioned are the components that represent the Albanian Tax System as a whole. These components are the result of 30 years of experience in a market-oriented economy, and still, all the components and the whole system continue to be in transi-

tion [Angjeli 2010]. Tax policymakers and experts in the field create meetings, papers and discussions about the tax system and the elements that need changes or need better adaption. The process of the change of taxation system was made with the help of other European Countries in order to implement and adopt the best practices from these countries that passed from a closed communist system toward a market-oriented economy before us. Actually, it is clear to each one of us that the Albanian Tax System has to improve a lot of things, and there are a lot of problems facing today's tax system, but, considering this an important issue to discuss, we will explain further details below.

RESEARCH METHODOLOGY

Regarding this study, we used secondary data found through official sources of data in Albania regarding the tax rate obligations over the years. We analysed the data by working on changes in different periods and comparing the percentages of changes. We also analysed the effects of the changes by taking concrete examples of the salaries of farmers in accordance with certain categories of income from employment. We built a table with the data of tax rates and absolute values of tax obligations for many years, creating three categories of data:

The first category refers to the period when there was only one constant tax rate of 10% for all income (wage, second income etc.)

The second category refers to the first period when a progressive tax system was adopted, at first only on wage income, and later on other income for individuals.

The third category corresponds to the last period a year ago when the last change in the tax rate on individuals' income from employment occurred, as well as in the way of calculating taxation on any other secondary income from employment.

We have also used primary data taken from interviews with about 100 farmers in different areas of the country, most of them in the villages of Tirana. Some of the interviews did not result in success as some farmers don't have sufficient knowledge of taxes and consult with external economists about their business. However, 100 interviewees were able to answer questions correctly after receiving training on tax obligations and the effects of changes in their personal income. We used a single hypothesis for the study:

H_0: Farmers have no positive attitude towards changes in the tax on personal income.

H_1: Farmers have a positive attitude towards changes in the tax on personal income.

RESULTS

To analyse the changes that tax rates have undergone in the last ten years, we have built a matrix divided into four categories: the period before 2013 (which marks 8 years without major changes in tax rates, a simple tax was applied), the period 2014–2020 (there was a major change from simple tax to a progressive tax, the period 2021 (after the COVID-19 pandemic, there were changes in efforts to ease the tax burden), the next period from July 2022 (changes are expected in the way the tax is calculated, although it remains a progressive tax). Below we present a matrix table with the rates of recent years regarding some of the most important forms of contributions:

If we consider a wage level of EUR 1200, in 2013, the tax level would have been EUR 120; in 2020, the tax level would have been EUR 143.5; in 2021, the tax level would have been EUR 123.5; and in 2022, it will be again EUR 123.5. If we consider a wage level of EUR 2000, in 2013, the tax level would have been EUR 200; in 2020, the tax level would have been EUR 327.5; in 2021, the tax level would have been EUR 302.5; and in 2022 it will be again EUR 260.6. The recent tax rates for employment tax are complex and difficult to understand and to be adopted correctly by farmers and small enterprises, and will add higher costs of training or financial consultation to correctly report financial information for tax purposes. Regulating the tax system for the agricultural sector is important in Albania since we have a high share of employment in agriculture. This is considered one of the biggest problems in Albania's development [Kozak and Muça 2020]. We suggest more simple regulation for taxpayers that have 1–5 employees in their economic entities, or if they have total revenues lower than EUR 70,000. Another problem to be considered about small farming enterprises is the invoices to be recorded and reported

Table 1. Tax and Contribution rates in Albania from 2013–2022

Related Data	Previous important change (2013–2014)	Previous year (2020)	Current (since October 2021)	Approved in July 2022
Personal Income Tax Rate (PIT)	10%	Income EUR 0–250/Tax 0% Income EUR 251–1000/Tax 13%; Income > EUR 1000 Tax 23%	Income EUR 0–250/Tax 0% Income EUR 251–1250 Tax 13%; Income >EUR 1250 Tax 23%	{Income EUR 0–333 0%}; Income EUR 333–4201/2 (13% Wage – EUR 333) Income > EUR 420 {Inc EUR 333 0%; Inc EUR 334–1667 Tax 13% of Inc over EUR 250; >EUR 1667 EUR 184 plus Tax 23% of Value over EUR 1667
Corporate Tax Rate	10%	15%	15%	15%
Sales Tax Rate	20%	20%	20%	20%
Social Security Rate For Employees	9.5%	9.5%	9.5%	9.5%
Social Security Rate For Companies	15%	15%	15%	15%
Social Security Rate	24.5%	24.5%	24.50%	24.5%
Health Insurance Rate For Companies	1.70%	1.70%	1.70%	1.70%
Max Wage Level For Social Security	EUR 792	EUR 1,100	EUR 1,100	EUR 1,180
Min Wage Level For Social Security	EUR 183	EUR 250	EUR 250	EUR 267
Max Wage Level For Health Insurance	EUR 792	NA	NA	NA
Min Wage Level For Health Insurance	EUR 183	EUR 250	EUR 250	EUR 267
Health Insurance Rate for Companies	1.70%	1.70%	1.70%	1.70%

Source: Authors' own research.

as expenses and revenues, because these enterprises find many difficulties in receiving expense invoices with VAT. On the contrary, they have a recent obligation to report sales invoices with VAT by the recent tax system regulation. These imply a higher VAT to be paid to the state than the one that is the correct figure to be reported and paid.

A recent problem for all taxpayers in Albania is the obligation to report any income received by secondary resources as part of the basic wage by adding each payment to the basic level of wages in order to be taxed with higher rates (23%). This seems unfair because the taxpayer has been paying taxes and mandatory contributions for social and health insurance based on their first basic wage. There is no need to be the object of other taxes or contributions because they benefit only once from the system and with fixed services. The maximum level of wage to be considered when calculating health insurance contribution has been eliminated, and this means that there is no maximum level

of contribution you can give to the health insurance system, but you receive the same service, and there is no direct relationship between the contribution to be paid and the service received in exchange.

Farmers, in 90% of cases, are told that they would want a simpler and less variable tax rate in the long term; they seek greater transparency in the use of these taxes in favour of the services of incentives against them. Farmers think the tax rate should be lower and differentiated by the level of income and standard of general well-being in the area where they live in relation to the rest of the population.

CONCLUSIONS

In conclusion, the tax system seems to be becoming more discriminatory and ruthless towards small and medium taxpayers. There is no real differentiation for VAT, and there is no simplification of the tax system for small farms to promote the growth of their performance in the market. There are few initiatives to adapt the VAT declaration system to buying and selling invoices for this category, which does not stimulate farmers to expand and seek to enter new markets or increase their influence in current markets. Another inefficient change results in the treatment of the liberal professions as normal employees of economic units, taxing their income in the same way as the income of employees and taxing them progressively. The latest changes in fiscal reporting for small farmers seem to be less effective, and tend to create confusion, disorientation and dissatisfaction or discouragement of starting new businesses. We suggest a tax system that treats farmers differently, making incentives, stimulating them with successful incentives, as well as regulating the methods of fiscal reporting in order for fiscal policy to stimulate growth, production and financial performance. Finally, the second hypothesis was proven, which states that farmers don't have positive attitudes towards changing the tax standard on personal income. This comes due to the lack of good knowledge of fiscal policies, due to the decrease in the level of trust in the fairness of fiscal policies in promoting the economic activity of farmers, as well as because of the added costs that this constantly changing system imposes on farmers.

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SKUTKI NOWEGO SYSTEMU PODATKOWEGO W WIEJSKICH GOSPODARSTWACH DOMOWYCH W ALBANII

STRESZCZENIE

Cel: System podatkowy jest kluczowym filarem ram koncepcyjnych projektowania i wdrażania polityki gospodarczej w Albanii. System ten, podlegający ciągłym zmianom i reformom, czasem nieskoordynowany lub bez kontynuacji, w niektórych przypadkach zawiera sprzeczne lub niejasne przepisy, które nie zapewniają trafnych decyzji dotyczących niektórych transakcji lub sytuacji. Zmiany przepisów prawa podatkowego i przepisów wykonawczych doprowadziły w ostatnim czasie do niezamierzonych błędów popełnianych przez albańskich podatników, co w większości przypadków znajduje odzwierciedlenie w małych przedsiębiorstwach lub wiejskich gospodarstwach domowych. Sytuacja jest bardziej skomplikowana na wsi, gdzie tylko 10–12% ogółu gospodarstw posiada numer identyfikacji podatkowej (NIPT). Głównym celem opracowania jest ocena wpływu zmian stawek podatkowych na dochody osobiste rolników. **Metodologia:** W badaniu wykorzystano metodę badań opisowych, a także zebrano dane pierwotne w 100 wywiadach bezpośrednich z rolnikami. Przeprowadzona analiza danych umożliwiła sformułowanie wniosków. **Wyniki:** Z badań wynika, że stawka podatku dochodowego zmieniała się wielokrotnie w ciągu dekady, a zmiana ta nie sprzyjała rolnikom.

Wnioski: Stawki podatkowe w Albanii zmieniały się nieregularnie i nie miały oparcia w zrównoważonej, długoterminowej polityce. Należy to szybko poprawić, aby nie zniechęcać rolników do kontynuowania ich działalności rolniczej oraz pozarolniczej.

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ECONOMIC ASSESSMENT OF THE BIOLOGICAL AGENT USE IN ECOLOGICAL POTATO PRODUCTION – SYSTEM DYNAMICS SIMULATION

Mariusz Maciejczak[1]✉, Krzysztof Treder[2], Janusz Urbanowicz[2], Jerzy Osowski[2], Igor Olech[3]

[1]Warsaw University of Life Sciences – SGGW
[2]Plant Breeding and Acclimatization Institute – National Research Institute
[3]Warsaw University of Life Sciences – SGGW

ABSTRACT

Aim: The aim of this study is to assess the economic viability by calculating the potential profits and expenses for farmers, and to simulate the impact of the application of a microbiological agent on the potato plant in a field trial. The field experiment aimed to identify the role of the biological agent while substituting the synthetic plant fertilization and protection. **Methodology:** The system dynamics method was applied to the data provided from one planting season of field experiments conducted in the framework of the PotatoMETABiome project. From eleven tested varieties on six different scenario plots, the most economically viable variety – Pasja Pomorska – was tested. The comparative approach was applied to show the results of inoculating potato plants with biological agents and using synthetic pesticides and fertilizers. **Results:** The results show that the application of biocontrol agents increases the quality and quantity of the potato yield compared to a variant in which no synthetic agents are used. These are, however, higher while applying the latter. It can therefore be argued that the microbiological agent could support ecological potato production, yet it does not reach the economic break-even point yet. **Conclusions:** Bearing in mind the limitations resulting from the experimental nature of field research, the level of economic profitability of innovative biological preparations and the importance of their use in agriculture have been demonstrated.

Key words: potato, biocontrol, beneficial microorganisms, system dynamics, scab, rhizoctonia, economic simulation

JEL codes: D22, O13

INTRODUCTION

Potato is the fourth most cultivated consumption crop in the world after wheat, maize, and rice [Saber et al. 2015, Wang et al. 2019, Cui et al. 2022, Feng et al. 2022, Sabhikhi and Hunjan 2022, Vilcacundo et al. 2020]. Therefore, it is fundamental for global food security [Wahyuni et al. 2018, Shuang et al. 2022], as well as the food security of specific nations, such as China [Cui et al. 2022], India [Rich and Dizyee 2016], and Indonesia [Baihaqi et al. 2020], which alone represent more than one third of the global population.

Mariusz Maciejczak, https://orcid.org/0000-0002-0630-5628; Krzysztof Treder https://orcid.org/0000-0002-8764-0574; Janusz Urbanowicz https://orcid.org/0000-0001-9007-0333; Jerzy Osowski https://orcid.org/0000-0002-4618-9991; Igor Olech https://orcid.org/0000-0003-1920-8760
✉mariusz_maciejczak@sggw.edu.pl

Potato production is plagued with widespread diseases, such as blight, bacterial wilt, dry and wet rot, rhizoctonia and scab. Multiple methods are applied to minimize their negative impact, and new ones are being developed, such as biocontrol – the use of organisms that could complement or even substitute some of the existing potato plant-protection methods. Potato biocontrol is based on beneficial microorganisms, i.e., bacteria and fungi [e.g., Vilcacundo et al. 2020]. Despite some successes, potato biocontrol is not widespread in the commercial market, as the outcomes from controlled laboratory trials have shown more satisfying outcomes than field trials. Similar outcomes were found in our experiment. Yet, as one of the tested potato varieties (Pasja Pomorska) has shown potential, we have simulated potential economic outcomes from the application of the biocontrol of this variety in the ecological field.

OBJECTIVES

There are two primary goals of this article. First, as biocontrol for potatoes has not yet made its way from the laboratories to the markets [Montesinos 2004, Mejdoub-Trabelsi et al. 2022, Vongati et al. 2022], thus being of limited access to farmers [Pathak et al. 2017], the economic viability of such experiments is assessed, calculating the potential profits and expenses for farmers. Second, as for the environmental pollution concerns [Vilcacundo et al. 2020, Meng et al. 2022], and new upcoming requirements for production in the EU countries (25% of the farm's production should be ecological), the demand for biological plant protection (biocontrol agents or microbial pesticides) and growth enhancement (biostimulants or microbial fertilizers) may gain momentum [Gitner et al. 2022], making the case for the economic assessment even more relevant. Even though the EU has encouraged the usage of biocontrol since 2009 [Vilcacundo et al. 2020], the upcoming institutional arrangement is going to demand certain behavior amendments from farmers. Moreover, most of the research concerning biocontrol agents is performed in the biological sciences, such as biotechnology, microbiology, genetics, chemical engineering, pathology, or phytopathology. While these are primary to economics regarding the effectiveness of these microorganisms, to assess the economic utility of these methods, economic research must follow.

The article is ordered as follows. First, the economic features of potato production are described as the background for the further economic model construction. Second, the economic model of potato production and sales is developed using a system dynamics (SD) method. Third, the application of biocontrol for the two potato plant diseases – scab and rhizoctonia – tested in the model are described, in separate subsections for each disease and with a summary following it. Fourth, the model simulation is performed and concluded, and recommendations for the further research are suggested.

METHODS AND DATA SOURCES

To build a properly functioning model, a literature review was conducted that focused on three main areas:

1. The economic aspect of potato production, focusing on the methods used for its assessment, including the economic aspects of pest control (here: own-price elasticities of the pesticides and fungicides). Moreover, as the underlying reason for biocontrol research is to reduce the impact of disease, and the primary goal of the research is the economic assessment of this practice, the aspect of the economic utilization of the wasted potatoes in a waste biogas plant was considered;
2. A description and comparison of the two studied potato diseases (scab and rhizoctonia) and the development of the biocontrol methods in this field;
3. A review of the studies that apply the system dynamics method to potato production modeling.

The data for the research was gathered by the Plant Breeding and Acclimatization Institute, National Research Institute in Bonin in the West-Pomeranian voivodeship (north-west Poland). The potatoes were planted in six fields (Table 1), which were subject to different treatments (or none). From the outcomes of these plantings, simulation data was extracted and simulated for the most promising potato variety, i.e. Pasja Pomorska (Pomeranian Passion).

The gathered data was simulated using the system dynamics method. System dynamics is a technique that helps to recreate the structure of systems and test the possible outcomes [Herrera et al. 2022]. In other words, it makes it possible to predict the outcomes of particular fragments of complex systems, or of the complex systems as a whole [Baihaqi et al. 2021]. Some research supplements the potato farm profit with Monte Carlo simulations [see: Rich and Dizyee 2016, Herrera et al. 2022]. Similar to our research, other SD simulations are based on case studies [see: Rich and Dizyee 2016, Herrera et al. 2022]. SD applies Causal Loop Diagrams, which create a more complex system by overlapping each other (Fig. 2). In our study, there is one such diagram, which repeats fragments of the model created by Herrera et al. [2022], i.e., the system indicators provision (including such elements as potato production, cultivation area, production inputs, etc.).

Assessment of the economic viability of the potato production

The main factors impacting the revenue in the potato production are the yields and prices [Bombik and Wolska 2004]. The levels of the former can be impacted by the weather, soil quality, and the agrotechnique used, thus in Poland the production volatility is relatively high, with higher price risk, and decreasing competitiveness of potato production. The levels of the latter consequently depend on the yields (the lower the supply, the higher the price), as well as the costs associated with the production (seed tubers, fertilizers, pesticides, etc.) [Bombik and Wolska 2004]. Moreover, any reduction due to the impact of disease has to be justified by a corresponding increase in healthy production [Zarzecka and Gugała 2010]. The potato yield also increases with the size of the field [Bombik and Wolska 2004], as suggested by economies of scale. To measure the profitability of potato production, the main methods used are the gross surplus measurement and differential calculations [Zarzecka and Gugała 2010]. For the evaluation of a biocontrol, the main indicators used are the growth enhancement and control of the disease [Cui et al. 2022].

Potatoes are the basic staple food in many countries [Wahyuni et al. 2018]. With the prospective population increases, the demand for them is likely to increase [Rich and Dizyee 2016, Hakim and Perdana 2017]. Other future pressures on potato demand include a lack of arable land to expand production, diminishing growth of yields, and climate change [Rich and Dizyee 2016, Piwowar 2018]. The quantity of potato production may also further decrease, as during the season, the risk of pest attack increases [Baihaqi et al. 2021].

The rates of potato production, and the demand for them (due to their changing price), can also be influenced by the input costs, such as pesticides. Based on the meta-study on pesticide elasticity by Böcker and Finger [2016], the median demand elasticity in Europe is –0.3, with variability among studies equal to 0.3 (Fig. 1), thus showing the inelasticity of demand

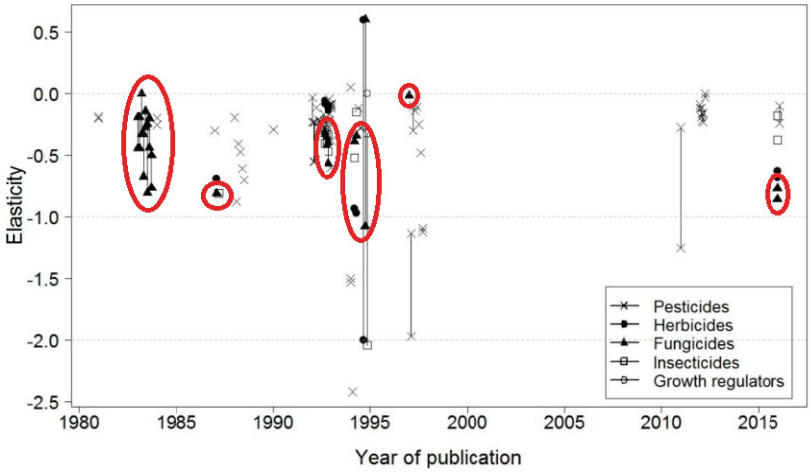


Fig. 1. Pesticide's own-price elasticities of demand following the year of publication. Fungicides are circled in red

Source: [Böcker and Finger 2016], own highlights – own elaboration

for such products. It shows that there is a demand for such products – regardless of changes in the price – as well as their substitutes, such as biocontrol. The potential demand for biocontrol could increase if pesticides are taxed, as is already the case in several EU countries [Böcker and Finger 2016], and as is suggested by some researchers, due to the damage pesticides cause to the soil biome and pollinators [Piwowar 2018].

Potatoes that are not fit for human consumption can still be economically utilized. According to UNECE (2017), some potatoes damaged by disease can be used for human consumption, while those that are unfit can be used as animal feed or to produce ethanol or biogas. As even diseased potatoes can often be consumed by people, some research has reported a low level of potato harvest losses [Tuka 2016, Jaiswal et al. 2022]. According to calculations presented by Tuka [2016], 8% of the potato harvests in Poland consist of losses, while in a study by Jaiswal et al. [2022], on-farm operational losses reach up to 5.84% (over 70% of total losses), while disease-caused losses account for 0.15%. The majority of potato loss (28%) in Switzerland [Mack et al. 2016] is used as animal feed (90%), while 3–8% is used for biogas production, and ca. 5% ends up in waste. Some, which may contain contaminating diseases, might be destroyed to limit the possibility of leakage to the environment and further spread. For this reason, all diseased potatoes in the model were assumed to be sold for the production of the biogas.

Potato scab and recent treatment methods, including biocontrol

Scab can be identified by the occurrence of small, cork-like holes on the surface of the potatoes [Yuan et al. 2019, Feng et al. 2022, Isayenka et al. 2022, Sabhikhi and Hunjan 2022]. It is one of the most widespread potato diseases in the world [Yuan et al. 2019, Wang et al. 2019, Feng et al. 2022, Isayenka et al. 2022, Shuang et al. 2022]; the main reason for its occurrence is recurrent soilborne Streptomyces scabiei (or scabies) bacteria [Khodakaramian and Khodakaramian 2013, Yuan et al. 2019, Wang et al. 2019, Feng et al. 2022, Isayenka et al. 2022], causing significant economic damage to producers [Feng et al. 2022, Wang et al. 2022] by lowering yields and downgrading their quality [Abdelrazek et al. 2021, Cui et al. 2019, Khodakaramian and Khodakaramian 2013, Yuan et al. 2019]. The latter is especially economically severe for potato producers [Sabhikhu and Hunjan 2022].

Since the second decade of the 21st century, new methods of scab treatment have been developed. Many of them consist of gene mapping for disease-resistance, i.e. developing disease-resistant potato varieties [Khodakaramian and Khodakaramian 2013, Yuan et al. 2019], or biocontrol agents, i.e. the application of microorganisms which support disease resistance [Cui et al. 2022] and yield increase.

Scab is a disease which is difficult to contain, as it spreads through the soil and seed potatoes. The increase in the incidences of the spread of scab is due to the fast development of the potato industry [Cui et al. 2022, Shuang et al. 2022], making it a victim of its own success. The disease is mostly widespread in the potato-growing regions [Shuang et al. 2022], but its occurrence also depends on the distribution of the pathogen and its interaction with tubers, and on environmental factors, such as the pH of the soil, moisture [Yuan et al. 2019, Abdelrazek et al. 2021, Cui et al. 2022, Feng et al. 2022], microbial content of the soil [Yuan et al. 2019], crop rotation [Khodakaramian and Khodakaramian 2013, Abdelrazek et al. 2021, Cui et al. 2022, Feng et al. 2022, Sabhikhi and Hunjan 2022] or leaving the land fallow [Sabhikhi and Hunjan 2022], strain resistance and health of the seed tubers [Abdelrazek et al. 2021, Feng et al. 2022, Sabhikhi and Hunjan 2022], and use of organic or chemical treatment [Khodakaramian and Khodakaramian 2013, Abdelrazek et al. 2021,]. This multiplicity of factors makes scab management more problematic [Yuan et al. 2019, Isayenka et al. 2022].

There is neither a potato variety fully resistant to scab [Isayenka et al. 2022], nor chemical or biological controls that can fully eradicate it [Feng et al. 2022, Sabhikhi and Hunjan 2022]. Depending on the source, some authors claim that the development of scab-resistant varieties is more effective [Isayenka et al. 2022], while others point toward chemical and biological (biocontrol agents) solutions [Sabhikhi and Hunjan 2022]. Others [Cui et al. 2022, Shuang et al. 2022] distinguish between chemical and biological potato plant protection against scab, pointing toward the

latter as being more friendly toward the environment, plants, people, animals, and microorganisms, and not leading to drug resistance. This might possibly lead to phasing out chemical pesticides [Shuang et al. 2022, Mejdoub-Trabelsi et al. 2022]. This recognition gave way to microbial biocontrol research [see: Wang et al. 2019, Cui et al. 2022, Feng et al. 2022, Sabhikhi and Hunjan 2022, Shuang et al. 2022], to a large extent to research on the Bacillus microorganisms [Meng et al. 2022]. Their impact has been recognized, as these bacteria not only act as pesticide, but as a fertilizer as well [Wang et al. 2019]. Although the research outcomes are promising, the precise mechanism of the biocontrol is still not entirely understood [Wang et al. 2019, Abbas et al. 2022, Cui et al. 2022, Isayenka et al. 2022].

Potato rhizoctonia and recent treatment methods, including biocontrol

Rhizoctonia solani is a disease which appears worldwide, causing canker and black scurf on the infected potatoes, reducing the quantity and especially the quality of the yield [Saber et al. 2015, Mejdoub-Trabelsi et al. 2022] and is responsible for up to 50% of economic losses in the potato industry [Mejdoub-Trabelsi et al. 2022].

Some researchers point toward the breeding of disease-resistant varieties as an effective method against it [Abbas et al. 2022], as well as controlling for pH, moisture, and temperature [Saber et al. 2015]. Depending on the research and the geographic location of the experiment, the effectiveness of fungicides is inconclusive, with some claiming its effectiveness [Abbas et al. 2022], while others denying it [Mejdoub-Trabelsi et al. 2022]. Other tested methods, such as treatment of seed tubers, crop rotation, and chemical control, are not sufficiently effective in combating it [Saber et al. 2015, Larkin and Brewer 2020, Abbas et al. 2022, Mejdoub-Trabelsi et al. 2022]. Mejdoub-Trabelsi et al. [2022] claim that crop rotation is altogether an ineffective method of fighting rhizoctonia. Larkin and Brewer [2020] compliment crop rotation with biocontrol and present it as an efficient alternative to the previous methods of combating potato diseases, although they recognize that crop rotation can have mixed effects on disease suppression, depending on what kind of plant was planted before potatoes. Since the second and third decades of the 21st century, new biocontrol methods have been being developed to combat this disease, which are based on the application of beneficial microorganisms.

Depending on the research, biocontrol can reduce the rhizoctonia by 30–60% [Larkin and Brewer 2020] or reduce the symptoms by 22.3–39.9% [Saber et al. 2015], by 15–62.6% [Khodakaramian and Khodakaramian 2013], or by 4–6 times [Abdelrazek et al. 2021]. Similar to biocontrol agents, biostimulants increased the share of marketable potato yield from 78.3% to 89.6% [Gitner et al. 2022]. This high success rate might be the consequence of their controlled trials, i.e. the experiments cited in this paragraph were performed in greenhouses.

Rhizoctonia and scab treatment with bioagents – common points

Both diseases have a global spread, and both might be the most damaging for the global potato production overall. The methods applied so far to curb them have not proven to be sufficiently effective. Thus, multiple studies have been conducted in the search for alternative pest control methods. Bioagents show some positive impact in combating both of the common potato diseases of rhizoctonia and scab. Larkin and Brewer [2020], although focusing on rhizoctonia, recognize the positive impact of biocontrol on the treatment of scab as well. Similarly, as with scab treatment, Bacillus microbes are most often cited as most effective against rhizoctonia [Saber et al. 2015, Larkin and Brewer 2020], while others [Abbas et al. 2022] point toward Trichoderma, which was also used for scab treatment in some research.

As in the case of scab, biocontrol not only inhibits the expansion of the disease, but also increases yields [Saber et al. 2015]. We confirmed such outcomes for one of the potato varieties tested in our experiment, i.e. Pasja Pomorska. The explanation offered by Saber et al. [2015] could explain the effective performance of only this variety, i.e. that biocontrol performs better in controlled, laboratory conditions than in the outdoors, due to the environmental differences. Only a few of the biocontrol agents have been developed into commercial products, thus supporting the potato production industry [Mejdoub-Trabelsi et al. 2022, Vongati

et al. 2022], even though increased development of this industry can be reported beginning in the 2020s [Meng et al. 2022]. The infant level of development may explain this. Vongati et al. [2022, p. 3] also mentions "short shelf life, susceptibility to environmental conditions, expensive production systems and efficacy problems," while legislative obstacles due to the lack of scientific evidence of their efficiency, biosafety or bioterrorism were previously a concern [Montesinos 2004], but currently they are considered not harmful for people and the environment [Pathak et al. 2017]. This shows a clear research gap for the modeling of the economic viability of such products.

System dynamics in potato production

SD has been applied to several papers focusing on potato production. While some are focused on production methods [DeFauw et al. 2012], seasonal production forecasts [Wahyuni et al. 2018], pest control [Pacilly et al. 2016], or potato supply chain management [Hakim and Perdana 2017], others focus on scenarios that might support policy-building [Baihaqi et al. 2021, Herrera et al. 2022, Rich and Dizyee 2016], or the positive impact of cooperatives on the potato supply chain and farmers' income [Baihaqi et al. 2021, Hakim and Perdana 2017, Herrera et al. 2022]. SD is frequently used among Indonesian researchers [Hakim and Perdana 2017, Wahyuni et al. 2018, Baihaqi et al. 2021].

As Herrera et al. [2022] states, the goal of SD is to discover the influence of feedback loops on the behavior of the system. Therefore, to fully understand the potential of the returns made possible by the researched methods, the following iterations of potato seeding should be performed (i.e. plantings). As the future is unknown and can only be estimated, several alternative scenarios can be tested. SD is seen as a useful tool for executing such scenarios. As the final model was limited to two scenarios – biome application and no fertilizer, and no pesticide use, both for the Pasja Pomorska variety – the only additional expense is the cost of the biocontrol agent itself. In our research, the first round of seeding was repeated virtually in software, so was based on a single trial. This trial was repeated 100 times. The first 30 repetitions can be seen in Table 7. As Rich and Dizyee [2016] highlight in their technical description of SD, the future behavior of the system can be simulated.

Data and model preparation

A one-year (2022) field study was conducted in a research facility in Bonin, in north-western Poland. The potato tubers were planted in six separate fields. Each field was subject to a different type of treatment, all of which are presented in Table 1. As is further justified, the biological agent was only applied to the last plot of land (number 6).

This study aimed to construct a model that will: 1) identify the cash flow of a potato farmer, 2) model potential outcomes of the potato farming, given six different conditions (i.e. six different scenarios). After the initial research, scenarios 1 and 6 were selected for the modeling as their comparison made a viable economic assessment of the biocontrol agent possible. Based on the previous research, the process by Hakim and Perdana [2017], as described in

Table 1. Six scenarios/experiments conducted in Bonin research facility in Poland

No.	Scenario/plot description
1	No fertilization or chemical protection [0/0/0]
2	Fertilization, without chemical protection [1/0/0]
3	No fertilization, with chemical protection [0/1/0]
4	Fertilization with chemical protection [1/1/0]
5	No fertilization or chemical protection + EcoStyle product [0/0/2]
6	No fertilization or chemical protection + microbial biocontrol consortia [0/0/3]

Source: own research, data obtained from the Plant Breeding and Acclimatization Institute – National Research Institute

Table 2. Potato production value chain, based on studies modeling its value chain using SD

Process	[Hakim and Perdana 2017]	[Rich and Dizyee 2016]
1	Input supply	Planting
2	Production	"Potatoes in field"
3	Harvest	Harvesting
4	Post-harvest	Sale (60%; 40% is "stored for seed lost, processed, consumed on-farm" so not accounted for in the model)
5	Marketing	N/A – not accounted for in the model

Source: own study based on Hakim and Perdana [2017] and Rich and Dizyee [2016]

Table 2, was included in the model, excluding the marketing cost.

Further, the impact of the diseases on yields was assessed. First, the averages of all the plots were collected in one table and converted into the percentage subject to pest damage (Table 3). The following conclusions were made from this initial assessment:

- potatoes fertilized and treated with pesticides have the highest yields, at least twice the average of the other crops,
- the higher the yield, the higher the disease incidence, which might be related to the density of the potatoes in the ground,
- the bioagent produced a lower yield than potatoes not fertilized and not treated with a pesticide at all.

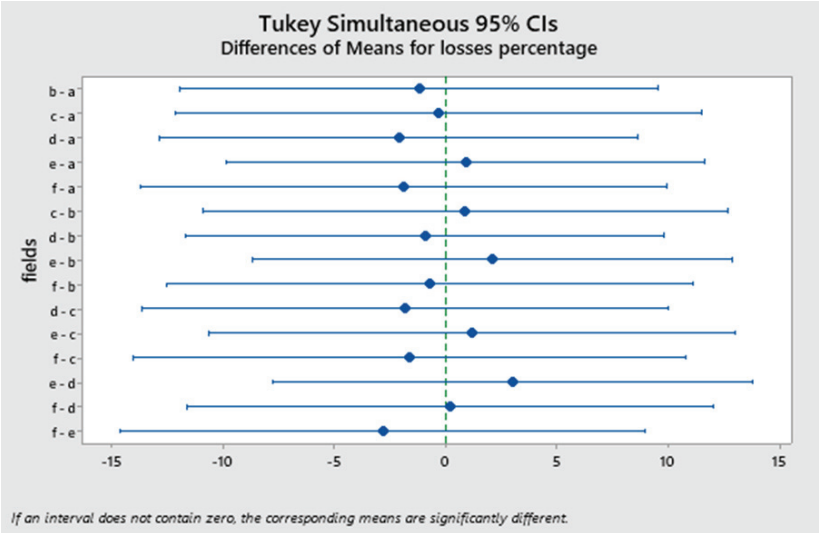
Based on the collected outcomes, the fields were further investigated according to the particular potato variety. Each field contained an identical set of varieties (Atol, Bihoro, Brda Stara, Danuta, Desire, Jelly, Kama, Krab, Pasja Pomorska, Rudawa, Saldo). Further comparisons have shown that the biocontrol substantially increased the yields and decreased the level of disease for the Pasja Pomorska variety. To check the differences of the means in different fields, a Tukey's range test was performed.

The Tukey's test is performed to check the distance between the means of different data sets. The differences between the losses in the different fields (a–f) are compared below. As can be seen below, field "f" (field on which biome was used instead of pesticides, and where fertilizers were not applied) shows all the lowest averages compared to the other fields (including of the "d–c" difference), showing that the percentage losses for field "f" were the lowest compared to all the other fields.

Table 3. Average tuber yield weight (average of 3 replicates), weight of diseased tubers by observed disease as a percentage. All variants and means.

Field	Total yield [kg]	Blight [%]	Wet Rot [%]	Dry Rot [%]	Rhizoctonia [%]	Scab [%]
1	2.9991	0	0.06	0.12	19.25	30.34
2	4.1782	0	0.04	0.35	14.80	29.83
3	4.8364	0	0	0.04	13.40	34.62
4	8.0600	0.33	0.48	0.85	7.68	32.19
5	3.8455	0	0.35	0.19	10.02	42.88
6	2.2118	0	0	0.04	18.91	24.29

Source: own calculation, based on the data obtained from the Plant Breeding and Acclimatization Institute – National Research Institute



Source: own research, based on data obtained from the Plant Breeding and Acclimatization Institute, National Research Institute in Bonin

Moreover, it could have been compared with the ecological field "a" (meaning that no fertilizer or pesticide was applied there), as both fields for this variety were only infected by two diseases, i.e. scab and rhizoctonia. Also relevant is that these two diseases are shown to be the most damaging for all fields.

Model structure

The initial examination of the data showed that a viable comparison can be drawn only for one of the varieties. Similar to the biocontrol research of Wang et al. [2019], the selected fields were not treated with any chemical material (fertilizers, pesticides, etc.). The variety whose growth can be supported by the biome is Pasja Pomorska (eng. Pomeranian Passion) which, overall, is a variety typically delivering substantial yields (see Table 4).

When comparing the ecological production where neither fertilizers nor pesticides were used with the production in which the biome was applied, other factors have to be accounted for, such as:

- loss rate (diseased potatoes sold for an alternative use, e.g. biogas production, which helps to partially redeem the financial loss)
- potato market price (the price elasticities of demand were not accounted for)
- diesel consumption (as for the "no fertilization or pesticides" method, there was no diesel consumption. It has to be checked whether diesel expenses would make the biome application less financially viable. Finally, the diesel price for the bioagent application was not included, as it can be performed at the same time as harrowing)
- price of the biome itself

Table 4. Cultivation of Pasja Pomorska using ecological methods (no fertilization, no pesticides; and biome application).

	Weight of potatoes [kg]		Relation between healthy and infected potatoes [%]	
	Healthy potatoes	Infected potatoes	Healthy potatoes	Infected potatoes
No fertilization, no pesticides	2.72	2.57	51.42	48.58
Biome application	3.77	2.55	59.65	40.35

Source: Plant Breeding and Acclimatization Institute – National Research Institute

As reported by Gitner et al. [2022], the highest costs in the potato cultivation were labor, fertilizers and seed tubers. As seed tubers were used from the preceding season in our calculations (see Table 5 and Figure 2), they were not accounted as an expense. As fertilizer was not used (as much as biocontrol is not a fertilizer *per se*), and the planting used manual labor, these factors were also not accounted for. The main intention of the two simulations was to show the difference in costs, as well as potential gains in yields. The model does not account for the inflation rate or the elasticities of fertilizers and plant protection, as from the data examination, no fertilizer and pesticide-supported varieties were selected. All the formulas can be seen in Table 5. Before applying the data to the model, it was accordingly recalculated for the plot size of 1 hectare, as the experimental plots were of size 0.0237 hectare.

Table 5. Formulas and data included in the model

Name of a variable	Calculation/Formula	Data source	Inclusion justification
Yield	30*0.03*42; Field-Potatoes for sale	Research facility in Bonin	Seed tubers per hectare
Field	[Plot 1 or 6 yield]*Yield (based on Table 6)	Research facility in Bonin	To obtain a full hectare
Loss	Field*(Rhizoctonia+Scab)	Research facility in Bonin	Subtraction of wasted potatoes
Rhizoctonia	Differs for both scenarios (based on Table 6)	Calculated from Bonin data	Occurring disease in [%]
Scab	Differs for both scenarios (based on Table 6)	Calculated from Bonin data	Occurring disease in [%]
Utilization	Waste price*Loss	Outcome	Loss minimization
Waste price	0.4 [zloty per kilogram]	Based on data found online	Price of wasted potatoes
Healthy yield	Field-(Rhizoctonia+Scab)	Outcome	Yield for human consumption
Potatoes for sale	Healthy Yield	Outcome	Included for modeling reasons
Potato price per kg	Yield*1 [zloty per kilogram]	Based on data found online	Yield times price
Potato sale minus inputs	Potato price per kg-Biome cost	Outcome	Revenue minus cost
Biome cost	700 [zlotys per hectare]	Research facility in Bonin	Cost of the bioagent
Income	Utilization+Potato sale minus inputs	Outcome	Model outcome

Source: own study

Table 6. Yields and disease ratios for the two chosen scenarios

Technique	Weight of tubers [kg]		
	Total Yield	Rhizoctonia	Scab
No fertilizer or pesticide	5.29	2.15	0.42
Biome	6.32	2.42	0.13

Source: data obtained from the Plant Breeding and Acclimatization Institute – National Research Institute

As the experiment has shown, Pasja Pomorska is not affected by the following diseases, which were infecting the other varieties: blight, wet and dry rot. It was still affected by rhizoctonia and scab.

RESULTS AND DISCUSSION

The data presented in this research is modeled through the technique of system dynamics. Six experiments were conducted, which were used as a proxy for the farmers' expenses versus returns simulations. The examination of the original and simulated data confirmed that biome would not produce a higher yield than potatoes cultivated using conventional methods, so the simulations were limited to two scenarios ("no fertilizer or pesticide" and "biome") on the most promising potato variety, which was Pasja Pomorska. The gross surplus measurement was calculated for both scenarios [Zarzecka and Gugała 2010], focusing on the main factors of potato production, i.e. yield and price, with the addition of the justified costs (focusing on the role of the bioagent in the profit creation) and recognition of the field size [Bombik and Wolska 2004, Zarzecka and Gugała 2010]; as well as both growth enhancement and control of disease [Pathak et al. 2017, Cui et al. 2022], which help to measure and analyze the benefit of the biocontrol usage. The integrated model is presented in Figure 2.

The model starts its simulation with 30 tubers of Pasja Pomorska (after finishing a planting cycle, it accumulates in the stock called Yield), which produces a yield in the "Field." The potato outcome is then split into two components: one is healthy potatoes ("Healthy Yield"), and infected ones ("Loss"). The rate of infection was calculated previously and is shown in Table 7. Losses are sold for biogas digestion (0.4 PLN/kg), while healthy potatoes are sold wholesale (1 PLN/kg). These are later accumulated in the stock called "Income." The cost of the biome and diesel are only subtracted from the "Biome" scenario (see: Figure 3, blue line). These costs are subtracted from the sale of consumption potatoes (but could also be subtracted from the final "Income").

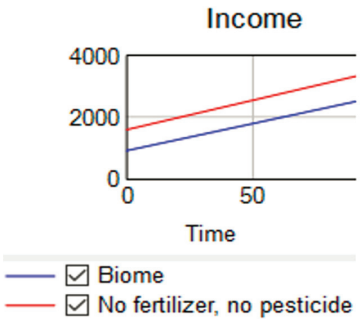


Fig. 3. Graph depicting the outcome of the two simulations
Source: VENSIM, an outcome of the simulation. Own study

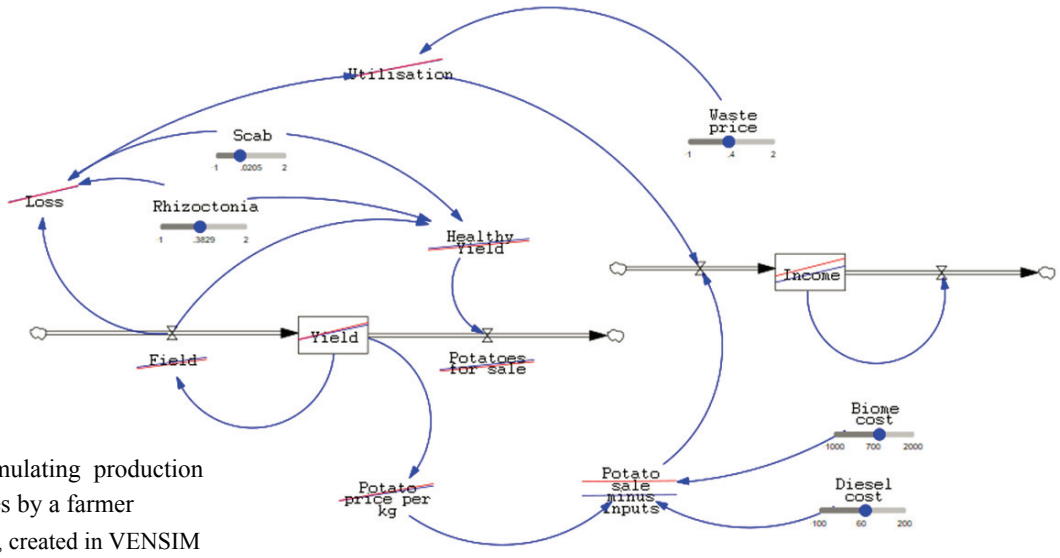


Fig. 2. Model simulating production and sale of potatoes by a farmer
Source: own model, created in VENSIM

Table 7. Differences between financial viability (Income) for farmers, for the scenarios of sole biome usage, and no plant protection, and no fertilizer usage

Time	Biome	No fertilizer or pesticide	Ratio
0	896.827	1580.75	1.763
1	914.508	1599.96	1.750
2	932.19	1619.17	1.737
3	949.872	1638.38	1.725
4	967.553	1657.58	1.713
5	985.235	1676.79	1.702
6	1002.92	1696	1.691
7	1020.6	1715.21	1.681
8	1038.28	1734.41	1.670
9	1055.96	1753.62	1.661
10	1073.64	1772.83	1.651
11	1091.32	1792.04	1.642
12	1109.01	1811.24	1.633
13	1126.69	1830.45	1.625
14	1144.37	1849.66	1.616
15	1162.05	1868.87	1.608
16	1179.73	1888.07	1.600
17	1197.41	1907.28	1.593
18	1215.1	1926.49	1.585
19	1232.78	1945.7	1.578
20	1250.46	1964.9	1.571
21	1268.14	1984.11	1.565
22	1285.82	2003.32	1.558
23	1303.5	2022.53	1.552
24	1321.18	2041.73	1.545
25	1338.87	2060.94	1.539
26	1356.55	2080.15	1.533
27	1374.23	2099.36	1.528
28	1391.91	2118.56	1.522
29	1409.59	2137.77	1.517
30	1427.27	2156.98	1.511

Source: VENSIM, outcome of the simulation. Own study

As for the Pasja Pomorska variety, while the yields are better for the biome (both quantity and quality), with the assumed prices (PLN 6 per liter of oil and consumption of 10 liters per hectare, PLN 700 per biome per hectare, 40 grosz per kg of potatoes for biogas, and 1 PLN per kg of consumption potatoes), it still works out less profitable than for the "no fertilizer or pesticides" variant. This was because with this variant, there was no additional cost of 700 + 60 PLN for planting (biome and diesel, respectively).

The biome would have to cost around 150 PLN to be profitable, instead of 700; or alternatively, if the biome treatment were performed during other activities, such as harrowing, the biome should cost ca. 210 PLN. As shown in Table 7, the financial "distance" between both selected trials would diminish over time, which was the function suggested by the software itself. Alternatively, the consumption price for such potatoes could be increased.

Similar to what was described by Wang et al. [2019], the decrease of the disease impact was not high enough. Wang et al. [2019] report that in field conditions, the reduction of the disease impact with the biocontrol agents was 8.8%, while in trials in controlled experimental conditions, it was 36.7% and 51.4%. The impact of the environment may account for this underperformance of biocontrol agents in field conditions as compared to chemical treatments.

Conclusion, recommendations and limitations

The methods that were chosen for the further assessment were extensive [Bombik and Wolska 2004] – i.e. no chemical fertilization or plant protection were used on the chosen fields. Extensive methods have shown the most promising outcomes for the further economic assessment, despite the overall higher yields of the intensive methods [Bombik and Wolska 2004], as well as the higher direct costs of the extensive (or ecological) farming [Zarzecka and Gugała 2010]. Despite that, farmers – especially in the EU – might consider turning toward bioagents as they will soon face new institutional arrangements and requirements. The European Green Deal demands that farmers set aside 25% of their production for ecological production. This increases the possibility of wider biome use by farmers. With economies of scale, the sales price

of the biome should also decrease. Moreover, special focus should be put on research into the impact of biome on the protection of potatoes from two diseases: rhizoctonia and scab.

As the testing of biome continues, we recommend adding to the model:

- potato price elasticities, which could react within the model to the estimated inflation rates,
- possibility of the establishment of an EU-wide pesticide tax, thus increasing the economic viability of the application of biome in other potato varieties,
- differences in the resistance to extreme weather events,
- further research on the soil composition and mineral depletion, comparing conventional methods (fertilizers and pesticides) with biome,
- impact of the European Green Deal.

Some limitations to this study can be identified. As there is only one set of outcomes from the field experiment (i.e. from one season of potato planting), the research should be followed up and expanded with repeated trials in the future, to confirm the current findings.

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OCENA EKONOMICZNA WYKORZYSTANIA PREPARATU BIOLOGICZNEGO W EKOLOGICZNEJ PRODUKCJI ZIEMNIAKA – SYMULACJA DYNAMIKI SYSTEMU

STRESZCZENIE

Cel: Celem pracy była ocena opłacalności ekonomicznej poprzez obliczenie potencjalnych przychodów i kosztów dla rolników, jak również symulacja wpływu ekonomicznego, zastosowania środka mikrobiologicznego w uprawie ziemniaka w ramach doświadczenia polowego. Doświadczenie polowe miało na celu określenie roli środka mikrobiologicznego w uprawie ziemniaka jako zastępującego syntetyczne nawozy oraz środki ochrony roślin. **Metody:** Do symulacji wykorzystano dane z jednorocznego eksperymentu polowego, które przeanalizowano za pomocą metody dynamiki systemowej. Z jedenastu testowanych odmian na sześciu różnych poletkach doświadczalnych wybrano jedną najbardziej ekonomicznie opłacalną odmianę – Pasja Pomorska. Zastosowano podejście komparatystyczne do przedstawienia wyników inokulacji roślin ziemniaka czynnikami biologicznymi w porównaniu do stosowania syntetycznych pestycydów i nawozów. **Wyniki:** Wyniki badań wskazują, że zastosowanie środków biokontrolnych zwiększa jakość i ilość plonu ziemniaka w porównaniu z wariantem, w którym nie stosuje się środków syntetycznych. Są one jednak wyższe przy zastosowaniu tych ostatnich. Stwierdzono, że czynnik mikrobiologiczny mógłby wspierać ekologiczną produkcję ziemniaka, jednak jak dotąd nie osiąga ona zadawalającego ekonomicznego progu opłacalności. **Wnioski:** Mając na uwadze organiczenia wynikające z eksperymentalnego charakteru badań polowych, wykazano poziom ekonomicznej opłacalności innowacyjnych preparatów biologicznych oraz znaczenie ich zastosowania w rolnictwie.

Słowa kluczowe: ziemniak, biokontrola, pożyteczne mikroorganizmy, dynamika systemu, parch, rizoktonioza, symulacja ekonomiczna

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INCREASING THE EFFECTIVENESS OF SUPERVISORY BOARDS AS ONE OF THE OBJECTIVES OF THE AMENDMENT TO THE CODE OF COMMERCIAL COMPANIES

Renata Anna Stefaniuk

University of Łódź

ABSTRACT

Aim: The purpose of this article is an assessment of the legitimacy of introducing changes to the Commercial Companies Code regarding the effectiveness of a Board of Directors, then comparing the results of the research performed by the author of the article to the current practices of the functioning of Boards. **Methodology:** The research covered the practical activities of company supervisory board members. A quantitative survey was conducted from 2018 to 2021 in the form of a questionnaire distributed via email, the website www.webankieta.pl, and delivered in person in paper form. A survey was conducted on people in managerial positions (54%) where men were the majority of those polled (71%). The surveyed population was chosen based on their professional experience as managers and members of the board in the state-owned enterprises. **Results:** On a sample of 100 respondents, it was observed that, provided the supervisory board is committed to their duties and consists of qualified personnel, the supervisory board contributes to the improvement or good functioning of the company, and often even its development. **Conclusions:** The main conclusion that has been formulated is confirmation of the legitimacy of introducing legal changes aimed at increasing the effectiveness of supervision, especially in the advisory and information areas, which are of key importance in the correct diagnosis of the company's situation and in the proper shaping of the development strategy. Due to the confidentiality that members of supervisory and management boards are subjected to, it is very difficult to obtain from them the precise answers necessary to study the functioning of supervisory boards and management boards.

Key words: supervisory board, efficiency, corporate governance, corporate governance, amendment to the Code of Commercial Companies

JEL codes: M1, M10, M12, M14

INTRODUCTION

The term "effectiveness of supervisory boards" often appears as a statement that is virtually impossible to formulate in terms of metrics. Many authors have tried to describe the effectiveness of supervision, but have only succeeded in specifying that their effectiveness in Poland is very limited to begin with due to the separation of the functions of the supervisory and executive bodies, as well as the lack of subordination of any of the mentioned bodies. Before the last amendment to the Code of Commercial Companies, the supervisory board having no possibility of constant monitoring of the company's operating activities, relied only on information provided to it voluntarily by the executive body, which often did not share information on

Renata Anna Stefaniuk https://orcid.org/0000-0001-9197-924X
✉stefaniukrenataanna@gmail.com

the most important matters related to the company and thus reduced the supervisory officers to the role of executors of the management board's requests. The issue of the loyalty of the company's bodies, but also their term of office, before the last amendment to the Code of Commercial Companies aroused much controversy and required clarification in the form of regulations. In addition, the supervisory board's advisor, who was to review the actions of the management board, was selected by the executive-management body itself, so he often did not convene supervisory board meetings to protect some of the management board's mistakes.

In the foreign literature, P. Drucker talked about two types of assessments: *effectiveness* and *efficiency*. On the other hand, S. Kownacki (1976), T. Pszczolowski (1978), and J. Zieleniewski (1982) discussed the same concepts in the polish literature. Moreover, W. Gasparski and T. Pszczolowski interpreted the same two concepts in English. All the authors unanimously associated the term *effectiveness* with the category of efficiency.

A. Szpaderski (2006) distinguished the concept of efficiency and effectiveness in such a way that the first of these categories (efficiency) refers to the achievement of the "intended goal," and effectiveness to the achievement of "positive results."

In most publications devoted to management, the interpretation of *effectiveness* refers to the problems of achieving goals and is referred to as *management effectiveness.* Within this interpretation, the assessment of effectiveness boils down directly to comparing the results with the objectives. We can find such examples in studies by C.I. Barnarda (1938), G.T. Yarnada (1972), H. Koontz and C. O'Donnell (1984), R. Simons (2000), R.J. Pearce (2000) and Kowal (2013). Previous research on the effectiveness of supervisory boards has been conducted mainly in relation to the single-tier system, where boards of directors performed both supervisory and management functions, while in the Polish two-tier model of statutory bodies, research has been conducted by L. Bohdanowicz [2018], which however concerned the relationship between the financial performance of Polish public companies as measured by ROA and the number of supervisory board meetings which is, in this case, a measure of supervisory activity [Bohdanowicz, 2018], and not strictly speaking its effectiveness. The research described in this article indicated the supervisory board's involvement in the company's affairs, and pointed to limitations in its supervisory activity due to the relations of board members, and the supervision itself in a two-tier environment, which is characterized by a somewhat different model of operation compared to the single-tier system. Thus, this article fills a research gap. It is an attempt to answer the question of what an effective supervisory board means, and whether it was necessary to increase its powers under the draft amendments to the Commercial Companies Code (CCC).

What is meant by an "effective supervisory board"

Supervisory boards operating in a dualistic system[1] face a number of adversities in performing their duties effectively within the framework of corporate governance structures. There is still a view that there is no way to do this, and, in any case, no one has so far succeeded in demonstrating empirical correlations between specific dominant characteristics of supervisory boards and the company's performance [Johnson et al. 1996]. According to E. Gutenberg, the supervisory board should perform not only supervisory, advisory, and decision-making functions, and create a climate of cooperation and exchange of information, but also coordination functions to actively participate in the process of creating the company's value [Gutenberg 1970]. This view is confirmed by the results from the Deloitte report "Supervisory Boards in Poland. What are their priorities? Where do their responsibilities end? How do they function?", based on which it was concluded that "a well-functioning supervisory board, in which the right mechanisms and tools are used, can materially support the company's development" [Deloitte

[1] "The dualistic system is a system based on which there is a division of powers between the management board and the supervisory board. The management board has the authority to manage the company's affairs and represent it externally. This includes all judicial and extrajudicial matters. The supervisory board, on the other hand, is the body that controls the company in all matters" [Łukasik 2021].

2019]. One of these is the clarification of the supervisory board's authority over the management board's actions in the company's articles of association and bylaws, i.e. in the company's internal documents, which ensures the smooth operation of supervision [Walczak 2014].

The supervisory board, lacking the ability and right to interfere in the company's operations, must rely on the quality of information provided to it by the executive-management body [Jeżak 2012]. However, based on the results of the research presented later in this article, it can be concluded that supervisory boards rely on poor-quality materials provided to them by the management boards, and/or get any information far too late. In line with the CCC, a supervisory board should exercise "continuous supervision over the company's activities in all areas of its operations" [Article 382 of the Code of Commercial Companies], which naturally involves permanent observation of activities taking place in the company and in the surrounding environment, if the supervisory body is involved in the company's affairs and cares about the sound performance of its duties. This includes not only the financial, market, economic, technical, and technological spheres, but also the social and digital spheres. More than 70% of respondents to the author's survey confirmed that supervisory boards carry out their code duties, and almost 80% of respondents replied that the supervision actively supports the operating body in the capacities to which it is entitled. In addition, the supervision often has to face the diversification of companies' activities, covering simultaneously the production, trade and service spheres, and the area of influence reaches not only the markets of European countries but also global markets [Forum Rad Nadzorczych 2017]. Therefore, delays on the part of the management board in providing the supervisory board with information on the company's current operations, development plans, and strategies reduces the supervisory board's chances of acting properly in line with its purpose, including the chances of identifying risks to the operation of companies on capital markets. It should be remembered that under Articles 219 § 2 and 375^1 of the Commercial Companies Code, the supervisory board does not have the right to issue binding instructions to the management board regarding the conduct of the company's affairs, so it must rely on information provided by the management board. However, the management board, due to the lack of real legal consequences, often provides superficial information, or it does not reach the supervisory board members at all or far too late [Skowron 2018]. Already more than twenty years ago, Swiss expert J. Strasser [1989] stated that a supervisory board that only supervises is a relic of the past (a view shared by Lorsch and Sailer [1995], because participation in finding solutions, i.e. building strategies in times of crisis or threats to the company, requires a great deal of expertise on the part of the executive and supervisory body, as well as assigning great importance to information flowing from the management board to the supervisory board [Aluchna and Kuszewski 2020]. Based on the results of the survey, it can be concluded that the supervisory board wants and actively participates in the formulation of all plans and evaluations of the company's reports, as this can contribute to the company's good financial performance, and thus to their rating as an effective body in the eyes of the owners of the company who appoint them to this position [ed. Żukowska et al. 2016]. According to S. Douma [1997], skeptical, unemotional, objective comments from the supervisory board, as well as constructive criticism, contribute to the correct course and results of building a vision of the company's strategy. Thus, the advisory sphere of the supervisory board can protect the management board from making erroneous decisions resulting from their inability to take a broader view of an issue due to their personal, including emotional, involvement in the problem.

From the shareholders' perspective, the supervisory board is often considered effective when it is primarily concerned with analyzing, evaluating, and preventing the inefficient use of financial capital. At this point, it is necessary to cite the view of M. Friedman, who believed that the supervisory board should have one goal in order to be considered an effective body, namely, to maximize shareholder profit, because any other goal is economically inefficient. He stressed the fact that allocating income to purposes other than multiplying value for the company's owners can be seen as stealing from the shareholders.

According to Jeżak, an effective supervisory board also depends on the degree of professionalization of its

members [Jeżak 2012]. Therefore, it involves entrusting this function only to people with the appropriate knowledge, experience and qualities that contribute to the effective performance of supervisory functions, that is, the organization and chairmanship of meetings, the activity of supervisory board committees and the creation of systems for evaluating the effectiveness of the supervisory body [Bohdanowicz 2009]. However, in the theory, as well as in the practice of corporate governance, there are no specific indicators measuring the level of effectiveness of supervisory boards. Ł. Tyrolski, in the article "Factors influencing the quality of the supervisory board and its impact on the activities of the company on the Warsaw Stock Exchange" investigated on the basis of a built econometric model whether "the composition of the supervisory board is statistically significant in assessing the effectiveness of a given company – measured using Tobin's Q ratio"[2] [Tyrolski 2015]. After conducting the research, the author of the article concluded that the results do not make it possible to confirm the positive or negative influence of the supervisory board on the efficiency of companies evaluated from the perspective of capital markets. However, the first to present this ratio was L. Bohdanowicz, who in the article entitled "Financial performance of Polish public companies and the activity of their supervisory boards" examined the relationship between the financial performance of public companies as measured by ROA and the number of supervisory board meetings. He showed that supervisory boards become more active when the financial performance of the companies they work for is deteriorating [Bohdanowicz 2018].

Ewa Walińska, on the other hand, in her article entitled "Improving Financial Statements as a Tool for Effective Corporate Governance" emphasizes the fact that only reliable and credible financial statements can ensure that the supervisory board can operate effectively within the framework of corporate governance structures. Without precisely prepared documents and the supervisory board's involvement in their creation, so that they do not raise doubts due to their compliance with the law and the factual circumstances, the supervisory board would not be able to actively participate in building the company's strategy for the next years of its activity [Walińska 2014].

Taking into account the fact that supervisory boards have since the 1990s been accused of being ineffective in their official duties, and have even been judged as passive [Stiles and Taylor 2002], and often even subordinated to the will of the executive-management body [Jeżak and Bohdanowicz 2016], it is possible to formulate the hypothesis that supervisory boards have so far been ineffective in performing their duties in Polish public companies as a result of, among other things, the restrictions placed on this body by the commercial law. Nonetheless, this negative assessment of supervision necessitates conducting new research on the statutory bodies of companies, especially in Poland.

Draft amendments to the CCC on supervision in companies

The above-quoted opinions clearly suggest that changes in the direction of increasing the effectiveness of supervisory boards of companies under the commercial law are necessary and even inevitable. The executive and supervisory bodies should be partners with a common goal, namely the development of the company for which they work [Rybicki 2022]. However, an information imbalance between the two, as well as insufficient control mechanisms, prevents supervisory board members from performing their code duties. As we read in the explanatory memorandum on amendments to the Commercial Companies Code and certain other laws, "the supervisory board should work as a body that guarantees that the members of the management board, who conduct the company's affairs, will only take actions that are in line with the company's interests. The condition for the feasibility

[2] "A ratio that measures the incentives for a company to invest and/or be acquired (Q ratio, Tobin's Q ratio, Tobin's Q)" – the ratio of the price of capital on the stock market to the economic replacement cost of that portion of capital. The ratio was developed by American economist James Tobin (source: A General Equilibrium Approach to Monetary Theory, "Journal of Money, Credit and Banking," February 1/15-29, 1969) and has been the subject of enough independent studies to confirm its predictive effectiveness" [Monitor FX 2021].

of the formulated structural assumption of a company is the information balance occurring between the management board and the members of the supervisory board." In addition, according to the legislator, complete and reliable information on all processes planned or already taking place in the company, provided that it is communicated in a timely manner, affects the partnership relationship between the executive and supervisory bodies within an organization. In situations where the company's interests are threatened, often supervisory board members explained that their lack of reaction to prevent the situation from arising was due to a lack of knowledge caused by the management's failure to inform them. This fact is corroborated by the respondents, where more than half (58.0%) said they had strong doubts about the quality or timing of any information provided to them by the management board regarding the company. Under Article 3801 of the draft CCC, the management board will be required to provide the supervisory board with information in writing on a regular or prompt basis, with §3 setting deadlines for the provision of data. Admittedly, this provision, like many others under the amendments to the CCC, applies only to joint-stock companies, but it may provide a model for implementing these rules in limited liability companies as well. The provision on the necessity of providing the supervisory board with the requested information in a timely manner will also apply to entities performing services for companies, as well as proxies and persons employed by the company. The information, documents, reports and explanations specified in Article 219 §4 should be provided to the supervisory board immediately or no later than two weeks from the date of the relevant request to the authority or obligated person. The supervisory board may set a longer deadline for responding to its request.

The provisions of the draft CCC stipulating legal consequences for persons who do not submit information, documents, reports or explanations to the supervisory board in a timely manner, or which are inconsistent with the facts, or conceal data materially affecting the content of all such information are noteworthy.

An important point of the draft CCC is allowing the supervisory board to take advice from experts with expertise and qualifications to carry out certain analytical or preparatory activities [CCC, Article 219^2§ 2]. Until now, the supervisory board also had this option, but the advisor was selected or approved by the management board. According to the amendments to the Commercial Companies Code, the power to elect an advisor to the supervisory board will be granted to the members of the supervisory body, bypassing the management board, but at the expense of the company most often within a predetermined budget allocated strictly for this purpose. The report prepared by the supervisory advisor must be communicated to shareholders in each case. In accordance with Article 382 of the draft CCC^{31}, the supervisory board is obliged to report as part of the annual report of supervisory officers on the amount of the total remuneration of experts for all studies commissioned by the supervisory board.

The legislator also included "regulation *in the form of a law on the role of the chairperson of the supervisory board as the person responsible for duly organizing the work of this body. This is because many times, the effectiveness of internal supervision in a company depends on the activity and diligence in the exercise of powers by the supervisory board chairperson". According to the author of the law, the chairperson of the supervisory board should move away from his or her frequent role as executor of management board requests and focus on the implementation of the schedule and work of the supervisory board.* The management board or a member of the supervisory body may request a meeting of the supervisory board, stating the proposed agenda. The chairperson of the supervisory board shall convene a meeting with an agenda in accordance with the request so that it is held within two weeks of receiving the request [CCC, Article 221^1 §4]. If the chairperson of the supervisory board does not convene the meeting, the requesting party may convene the meeting him/herself [CCC, Art. 221^1 §4].

The pandemic, as well as the not infrequent absence of supervisory board members from meetings of this body, forced the legislature to introduce the right to "remote" participation in supervisory board deliberations via the Internet. This is also expected to affect the efficiency of the passed resolutions.

The draft amendment to the CCC also expands the catalog of persons excluded from serving as members of the management board, supervisory board, audit

committee, proxy, and liquidator. In addition to persons convicted of *crimes against* economic turnover, protection of information, credibility of documents, property, trading in money and securities, the ban on serving on the aforementioned bodies also now concerns those guilty of the offenses of receiving bribes, bribery, paid patronage and abuse of office, i.e., the crimes specified in Articles 228–231 of the Criminal Code.

The issue of the term of office and mandate of corporate bodies is another aspect addressed in the revision of the Commercial Law [Ministry of State Assets, 2020]. On this subject, two lines of interpretation were presented regarding the term of office of a particular body. The first one testified that terms of office should be counted according to full fiscal years, while the second one emphasized that the term of office begins from the date of appointment, and the last year of office would be a full fiscal year [Pinior 2019]. The draft amendment to the CCC unambiguously specifies that the term of office is calculated in full fiscal years, unless the articles of association provide otherwise.

The legislator, in the context of effective supervision, also touches on "the catalog of the duties of members of the bodies and the determination of the principles of their liability for their actions or omissions." So far, although the Commercial Companies Code has taken into account the prohibition of competition, conflicts of interest and exclusion of the right of representation in cases of dismissal of members of the management board, the duty of loyalty has been treated rather superficially. The problem of legal liability of supervisory members arose especially when the supervisor did not violate a legal norm in the course of his duties, but as a result caused damage to the company. The answer to this deficit of legal conditions for the functioning of the supervisory board in the company is the introduction of the **Business Judgment Rule**. It relies on the exclusion of liability for damage caused to the company as a result of erroneous decisions of the bodies, but provided that they were made within the framework of reasonable business risk, including on the basis of information, analysis and opinions that should be taken into account under the circumstances in making a careful assessment [CCC, Article 483 §3]. Indeed, risk is a necessary part of doing business, and supervision gains protection in the event of incorrect decisions, but it will still be possible to draw legal consequences against members of bodies making reckless decisions.

The draft amendment to the CCC imposes an obligation on members of the supervisory board and the management board to maintain loyalty to the company, a prohibition on disclosing company secrets even after the expiration of their mandate, as well as selection by the supervisory board of the auditor auditing the company's financial statements of the meeting to evaluate the reports and the latter's obligation to participate in the meeting.

GENERAL CHARACTERISTICS OF RESPONDENTS AND RESULTS OF QUESTIONNAIRE

The survey included 100 respondents. There was a slight advantage of only 8 p.p. for those who held positions on company management boards (54.0%), were male (71.0%), had been employed in their current position for no more than 3 years (48.0%), and represented limited liability companies (61.0%). All respondents have experience in management and supervisory positions in SOEs.

More than half of the respondents (60.0%) indicated that in their company, the supervisory board is involved in areas of the company's business that are strategic to the company's development. One in three respondents (30.0%) said that the supervisory board sometimes indicated direction and strategies were prepared by the management. Only 10.0% issued a negative response to the question (Fig. 1).

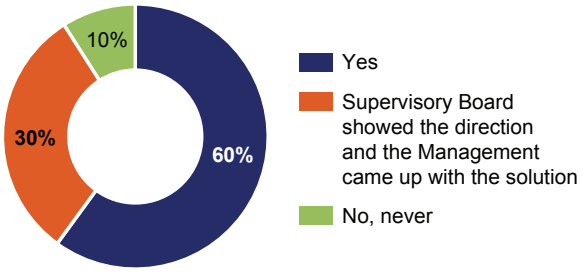

Fig. 1. Supervisory board's involvement in areas of the company's business that are strategic to the company's development

Source: the author.

More than half of the respondents (67.0%) admitted that the need to hire a specialist (supervisory advisor) occurred in their career, but for fear of the management board's refusal, they did not request it. However, one in three respondents indicated that in the companies they represent, the supervisory board requested the hiring of a supervisory advisor on a matter of importance to the company, and the management board approved their request (Fig. 2).

Three-fourths of the people surveyed (76.0%) indicated that in the companies they represent, the supervisory board has shown the activity expected by the management board in the form of advisory and lobbying activities in situations of particular crisis for the company, but almost one in five respondents stressed the supervisory board's passivity (Fig. 3).

More than half of the respondents (55.0%) indicated that at the companies they represent, supervisory meetings are held once every two months, another 40% of respondents said that supervisory meetings at the companies they work for are held at least once a month, and the remaining 5% said meeting are held no more than once a quarter (Fig. 4).

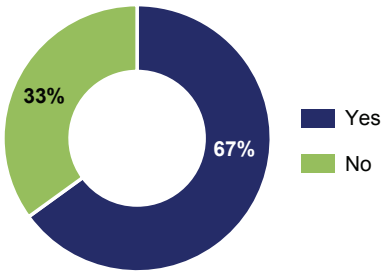

Fig. 2. The board's request to hire a supervisory advisor
Source: the author.

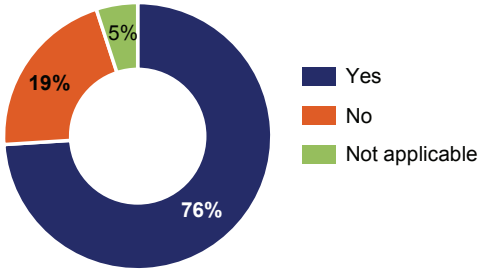

Fig. 3. Supervisory board activity in crisis situations for the company
Source: the author.

The majority of respondents (68.0%) stressed that the supervisory board's ineffectiveness is due to the limitations of their functions under commercial law, while almost 27% of respondents denied legal underpinnings as a barrier (Fig. 5).

Finally, more than half of the respondents (58.0%) confirmed that they had strong doubts about the quality or timing of information provided to them by the management board regarding the company (Fig. 6).

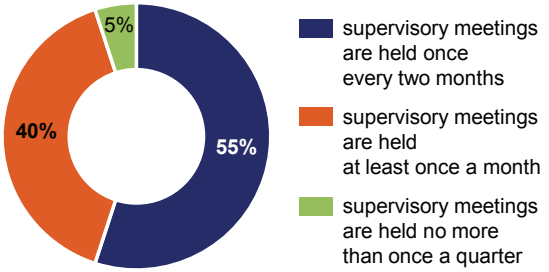

Fig. 4. Frequency of supervisory board meetings held
Source: the author.

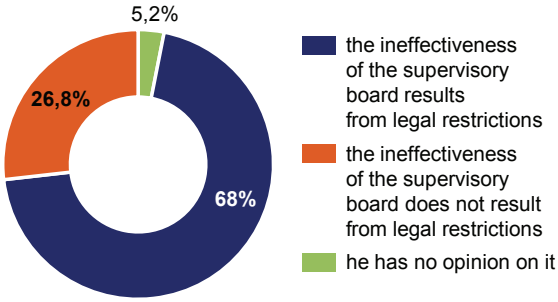

Fig. 5. Impact of legal restrictions on the effectiveness of supervisory boards
Source: the author.

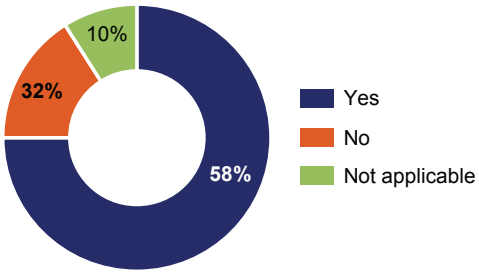

Fig. 6. Quality and timing of communication of all company-related information by the management board to supervisory board members
Source: the author.

CONCLUSIONS

The purpose of the study presented in this article was to determine the degree of effectiveness of the supervisory board within the structure of Polish SOEs. It is an attempt to answer the question of what an effective supervisory board means, and whether it was necessary to increase its powers under the draft amendments to the Commercial Companies Code.

The changes proposed by the legislator to increase the effectiveness of supervisory boards have their justification not only in theory but also in practice and research, such as the research conducted by the author of the article. Based on this, it can be concluded that the hypothesis that supervisory boards have not been effective in carrying out their duties in Polish SOEs is inaccurate. The research presented within this article shows that the supervisory boards worked effectively and showed initiative, provided that the selection of personnel was not dictated only by party affiliation. This does not change the fact, however, that the respondents confirmed the existence of legal barriers in the area of the functioning of supervisory boards, which limit the effectiveness of their activities in fulfilling their code and statutory duties.

However, the potential of supervisory boards is often not fully utilized by either the shareholders themselves or the management board. This is largely due to legal restrictions on the scope of the supervisory body's authority within corporate governance structures. The survey respondents overwhelmingly confirmed the supervisory board's active involvement in an area of the company's business of strategic importance to the company's development. However, the management board not being legally obligated to provide the supervisory board with necessary information on the corporation also prevented the supervisory board from responding appropriately to emerging or potential risks inside or outside the organization. All the other issues included in the amendments to the CCC that strengthen the supervisory board's position are also of great importance, since from now on the supervisory board becomes, thanks to these regulations, an equal partner to the management board with real instruments to carry out its supervisory duties in a manner consistent with the law and the companies' corporate documents.

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ZWIĘKSZENIE SKUTECZNOŚCI RAD NADZORCZYCH JAKO JEDEN Z CELÓW NOWELIZACJI KODEKSU SPÓŁEK HANDLOWYCH

STRESZCZENIE

Cel: Celem artykułu jest ocena zasadności wprowadzenia zmian do Kodeksu Spółek Handlowych w zakresie efektywności zarządu. Następnie porównano wyniki badań przeprowadzonych przez autorkę artykułu z dotychczasowymi praktykami funkcjonowania Izb. **Metodologia:** Badaniem objęto praktyczną działalność członków rad nadzorczych spółek. Badanie ilościowe przeprowadzono w latach 2018-2021 w formie ankiety dystrybuowanej drogą mailową, na portalu www.webankieta.pl oraz dostarczanej osobiście w formie papierowej. Badanie przeprowadzono wśród osób na stanowiskach kierowniczych (54%), wśród których większość ankietowanych stanowili mężczyźni (71%). Badana populacja została dobrana na podstawie doświadczenia zawodowego na stanowiskach kierowniczych i członków zarządów w przedsiębiorstwach państwowych. **Wyniki:** Na próbie 100 respondentów zauważono, że jeśli rada nadzorcza jest zaangażowana w swoje obowiązki i składa się z wykwalifikowanej kadry, to rada nadzorcza przyczynia się do poprawy lub dobrego funkcjonowania firmy, a często nawet do jej rozwoju. **Wnioski:** Główny wniosek, jaki został sformułowany to potwierdzenie zasadności wprowadzenia zmian prawnych w kierunku zwiększenia efektywności nadzoru, szczególnie w obszarze doradczym oraz informacyjnym, które mają kluczowe znaczenie w prawidłowym diagnozowaniu sytuacji spółki oraz we właściwym ukształtowaniu strategii rozwoju. Ze względu na poufność, jakiej podlegają członkowie rad nadzorczych i zarządów, uzyskanie od nich precyzyjnych odpowiedzi niezbędnych do zbadania funkcjonowania rad nadzorczych i zarządów jest bardzo trudne.

Słowa kluczowe: rada nadzorcza, efektywny, nadzór korporacyjny, ład korporacyjny, nowelizacja Kodeksu Spółek Handlowych

JEL codes: M1, M10, M12, M14

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ORIGINAL PAPER

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INDIVIDUAL FARMERS' BANK LOANS AND DEPOSITS IN POLAND UNDER ECONOMIC UNCERTAINTY DURING THE COVID-19 PANDEMIC

Monika Utzig✉

Warsaw University of Life Sciences – SGGW, Poland

ABSTRACT

Aim: The paper aimed to evaluate changes in farmers' bank loans and deposit value under economic uncertainty, mainly caused by the COVID-19 pandemic. **Methodology:** The statistical data from Narodowy Bank Polski for the span of January 2018–September 2022 was used and the dynamic indexes were computed. The Global Economic Policy Uncertainty Index was also used to show if the COVID-19 pandemic increased economic uncertainty. **Results:** The results show that in the analyzed period, an increase in the value of farmers' bank deposits and a drop in farmers' bank loans were observed. An increase in the value of farmers' bank deposits occurred when interest rates were extremely low, so it can be stated that the growth of the value of farmers' bank deposits resulted from economic uncertainty, and not from the rising profitability of deposits. At the same time, the value of farmers' bank loans decreased, but it is difficult to indicate if this is an effect of the tightening of banks' loan policies or of the farmers' aversion to risk. **Conclusions:** The research concerning economic entities' loan and deposit activity is a very important subject because of the increasing role of uncertainty nowadays. What is observed is that the value of farmers' bank loans dropped but it is difficult to state for sure if this was caused by economic uncertainty and therefore reduced capital needs of farms or by the reduction of banks' credit activity and negative credit decisions.

Key words: economic uncertainty, farmers, loans, deposits, COVID-19
JEL codes: D80, G21, Q14

INTRODUCTION

According to Frank Knight [1921], risk is measurable and uncertainty is unmeasurable. Uncertainty itself is connected with the lack of security and certainty [Bochenek 2012]. Nowadays, the role of economic uncertainty is increasing due to acts of terrorism, armed conflicts, the COVID-19 pandemic, and so on. There are some observations connected to households' behavior under economic uncertainty. According to Martin et al. [2020], under economic uncertainty, households spend their previous savings. According to Aaberage et al. [2017], households tend to decrease their consumption level. These two results conflict and it is valuable to investigate which of them is observable among individual farmers in Poland. Under increasing economic uncertainty, a decrease in the banks' loan supply is observed, which takes two main forms. The first form is a reduction in the availability of spot funds, and the second is related to the provision of liquidity insurance [Barraza and Civelli 2020, Wu and Suardi 2021]. Chinese data

Monika Utzig https://orcid.org/0000-0003-2393-0430
✉monika_utzig@sggw.edu.pl

shows that under economic and policy uncertainty, credit risk increases and leads to a decline in loan sizes [Chi and Li 2017]. According to European data, under economic uncertainty, the ratio of non-performing loans to total loans increases [Karadima and Louri 2021], which indicates that borrowers more often do not make repayments of principal and/or interest for at least 90 days.

The COVID-19 pandemic caused a sharp increase in uncertainty and has had a massive effect on the real economy and the financial sphere [Bakas and Triantafyllou 2020]. The COVID-19 pandemic influenced agriculture and the food system, mainly through unstable supply chains, increases in costs due to inflation, and consumers' reduced purchasing power [Skawińska and Zalewski 2020]. Besides the real market, the COVID-19 pandemic also affected the financial market. One of the areas influenced by the COVID-19 pandemic was the market of loans and deposits for individual farmers. According to the research of Daniłowska [2022], under uncertainty caused by the COVID-19 pandemic, the value of individual farmers' bank deposits increased, and the value of their loans decreased, despite the reduction of interest rates by the central bank. The drop in the value of bank loans for farmers may have been caused by bank politics [Zając et al. 2021] or by the tightening of the banks' credit policies [Daniłowska 2021].

The paper aims to evaluate changes in the value and structure of individual farmers' loans and deposits under economic uncertainty, especially that caused by the COVID-19 pandemic. The hypothesis was made that under economic uncertainty, farmers avoid incurring liabilities.

MATERIAL AND METHODS

To evaluate changes in the value and structure of individual farmers' bank loans and deposits under the economic uncertainty caused by the COVID-19 pandemic, data was used from the Narodowy Bank Polski database: banks' assets and liabilities [NBP 2022a]. Monthly data from January 2018 to September 2022 was used. In Narodowy Bank Polski's statistics, individual farmers, together with individuals and individual entrepreneurs, are included in the group of households [NBP 2022c]. Farmers are defined as natural persons whose principal source of income is agricultural production, and their activity is not registered as an enterprise, company, cooperative, or producer group. Among bank loans to farmers, there are loans on current account (loans to finance the current activities of a farm), investment loans (loans to finance new or to increase the existing capacity of the borrower, to finance a project aiming at the replacement, modernization and increase of fixed assets, loans for the purchase of real property, and other loans (loans to households not included elsewhere, e.g. loans for car purchase, loans for the purchase of securities). Farmers' bank deposits are divided into overnight deposits (e.g. deposits on current accounts, savings accounts without any agreed maturity), and deposits with agreed maturity (farmers' funds placed with a resident bank, which cannot be converted into currency before an agreed fixed term or that can only be converted into currency before that agreed term provided that the holder is charged some kind of penalty, e.g. a reduction of the interest due) [NBP 2022b].

To evaluate changes in the value and structure of individual farmers' bank loans and deposits, the dynamics indexes and the share of deposits were computed. The dynamics index (i) is measured as [Raczkowska and Wrzesińska-Kowal 2020, p. 21]:

$$i = \frac{y_1}{y_0}$$

where:

i – dynamics index,

y_0 – value of the phenomenon at the beginning of the period,

y_1 – value of the phenomenon at the end of the period.

RESULTS

One of the economic policy uncertainty measures is the Economic Policy Uncertainty Index (EPU) which measures the relative frequency of own-country newspaper articles that contain a trio of terms pertaining to the economy (E), policy (P), and uncertainty (U) [Baker et al. 2016]. Based on the EPU, the Global Economic Policy Uncertainty Index was built by Davis

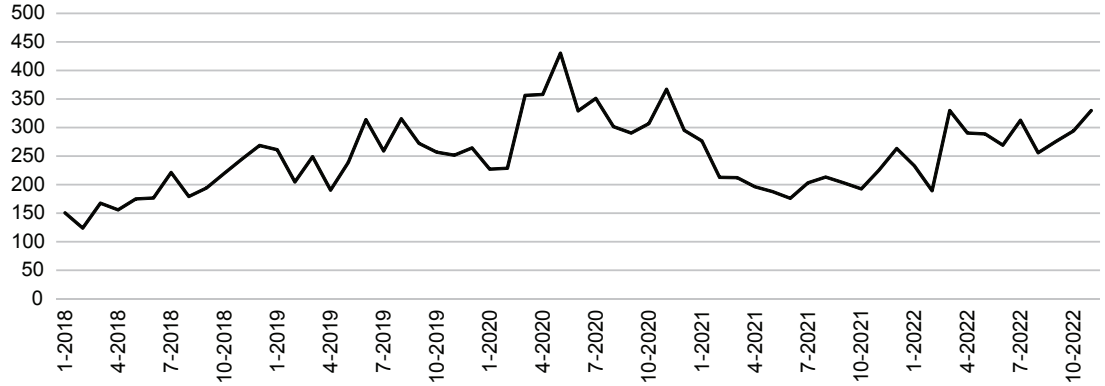

Fig. 1. Global Economic Policy Uncertainty Index from January 2018 to November 2022
Source: [Economic Policy Uncertainty 2022].

[2016]. This index is published for chosen countries and as a global index, which is the GDP-weighted average of national EPU indices for 21 countries: Australia, Brazil, Canada, Chile, China, Colombia, France, Germany, Greece, India, Ireland, Italy, Japan, Mexico, the Netherlands, Russia, South Korea, Spain, Sweden, the United Kingdom, and the United States [Economic Policy Uncertainty 2022]. The Global Economic Policy Uncertainty Index increased significantly in May 2020, two months after the beginning of the COVID-19 pandemic in March 2020 (Fig. 1).

The Global Economic Policy Uncertainty Index also increased with the beginning of the Russian invasion of Ukraine in February 2022, but the growth of the index was not as immense as at the start of the COVID-19 pandemic. We can match the heightened uncertainty with the first wave of the pandemic and with the beginning of the Russian invasion. It is also important that economic uncertainty increases during different kinds of crises, such as the 2007–2008 financial crisis and wars [Al-Thaqeb et al. 2020]. The aim of the research was to evaluate the value and structure of individual farmers' bank loans and deposits in Poland under economic uncertainty (Fig. 2).

From January 2018 to September 2022, bank loans to farmers dropped while bank deposits from farmers increased. In September 2022, the value of bank loans and other claims on farmers decreased in current prices by 10% from January 2018 and by 13.5% from the maximum seen in July 2019. The opposite situation

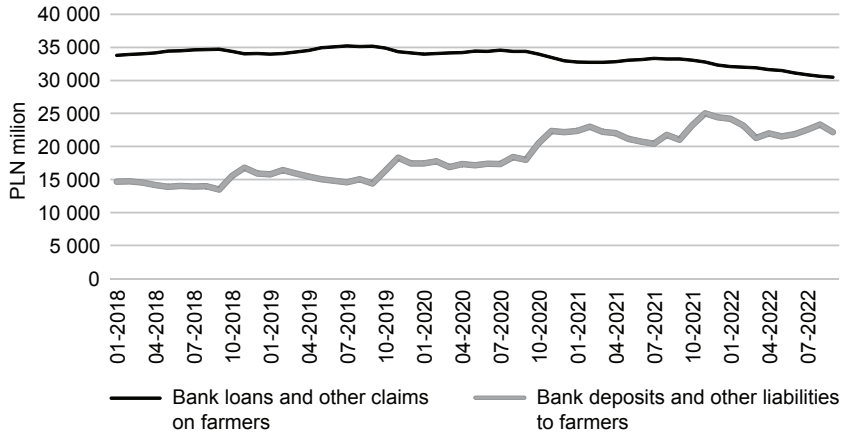

Fig. 2. Bank loans and deposits to farmers (in PLN million in current prices)
Source: [NBP 2022a].

is observed among bank deposits. The value of bank deposits from farmers increased by 51% from January 2018 to September 2022. The maximum level of bank deposits from individual farmers was observed in November 2021, and since then, it has dropped by 11%. Because farmers' bank deposits are characterized by seasonality, the dynamics index of the loans and deposits was computed with the base period being the same month of the previous year (Fig. 3). One of the reasons for the seasonality of farmers' bank deposits is direct payment and other transfers of public funds to agriculture resulting from the mechanisms of the Common Agricultural Policy, which significantly affects the income situation of agriculture in Poland [Golonko et al. 2021].

It can be observed that under economic uncertainty, the value of farmers' bank deposits increased significantly. Between August 2020 and May 2021, the yearly growth rate exceeded 20%. A decrease in farmers' deposits was observed only in March and April 2022. To sum up, one can state that the COVID-19 pandemic caused an increase in farmers' bank deposits.

Looking at the changes in farmers' bank loans, it should be mentioned that from June 2020 to September 2021, interest rates were extremely low (Fig. 4).

Despite the near-zero interest rates from June 2020 to September 2021, the value of bank loans to individual farmers decreased (Fig. 3), probably due to the farmers' fear, which led to them avoiding tak-

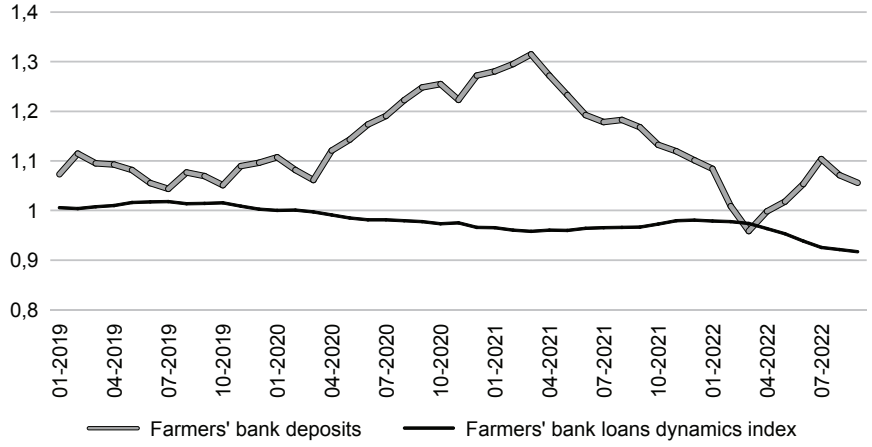

Fig. 3. Dynamics index of bank loans and deposits to farmers (base period – the same month of the previous year)
Source: Own calculations based on [NBP 2022a].

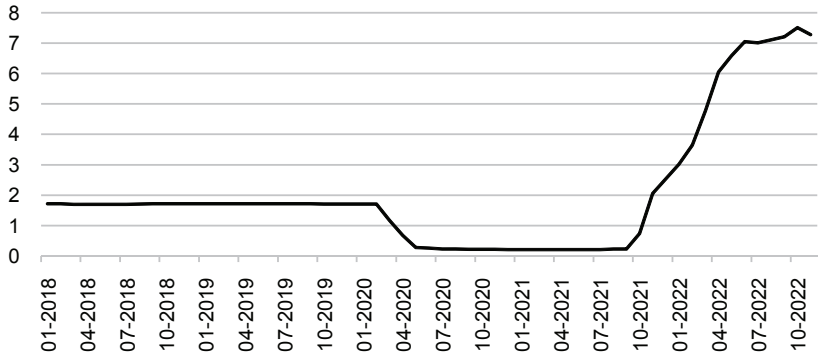

Fig. 4. Value of WIBOR PLN 3M (in %)
Source: [Stooq 2022].

ing out loans. So, it can be stated that the drop in farmers' bank loans was caused more by economic uncertainty than by the high loan cost. From February 2022, the decrease in farmers' bank loans accelerated, but it occurred together with an increase in the loan cost measured by the Warsaw Interbank Offered Rate (WIBOR). Extremely low levels of interest rates can also be seen as a reason for avoiding deposits with agreed maturity. The share of farmers' deposits with agreed maturity in total deposits dropped from levels of 5% in 2018 to shares below 2% between October 2021 and April 2022 [NBP 2022a]. It is also worth assessing how the growth of uncertainty affected the structure of farmers' bank loans (Fig. 5).

Among bank loans to farmers, investment loans dominated from January 2018 to September 2022 with a value of about PLN 12–15 billion. The share of loans in current accounts and loans for the purchase of real property were also important. In September 2022, the value of investment loans was lower by 23% than in January 2018. At the same time, loans in current accounts decreased by 11% and other loans by 28%, and only bank loans to farmers for the purchase of real property increased (by 11%) in current prices.

DISCUSSION AND CONCLUSIONS

The research shows changes in farmers' bank loans and deposits in the span covering the COVID-19 pandemic. In the analyzed period, an increase in farmers' bank deposits, as well as a drop in farmers' bank loans, were observed. The author indicated that this was caused not by changes in the costs and profitability of loans and deposits, but by the high level of economic uncertainty affecting farmers' decisions. The results are consistent with the results of another study showing that during the COVID-19 pandemic, microenterprises and farmers were particularly vulnerable to the negative consequences of the pandemic because, during the crisis period, banks were less willing to grant these groups of entities [Zając et al. 2021]. Another finding shows that during the COVID-19 pandemic, commercial banks tended to tighten their lending standards and terms [Daniłowska 2021], so it is difficult to evaluate if the drop in the value of bank loans was affected by the farmers' reluctance to take out loans or by banks' reluctance to approve loans. This is especially the case as farmers in Poland exhibit medium-to-high levels of risk aversion [Sulewski et al. 2020].

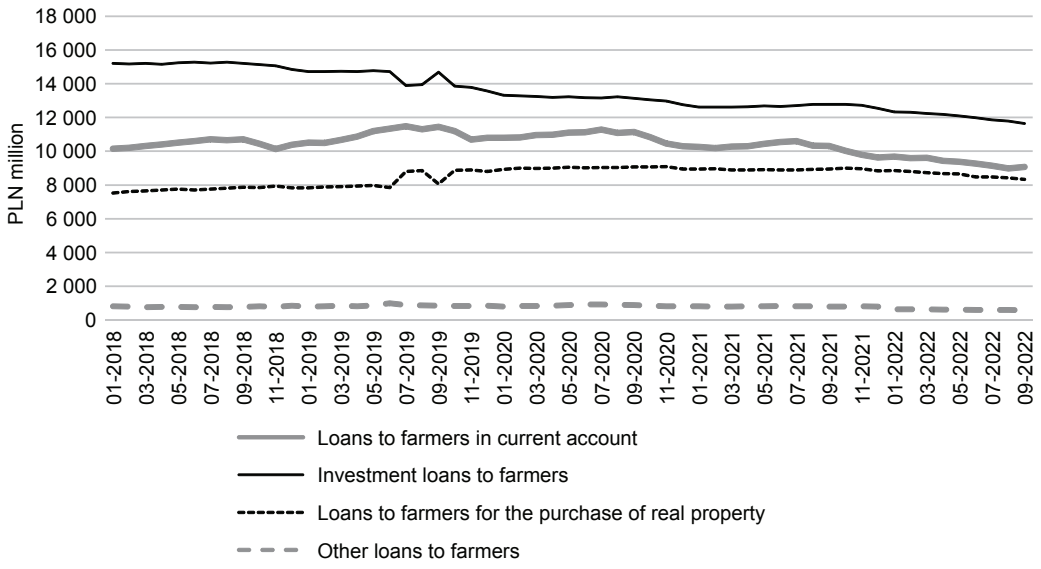

Fig. 5. Bank loans to farmers by type (in PLN million in current prices)
Source: [NBP 2022a].

Under economic uncertainty, the value of bank loans to individual farmers decreased and the value of bank deposits increased. Because interest rates and bank deposits' profitability were very low then, the share of overnight deposits increased when the share of deposits with agreed maturity decreased. Among bank loans to farmers, investment loans dominated in the analyzed period, loans on current accounts and loans for the purchase of real property were also very important. The value of bank loans to farmers decreased only slightly after the beginning of the COVID-19 pandemic. That may mean that both banks and farmers adopted a so-called wait-and-see strategy. After the period of very low levels of interest rates from March 2020 to November 2021, they increased slightly. The drop in creditworthiness, caused by the increasing interest rates, coincided with the start of the Russian invasion of Ukraine in February 2022 and a significant decrease in bank loans to farmers was observed.

The presented research is valuable because it is important to investigate how uncertainty affects economic circumstances. Bank deposits are the form of holding farmers' savings or free financial resources, and bank loans are one of the sources of financing for their economic activity.

The research is not without limitations. The presented data are aggregated and do not show the differences between the types of agricultural production, sizes, and locations of farms. This may constitute a direction for further research. The problems that specific farms face can result in the need for additional loans, which may be inaccessible due to a lack of creditworthiness, so, it is also important to verify if the decrease in the value of bank loans is determined by reducing capital needs of farms or by negative credit decisions. The increase in the value of bank deposits from farmers could also be caused by a financial surplus from agricultural production or from refraining from making financial decisions, especially from spending money. It is also worth investigating the reasons for that increase.

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KREDYTY I DEPOZYTY BANKOWE ROLNIKÓW INDYWIDUALNYCH W POLSCE W WARUNKACH NIEPEWNOŚCI GOSPODARCZEJ PODCZAS PANDEMII COVID-19

STRESZCZENIE

Cel: Celem opracowania była ocena zmian wartości i struktury kredytów bankowych dla rolników indywidualnych w warunkach niepewności gospodarczej, głównie spowodowanej przez pandemię COVID-19. **Metodyka:** Wykorzystano dane statystyczne Narodowego Banku Polskiego za okres od stycznia 2018 do września 2022 oraz policzono indeksy dynamiki. Wykorzystano również Globalny Indeks Niepewności Gospodarczej i Politycznej w celu pokazania, czy pandemia COVID-19 skutkowała zwiększeniem niepewności gospodarczej. **Wyniki:** Wyniki wskazują, że w badanym okresie obserwowano zarówno zwiększenie wartości depozytów bankowych rolników, jak i spadek kredytów rolników. Zwiększenie wartości depozytów rolników występowało, gdy stopy procentowe były ekstremalnie niskie, dlatego można stwierdzić, że zwiększenie wartości depozytów bankowych rolników wynikało z niepewności gospodarczej a nie z rosnącej zyskowności depozytów. W tym samym czasie, wartość kredytów bankowych dla rolników spadała, ale trudno jest wskazać, czy jest to efektem zacieśniania polityki kredytowej banków czy awersji rolników do ryzyka. **Wnioski:** Badania dotyczące aktywności kredytowej i depozytowej podmiotów gospodarczych są bardzo ważne z powodu rosnącej roli niepewności w dzisiejszych czasach. To co jest obserwowane, to fakt, że wartość kredytów rolników spadła, ale trudno jest stwierdzić z całą pewnością, czy wynikało to z niepewności gospodarczej i ograniczonych potrzeb kapitałowych rolników z tego powodu, czy z redukcji aktywności kredytowej banków i negatywnych decyzji kredytowych.

Słowa kluczowe: niepewność gospodarcza, rolnicy, kredyty, depozyty, COVID-19

CONTENTS
SPIS TREŚCI

INSTRUCTIONS TO AUTHORS

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