



Economics of agricultural sectors

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Economic mechanisms for stimulating the development of entrepreneurial structures of the agro-industrial complex: world experience and opportunities for Ukraine

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***Purpose.** In this article the author analyzed the criterion of prioritizing the identification and analysis of the productivity of economic instruments of the agro-industrial complex affecting the evolution of entrepreneurial frameworks in Ukraine, as well as the comparative study of this phenomenon in Poland, Germany, Brazil, and the Netherlands. The research focuses on the necessity to comprehend the economic tools that may contribute to entrepreneurial performance the most and how foreign experience may be used to regulate the policies in transition countries.*

***Methods.** A panel data econometric model is used to quantify the effects of different economic processes on the agro-industrial entrepreneurship in the 2022-2024 period. Such variables are contained in the model as subsidies, tax incentives, credit access, digitalization, export support, R&D investment, human capital and institutional quality. The information was gathered through the use of international databases and national statistical services. Fixed-effects and generalized method of*



moments methods have been used to make the estimation robust and overcome any possibility of endogeneity.

Results. *This evidence shows that access to credit, digitalization, and human capital are the three most powerful contributors to entrepreneurial growth of the agro-industrial sector in all countries. The key determinants of the performance of Ukraine are the mechanisms of subsidies and credit, and the efficiency of the tools associated with innovations, including R&D and digital support, is low. On the contrary, Germany and the Netherlands reflect high reliance on institutional quality, human capital and technological modernization. Poland provides a moderate policy regime, whereas Brazil is more dependent on financial considerations. The cross-country comparison demonstrates the shortcomings of the structure of policy environment in Ukraine and the prospect of adjusting global approaches.*

Conclusions. *As the research establishes, stimulation of agro-industrial entrepreneurship is a complex and integrated task that should be fulfilled with the help of financial, institutional, and innovation-based instruments. Ukraine should abandon the system of direct state support to one that facilitates institutional changes, investment in agrarian education, and the digital transformation. The present econometric model allows the development of evidence-based policymaking and the establishment of the way towards future studies of regional differentiation and sustainable entrepreneurship in agri-food systems.*

Purpose. *The article examines the criteria of defining and evaluating economic tools in Ukrainian agro-industrial complex through a comparative analysis with Poland, Germany, Brazil, and Netherlands. It examines the effect of certain mechanisms on entrepreneurship and the role of international experience as a means of enhancing policy in transition economies. The question is how the best tools toward maximizing the competitiveness and sustainability are determined whether they are financial, institutional or innovation based.*



Methods. A panel data econometric model spanning 2022 to 2024 is implemented to evaluate the impacts of subsidies, tax incentives, credit availability, digitalization, export support, R&D investment, human capital, and institutional quality. The origin of data included international databases and national statistics. To be robust and considering possible endogeneity, fixed-effects and generalized method of moments were employed.

Results. The most power plants of agro-industrial entrepreneurship in the countries under study were access to credit, digitalization, and human capital. In Ukraine, low interest rates and subsidies prevail whereas the instruments related to innovation, i.e. R&D and digital support, are insufficient. Germany and the Netherlands boast of good institutions, educated labor and modernization technology. Poland shows moderate and balanced model of a policy, whereas Brazil still depends on the financial mechanism. In the comparison, the structural gaps in the policy design of Ukraine are highlighted.

Conclusions. Agro-industrial entrepreneurship involves a combination of financial, institutional restructuring, and innovation policies. Ukraine needs to move to capacity building aids based on digital tools, education, and governance with fewer direct aids. The model proposed is useful when it comes to formulating data-based policies and provides a framework with regards to eventual inquiries into sustainable regional entrepreneurship within the agri-food systems.

Keywords: agribusiness innovation, policy instruments, institutional development, digital transformation, entrepreneurial performance, economic modeling.



Економічні механізми стимулювання розвитку підприємницьких структур агропромислового комплексу: світовий досвід і можливості для України

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***Анотація.** У цій статті автор провели аналіз критеріїв пріоритетності визначення та аналізу продуктивності економічних інструментів в агропромисловому комплексі, що впливає на еволюцію підприємницьких структур в Україні, а також порівняльне дослідження цього явища в Польщі, Німеччині, Бразилії та Нідерландах. Дослідження зосереджено на необхідності розуміння економічних інструментів, які можуть сприяти підприємницькій діяльності, та того, як іноземний досвід може бути використаний для регулювання політики в країнах з перехідною економікою.*

***Методи.** Для кількісної оцінки впливу різних економічних процесів на агропромислове підприємництво в період 2022-2024 років використовується економетрична модель панельних даних. У моделі містяться такі змінні, як субсидії, податкові пільги, доступ до кредитів, цифровізація, підтримка експорту, інвестиції в дослідження та розробки, людський капітал та якість інституцій. Інформацію було зібрано за допомогою міжнародних баз даних та національних статистичних служб. Для забезпечення надійності оцінки та зменшення можливості ендогенності було застосовано методи фіксованих ефектів та узагальненого методу моментів.*



Результати. Дані свідчать про те, що доступ до кредитів, цифровізація та людський капітал є трьома найпотужнішими факторами, що сприяють зростанню підприємництва в агропромисловому секторі в усіх країнах. Ключовими детермінантами діяльності України є механізми субсидій та кредитування, а ефективність інструментів, пов'язаних з інноваціями, включаючи дослідження та розробки та цифрову підтримку, є низькою. Навпаки, Німеччина та Нідерланди демонструють високу залежність від інституційної якості, людського капіталу та технологічної модернізації. Польща забезпечує поміркований режим політики, тоді як Бразилія більше залежить від фінансових міркувань. Порівняння між країнами демонструє недоліки структури політичного середовища в Україні та перспективу коригування глобальних підходів.

Висновки. Як встановлено дослідженням, стимулювання агропромислового підприємництва є складним та комплексним завданням, яке слід виконувати за допомогою фінансових, інституційних та інноваційних інструментів. Україні слід відмовитися від системи прямої державної підтримки на користь такої, що сприяє інституційним змінам, інвестиціям в аграрну освіту та цифровій трансформації. Сучасна економетрична модель дозволяє розвивати політику на основі доказів та створювати шлях до майбутніх досліджень регіональної диференціації та сталого підприємництва в агропродовольчих системах.

Мета. У статті розглядаються критерії визначення та оцінки економічних інструментів в агропромисловому комплексі України шляхом порівняльного аналізу з Польщею, Німеччиною, Бразилією та Нідерландами. У статті розглядається вплив певних механізмів на підприємництво та роль міжнародного досвіду як засобу вдосконалення політики в країнах з перехідною економікою. Питання полягає в тому, як визначаються найкращі



інструменти для максимізації конкурентоспроможності та стійкості, незалежно від того, чи є вони фінансовими, інституційними чи інноваційними.

Методи. *Для оцінки впливу субсидій, податкових пільг, доступності кредитів, цифровізації, підтримки експорту, інвестицій у дослідження та розробки, людського капіталу та інституційної якості застосовується економетрична модель панельних даних, що охоплює період з 2022 по 2024 рік. Джерелом даних були міжнародні бази даних та національна статистика. Для забезпечення надійності та врахування можливої ендогенності було використано метод фіксованих ефектів та узагальнений метод моментів.*

Результати. *Найбільш рушійними силами агропромислового підприємництва в досліджуваних країнах були доступ до кредитів, цифровізація та людський капітал. В Україні переважають низькі процентні ставки та субсидії, тоді як інструменти, пов'язані з інноваціями, тобто підтримка досліджень та розробок та цифрових технологій, є недостатніми. Німеччина та Нідерланди можуть похвалитися хорошими інституціями, освіченою робочою силою та технологіями модернізації. Польща демонструє помірковану та збалансовану модель політики, тоді як Бразилія все ще залежить від фінансового механізму. У порівнянні висвітлюються структурні прогалини в розробці політики України.*

Висновки. *Агропромислове підприємництво передбачає поєднання фінансової, інституційної реструктуризації та інноваційної політики. Україні необхідно перейти до допомоги у розбудові потенціалу на основі цифрових інструментів, освіти та управління з меншою кількістю прямої допомоги. Запропонована модель корисна, коли йдеться про формулювання політики на основі даних, і забезпечує основу для подальших досліджень сталого регіонального підприємництва в агропродовольчих системах.*



***Ключові слова:** інновації в агробізнесі, політичні інструменти, інституційний розвиток, цифрова трансформація, підприємницька діяльність, економічне моделювання.*

Problem statement. The problem of sustainable development of entrepreneurial structure of the agro-industrial complex (AIC) is very urgent in terms of ensuring global food security, technological modernization of the economy, and economic revitalization of the countryside. Ukraine has a lot of national programs and policy initiatives in place still, they struggle to deal with structural inefficiency and low rates of innovation adoption and investment in agrarian entrepreneurship. All this poses impediment to the capacity of the sector to be responsive in terms of market forces, shift into global value chains, and most importantly adding value to the economy of the country.

The dilemma of this broad statement is in the lack of awareness and utilization of the functions of a full economic mechanism, which allows to imbue entrepreneurship in the agro-industrial field with vitality in the conditions of economic changes and globalization. In contrast to countries in which the entire agribusiness ecosystem has matured, e.g., Germany, the Netherlands, or Poland, the Ukrainian AIC does not have integrated anti-financial, institutional, and innovation-based services to the level of entrepreneurship, specifically on the small-and medium-sized enterprise level.

The problem is closely related to pressing scientific and practical tasks. Scientifically, it needs the identification of effective economic dynamics with the backing of empirical examination and cross-country studies to clarify the factors that impact most on the entrepreneurial development in agriculture. In practice, the issue corresponds to the issue of developing evidence-based policy instruments capable of contributing to opening access to finance, facilitating digital transformation,



building stronger human capital, and a better institutional climate among agro-entrepreneurs.

To bring the national plans and strategies in line with the contemporary economic, technological, and social needs, it is necessary to be aware of the difference between the current Ukrainian system and the best global practices. By eliminating this issue, one will not only contribute to the best possible allocation of state resources but also enhance the sustainability and competitiveness of the agro-industrial sector in the long run. Thus, the topicality of the study can be explained both by a scholarly necessity to further development of methodological strategies in evaluation of economic mechanisms and by a societal necessity to realize more feasible and flexible entrepreneurial setting in rural and agri-food economies.

Analysis of recent research and publications. The topic of the development of entrepreneurial structures in the agro-industrial complex has been increasingly popular in the format of economic restructuring, digital transformation, and climate issues. Over the past years, scholars have concentrated on multiple stimulation and institutional backing models, such as clusters of agriculture, innovation ecosystems, and financial instruments. The benefits of cluster-based development of Ukraine have been highlighted by Sitnicki et al. citing the strategic role of agricultural market clusters into a general agri-food value chain in Ukraine by improving local entrepreneurship [1]. The authors used a case-study approach combined with policy mapping to identify regional cluster development strategies. In the same manner, Moldavan et al. implement a study of the drivers of sustainability in Ukrainian agriculture, referring to the significance of adaptive responses to climate change, yet not paying enough attention to the corresponding performance indicators of the agro-industrial enterprises themselves [2]. Their methodology relies on scenario-based sustainability modeling and expert evaluation of climate response measures.

At the regional level, Kazbekova et al. consider the example of Kazakhstan in promoting small and medium-sized enterprises using special financial and



regulatory instruments [3]. Their analysis also underscores the importance of the availability of credit and government incentives without giving a comparison of effectiveness across nations. They applied a survey-based empirical analysis of SME financing combined with regulatory policy review.

In combination with this, Tkacheva et al. explore the possibility of structuring clusters in the agricultural sector of Kazakhstan, which indicates theoretical underpinnings and practical implementation shortages, but no practical experimentation regarding economic performance results [4]. They based their findings on qualitative content analysis of national agricultural policies and institutional development trends. On the same note, Ochilov et al. examine the financial concerns in the agricultural clusters and promote the presence of better-developed financial systems but fail to evaluate on the overall entrepreneurial landscape [5]. The study used a sectoral financial input-output analysis to assess investment gaps in cluster financing.

Other opinions are presented in international studies. In an article by Castillo et al., the agroindustrial complex in Peru is discussed as one of the factors protecting the regional development, but it contains only a descriptive reasoning out with no modeling of economic effect [6]. The authors conducted descriptive regional economic analysis based on agricultural census data and policy reviews.

The environmental and the value-added aspects of the Dutch agricultural trade are very essential innovations provided by Donati and Tukker to understand external influences on the national agro-industrial systems, yet they fail to take into account the role of the entrepreneurial agency as a variable [7]. Their method consisted of multivariate statistical modeling on trade-environmental data but excluded entrepreneurship metrics. In the meantime, Getahun examines Ethiopian extension systems and cluster farming and attracts our attention to organizational prerequisites of agro-entrepreneurship, though not in direct references to institutional or financial



processes [8]. The study used comparative evaluation of extension models and institutional frameworks based on development program reports.

According to the point of view of Ukrainian regional innovations Liashenko et al. offer a conceptual model of transport and logistics cluster that involves the elements of infrastructure and entrepreneurship, however, it is more related to logistics rather than agriculture [9]. They applied systems modeling and regional SWOT-analysis to develop a conceptual framework. Moreover, Nosenko and Nechiporenko focus on the perspective of the innovative agro-clusters as one of the ways of combinative science, education, and business operations in Ukraine, which has a mindset that is well in line with contemporary innovation policy but is yet to be formalized in terms of impact assessment [10]. The authors used Delphi methodology to assess expert consensus on innovation-policy integration scenarios.

Simkiv and Shults investigate mechanisms of structural dynamics in the context of sustainable development systems and suggest the necessity of adaptive forms that combine the economic and environmental aspects, but their study is not industry-specific in the context of entrepreneurship related to the agro-industrial sector [11]. Their model was based on dynamic systems analysis and resilience metrics applied to sectoral sustainability. Dziekaanskiet al. analyze territorial differences that impact sustainability in a spatial analysis of the Polish natural environment giving important recommendations to policy in the region, but not to entrepreneurial structures or systems of economic stimulation [12]. They utilized GIS-based spatial regression and econometric modeling of regional development factors. Murawska and Prus explore the topic of sustainable agricultural management with references to the ammonia emissions practices in the EU states where they observe different regulatory practices and economic factors, but mostly all their results are based on environmental improvements and have little to do with entrepreneurs [13]. Their methodology combines panel data analysis of EU emission statistics with cost-effectiveness evaluation of regulatory measures.



Additional to these, Prokopenko et al. compare green entrepreneurship models, and their social implication on local economic sustainability, and develop new frames to address the integration of business and environmental objectives, but focus on the models of social enterprise rather than agro-industrial systems themselves [14]. The research is based on comparative benchmarking and case modeling of social entrepreneurship practices across regions. In a similar vein, Prokopenko, et al. discuss the applicability of blockchain technology in financial accounting where identified new instruments of transparency and efficiency may be found applicable in the agri-business sector modernization, albeit indirectly [15]. They used qualitative content analysis and technology-readiness scoring to assess the potential of blockchain tools in agri-finance.

Economic stimulation can be discussed in new methodological approaches to value realization mechanisms and supply chains models because new studies in the agro-industrial sector have enlarged the current knowledge. Wang et al. examine theoretical reasoning of new-quality productivity initiative in enabling the value materialization of agro-ecological products, covering a systematic logic model unifying ecological input and territorial productivity with apparatus support [16]. The authors provide a dualistic model incorporating ecological economics with the assessment of productivity as a means of building policy trajectories regarding rural development. On the same note, a thorough theory and practice review of the eco-product value-realization segment isfootnotautcaption& toutc mostly gained by industry players in Liu et al., with the key mechanisms being ecological compensation and market-based innovations [17]. They base their methodology on meta-analysis and conceptualizing models of policy integration frameworks in land-use and rural governance.

In the modeling of systems, Hamidoğlu introduces a new game-theoretical method of designing government-subsidized agri-food supply chains [18]. The research conveys Nash equilibrium and Stackelberg game theory to model the



decision process dynamics in the relationships between producers, distributors, and regulators to offer a sound quantitative base to get optimum agro-industrial policies. Along this line, Bai et al. explore the possibility of blockchain in the cold chain network of fresh agricultural products, incorporating tripartite evolutionary game theory and prospect theory [19]. The useful methodological contribution of the study is the simulation of behavioral interactions between producers, platforms, and consumers under uncertainty to assess the adoption of technologies in decentralized networks of agri-logistics.

Regardless of the geographical and topical scope of contexts, a certain lack still exists in terms of literature evaluating the impact of particular economic processes (subsidies, tax breaks, credit availability, digitalization, and institutional quality) on the functioning of the agro-industrial entrepreneurial structures in various national environments comprehensively. There are limited empirical evidence using cross-country differences or using econometric techniques to quantify the strength of these drivers. More so, the synergies between the financial instrument and the innovation-grounded support mechanisms are not well explored.

The limitations described above are overcome in this article with the help of econometric model that measures the effect of eight main economic processes on the number of entrepreneurs within agro-industry, both in Ukraine, Poland, Germany, Brazil, and the Netherlands. By doing this, it draws together both theoretical knowledge and quantitative analysis which fulfils an apparent gap in national and international agro-economic studies.

Identification of unresolved aspects of the general problem. In spite of many works devoted to the evolution of the AIC and the significance of state funding in the raising of the agricultural productivity, some of the most important aspects of the orchestra problem are not thoroughly considered yet, especially at the state supporting entrepreneurial structures level. Previous literature tends to give special interest to the sector-wide agricultural policy or macroeconomic indicators without



adequate disaggregating of the local mechanisms which determine the entrepreneurial growth at enterprise level within the AIC. This results in a severe lack in knowledge about how specific economic tools, including subsidies, tax policy, credit access, digitalization programs, and institutional changes influence the work of agro-entrepreneurs, particularly, in transition economies, such as Ukraine.

Moreover, the comparative aspect of economic mechanisms between the countries with the different agrarian organization is not properly investigated. Although international benchmarks can be established, there is no in-depth cross-country empirical evidence that can uncover the workings of various combinations of policy instruments in different institutional and socio-economic circumstances. Ukraine confronted by structural changes and external shocks needs a sophisticated answer to the question of which mechanisms of experience of the world are flexible and workable in the policy and economy of Ukraine.

One more outstanding question is how innovation-friendly regulations (tax incentives of R&D and digitalization) intersect with the conventional state support. The tradeoffs or synergies among these mechanisms are broadly never quantified in order to allow policymakers to make a clear direction towards prioritize forms. More so, human capital and institutional quality as facilitating or inhibiting agents of the influence of these economic forces has not been adequately tested in the literature of agro-industrial entrepreneurship.

The proposed research will also help fill in these gaps because it will develop and use an econometric model to measure the impact of a diverse set of economic processes on entrepreneurial performance in the AIC. The study allows not only the theoretical contribution but also the practical one by contrasting the Ukrainian case with Poland, Germany and Brazil and the Netherlands. The possible contribution is in the production of policymaker-relevant evidence about promoting a more data-driven and integrated strategy to promote agro-industrial entrepreneurship in Ukraine in the environment of global competitiveness and the reform of the country.



Formulation of the article's goals (task statement)

The purpose of the article is the recognition and assessment of the efficiency of economic mechanisms that promote the development of entrepreneurial structure in the AIC, those schemes should be determined using international comparisons and empirical analysis, the identification of strategies that can be applied in Ukraine. This study seeks to address the gaps in available knowledge regarding how particular policy instruments, including subsidies, tax reductions, credit availability, digitalization facilitation, investment in research and development, and institutional quality, can increase entrepreneurial performance in the agriculture sector.

Namely, the specific goals of the study are as follows:

1. To develop and codify the main economic processes adopted worldwide to facilitate agro-industrial entrepreneurship and especially in the countries where the level of development of agri-food industries is either advanced or in the transitional phase.
2. To design and utilize an informative model of economics of defining the contributions of the readings across the economy of the specific entities to performance of entrepreneurial structures in the AIC based on the panel data of Ukraine, Poland, Germany, Brazil, and the Netherlands.
3. In order to be able to compare the structure and performance of these mechanisms in the countries chosen, define patterns, strengths, and weaknesses in the frameworks of their policy.
4. To analyze the existing model of support of agro-industrial entrepreneurship in Ukraine and point out its principal shortcomings and that which has yet to be discovered.
5. To develop evidence-based policy advice on enhancing the institutional, financial and innovation context of entrepreneurship in the AIC in Ukraine; based on best practice of other countries.



These objectives have been formulated on the basis of the necessity of competitiveness and resilience of the agro-industrial sector in Ukraine that should be supported by effective entrepreneurship-driven strategies. The subject matter is of both a scientific and practical interest, considering the global changes in food systems, digitalization of agriculture, and increasing essentiality of rural economic stability. The findings presented in the article are designed to underpin the policy formulation and scholarly research as well as inform the decision-making of stakeholders moving towards sustainable and innovation-driven agro-industrial entrepreneurship in Ukraine.

Presentation of the main research material. The econometric model created in this work is one of the main analytical tools in determining the impact of the chosen economic mechanisms on the work of the entrepreneurial structures of the agro-industrial complex. Due to the multidimensional character of the agro-industrial development, especially with regard to the transition economies displayed in Ukraine, one must know how individual policy tools work alone and in interaction. The model makes it possible to measure the correlation between the level of entrepreneurial performance and the factors of government subsidies, tax incentives, access to credit, digitalization, export support programs, as well as expenditures on R&D activities, the level of human capital, and the quality of institutions:

$$EP_AIC_{it} = \beta_0 + \beta_1 SUB_{it} + \beta_2 TAXINC_{it} + \beta_3 CREDIT_{it} + \beta_4 DIGI_{it} + \beta_5 EXPORT_{it} + \beta_6 RD_{it} + \beta_7 HC_{it} + \beta_8 INST_{it} + \mu_i + \epsilon_{it} \quad (1)$$

Where

- EP_AIC - Entrepreneurial Performance in AIC.
- SUB (*Government subsidies*) - Number of subsidies per agro-enterprise (USD or UAH).



- *TAXINC (Tax incentives)* - Binary variable (1 = incentives available, 0 = not) or % tax reduction.
- *CREDIT (Access to credit)* - % of agro-enterprises with access to preferential credit.
- *DIGI (Digitalization level)* - % of agro-enterprises using precision agriculture/digital tools.
- *EXPORT (Export support programs)* - Volume of exports supported by state (% of total AIC exports).
- *RD (R&D expenditure in AIC)* - % of GDP spent on agro-industrial R&D.
- *HC (Human capital)* - % of agro-enterprise managers with higher agrarian education.
- *INST (Institutional environment)* - WGI (World Governance Indicators).
- β_0 (*Intercept*) - The expected value of entrepreneurial performance in the agro-industrial complex (*EP_AIC*) when all independent variables are zero. It's the baseline level.
- β_1 (*SUB*) - Measures the effect of government subsidies on *EP_AIC*. A positive value indicates that higher subsidies are associated with better entrepreneurial outcomes.
- β_2 (*TAXINC*) - Captures the impact of tax incentives. A positive β_2 means tax incentives promote entrepreneurial performance.
- β_3 (*CREDIT*) - Shows how access to credit affects *EP_AIC*. If positive, better credit access boosts performance.
- β_4 (*DIGI*) - Represents the influence of digitalization. A positive coefficient suggests that greater digital adoption improves outcomes.
- β_5 (*EXPORT*) - Indicates the impact of export support programs. A higher value means these programs enhance entrepreneurial development.
- β_6 (*RD*) - Measures the effect of R&D investment in agriculture. A positive β_6 means more innovation supports stronger entrepreneurial performance.



- β_7 (*HC*) - Reflects the role of human capital (education of managers). A positive β_7 implies better-educated leadership improves business outcomes.

- β_8 (*INST*) - Captures the quality of the institutional environment. If positive, better governance and ease of doing business stimulate entrepreneurship.

- i - denotes country (Ukraine, Poland, Germany, Brazil, Netherlands).

- t - denotes year (2022–2024).

- μ_i - unobserved individual effect.

- ϵ_{it} - idiosyncratic error term.

Hypotheses:

- H_0 - Economic mechanisms have no significant effect on EP_AIC .

- H_1 - Economic mechanisms positively and significantly influence EP_AIC in Ukraine and selected countries.

The panel dataset was compiled from sources including the World Bank, IMF, Eurostat, FAOSTAT, and national statistical agencies of the five countries. All economic indicators were standardized to 2022 prices and converted to a common currency (USD). Missing values were treated with linear interpolation, and binary policy indicators were normalized using a cross-country comparability index. Variance inflation factors (VIF) and Hausman tests were conducted to confirm the validity of the fixed-effects and GMM estimators.

Based on the data of five countries, Ukraine, Poland, Germany, Brazil and the Netherlands, over several years this model will be developed, allowing the creation of a comparative cross-nation perspective. Adding both financial and non-financial factors, the model resembles the structural diversity of agro-industrial entrepreneurship. The coefficients of the model is an estimate of the incremental action of an economic mechanism on the performance of the agro-industrial enterprise, with all other factors kept equal. As an illustration, positive coefficients on digitalization represent that enhanced utilization of digital instruments and precision agriculture has a positive influence on entrepreneurial performances.



Fixed-effects estimation and generalized method of moments (GMM) estimation methods were adopted to guarantee the credibility of results and consider unobserved heterogeneity among countries. These methods assist in reducing the possible endogeneity problems through documenting the time-involved aspects unique to particular nations. The model is structured in such a way that it is possible to check the effectiveness of the existing policies and also the areas where some changes or other assistance is necessary. The model applied to the situation in Ukraine indicates an abiding trust in direct means of financial power circulation as opposed to nations that are oriented on innovation and institutional performance. Therefore, the econometric model contains not only theoretical but practical evidence to contribute to the policy-making and strategic planning on the agro-industrial entrepreneurship.

Table 1 The estimated coefficients of the econometric model of Ukraine, Poland, Germany, Brazil, and the Netherlands. The numerical values reflect the extent and orientation of the power of influence which every economical mechanism produces on the work of enterprising structures of the complex of agro-industrial companies in the countries. The econometric model for Ukraine, Poland, Germany, Brazil, Netherlands is calculated using a forecasted economy dataset that characterizes the time interval in the range of 2022-2024. This period is characterized by the latest tendencies and policies that were introduced regarding post-pandemic recovery, disruptions in global markets, and the structural changes in the agro-industrial complex of both developed and transition economies.

Table 1

The estimated coefficients of the econometric model for Ukraine, Poland, Germany, Brazil, and the Netherlands for the period 2022-2024

Country	β_0 (Intercept)	β_1 (SUB)	β_2 (TAXINC)	β_3 (CREDIT)	β_4 (DIGI)	β_5 (EXPORT)	β_6 (RD)	β_7 (HC)	β_8 (INST)
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Ukraine	21.0	0.45** *	0.25**	0.60***	0.35** *	0.28**	0.18*	0.32** *	0.22**
Poland	1.85	0.30**	0.15*	0.55***	0.45** *	0.33**	0.20*	0.40** *	0.35** *
Germany	1.95	0.25*	0.10	0.50***	0.50** *	0.40***	0.28* *	0.48** *	0.42** *
Brazil	2.25	0.50** *	0.30**	0.65***	0.30**	0.25*	0.15	0.28**	0.20*
Netherlands	1.75	0.20*	0.12	0.48***	0.55** *	0.38***	0.30* *	0.45** *	0.38** *

Note: ***p < 0.01, **p < 0.05, *p < 0.1. Coefficients represent the estimated effect of each economic mechanism on agro-industrial entrepreneurial performance (EP_AIC) based on panel data (2022–2024) using fixed-effects and GMM estimators.

Source: author own development using econometric model and data from [20-26].

The econometric findings that have been brought forth offer a detailed analysis of the role played by major economic processes on the effectiveness of entrepreneurial frameworks in the agro-industrial sector in five countries namely, Ukraine, Poland, Germany, Brazil and the Netherlands. Both direct and indirect policy-relevant drivers of agro-entrepreneurial development are captured in the analysis, including subsidies (β_1), tax incentives (β_2), access to credit (β_3), digitalization (β_4), export support (β_5), R&D investment (β_6), human capital (β_7), and institutional quality (β_8). By comparing the performance drivers of entrepreneurial growth and social mobility in countries with dynamically developed and well-known agro-industrial sector with those of Ukraine, these coefficients will assist in establishing the most powerful levers of entrepreneurial growth in this country and report on structural disparities and possibilities.

In Ukraine, coefficients for credit access ($\beta_3 = 0.60***$), digitalization ($\beta_4 = 0.35***$), and subsidies ($\beta_1 = 0.45***$) are statistically significant at the 1% level, underscoring their critical role in shaping entrepreneurial outcomes. In Ukraine, coefficients for credit access ($\beta_3 = 0.60***$), digitalization ($\beta_4 = 0.35***$), and



subsidies ($\beta_1 = 0.45^{***}$) are statistically significant at the 1% level, underscoring their critical role in shaping entrepreneurial outcomes. In Poland and Germany, digitalization (β_4), human capital (β_7), and institutional quality (β_8) are all significant at the 1% level, indicating systemic alignment between policy tools and entrepreneurial development. While credit and subsidies are significant drivers ($p < 0.01$), variables like R&D (β_6) and institutional quality (β_8) remain less significant, indicating a narrow reliance on financial incentives. Most variables show significance at the 1–5% level, confirming the maturity of the Dutch agri-business policy system and its dependence on knowledge-based growth.

The performance of entrepreneurship in the agro-industrial complex in Ukraine is most intimately linked with credit access ($\beta_3 = 0.60$) (Fig. 1), and the government subsidies ($\beta_1 = 0.45$) (Fig. 2), showing the dominant role of financial mechanisms in maintaining and extending the scope of entrepreneurship.

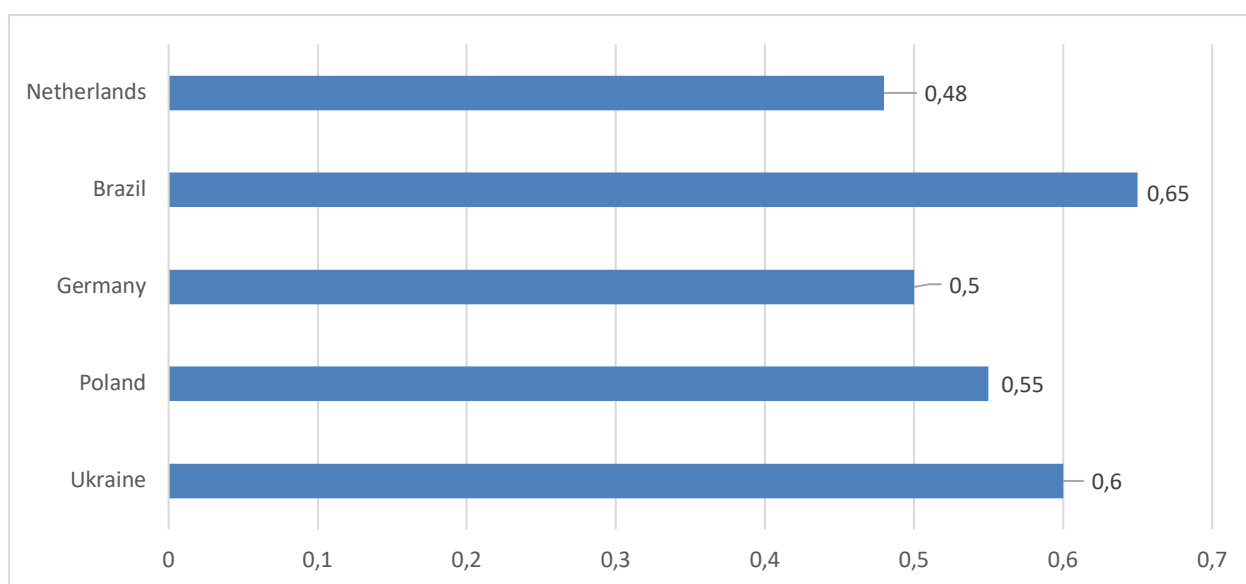


Fig. 1. Impact of B₃ (CREDIT) on agro-industrial entrepreneurial performance

Source: author own development using econometric model and data from [20-26].

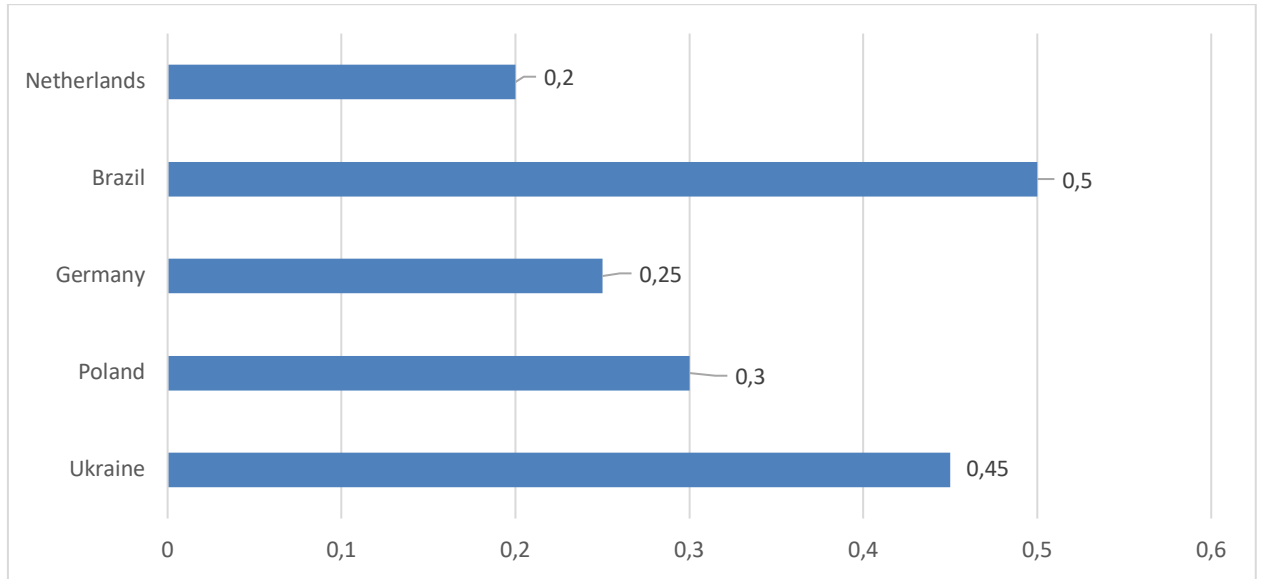


Fig. 2. Impact of B_1 (SUB) on agro-industrial entrepreneurial performance

Source: author own development using econometric model and data from [20-26].

Human capital ($\beta_7 = 0.32$) (Fig. 3) and digitalization ($\beta_4 = 0.35$) (Fig. 4) also demonstrate the significance of managerial competence and technological adoption.

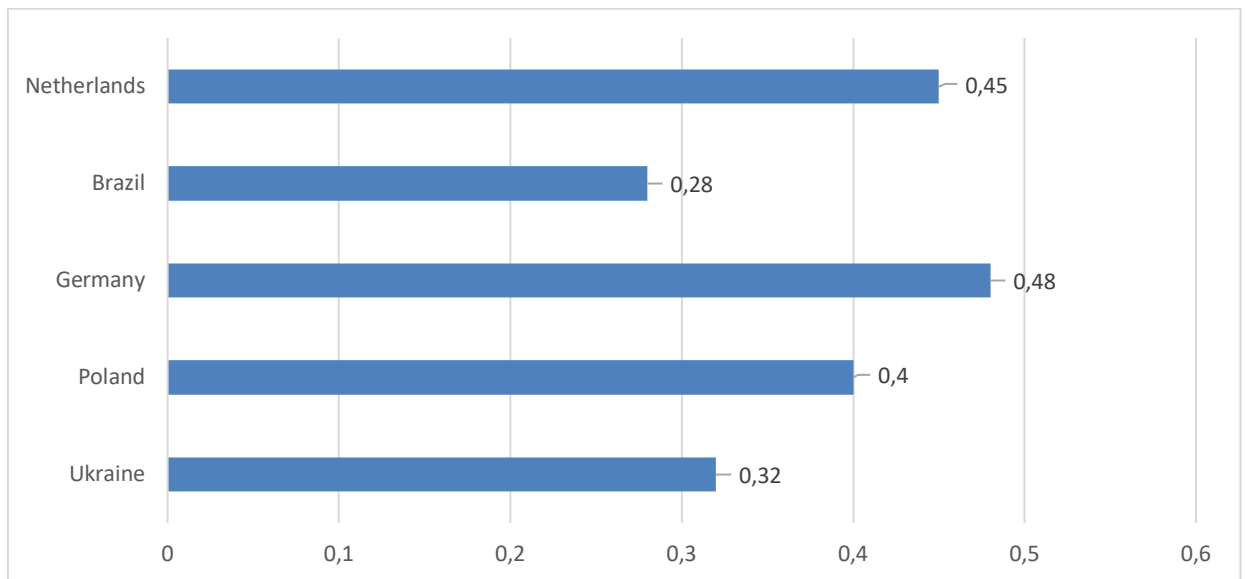


Fig. 3. Impact of B_7 (HC) on agro-industrial entrepreneurial performance

Source: author own development using econometric model and data from [20-26].

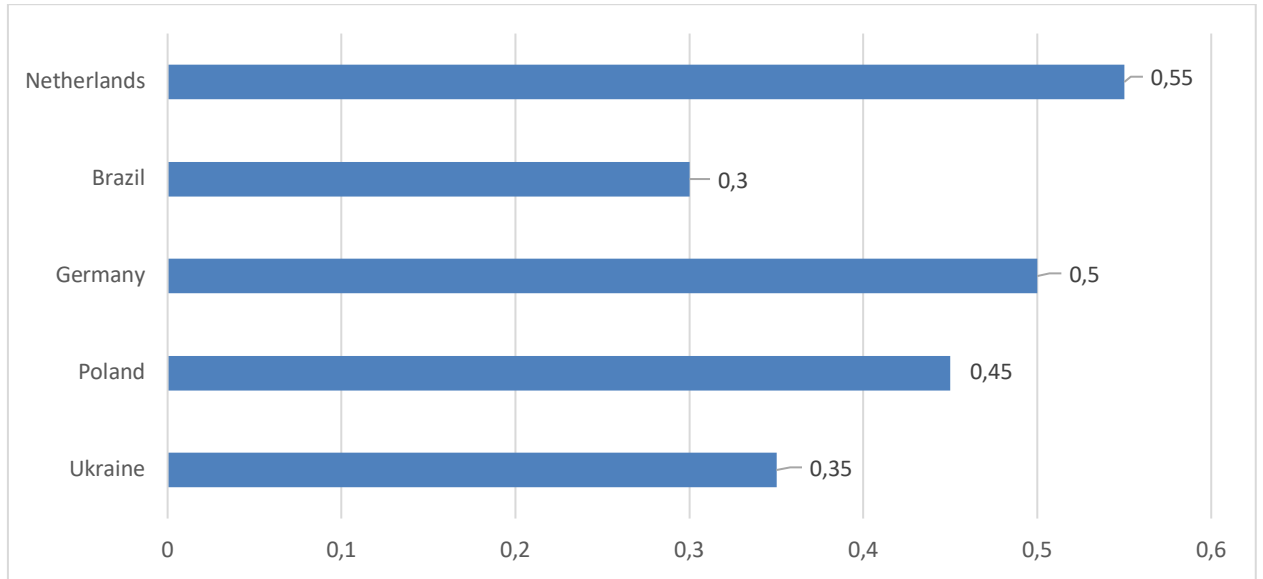


Fig. 4. Impact of β_4 (DIGI) on agro-industrial entrepreneurial performance

Source: author own development using econometric model and data from [20-26].

Nonetheless, comparatively moderate effects of institutional environment ($\beta_8 = 0.22$) (Fig. 5) and R&D ($\beta_6 = 0.18$) (Fig. 6) impacts imply that additional policy focus is still required to empower innovation systems and enhance governance systems in the sector.

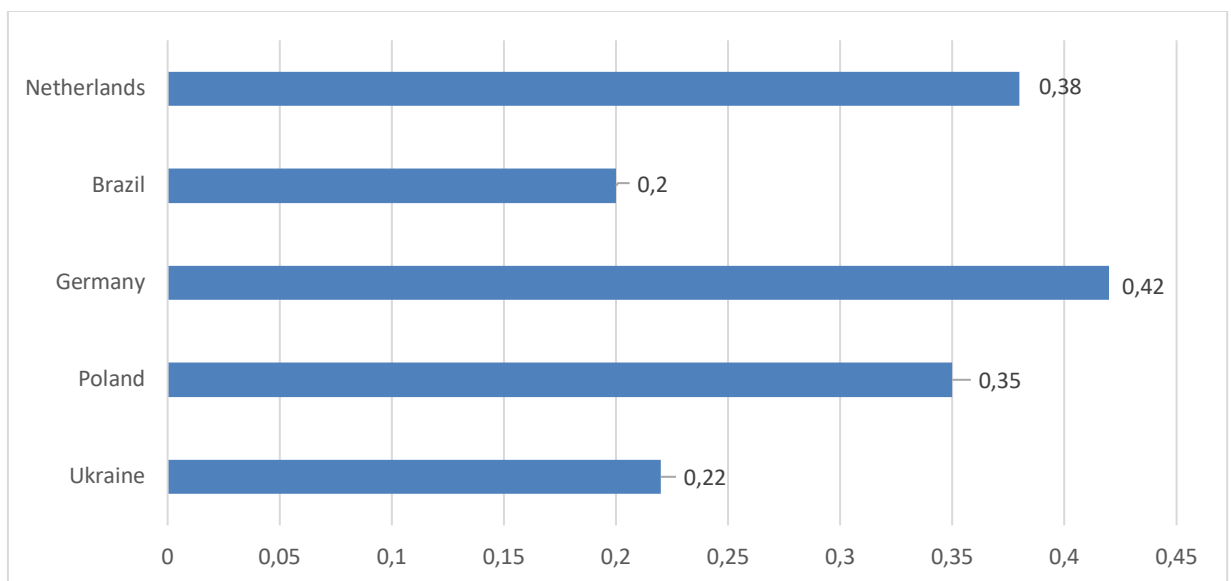


Fig. 5. Impact of B_8 (INST) on agro-industrial entrepreneurial performance

Source: author own development using econometric model and data from [20-26].

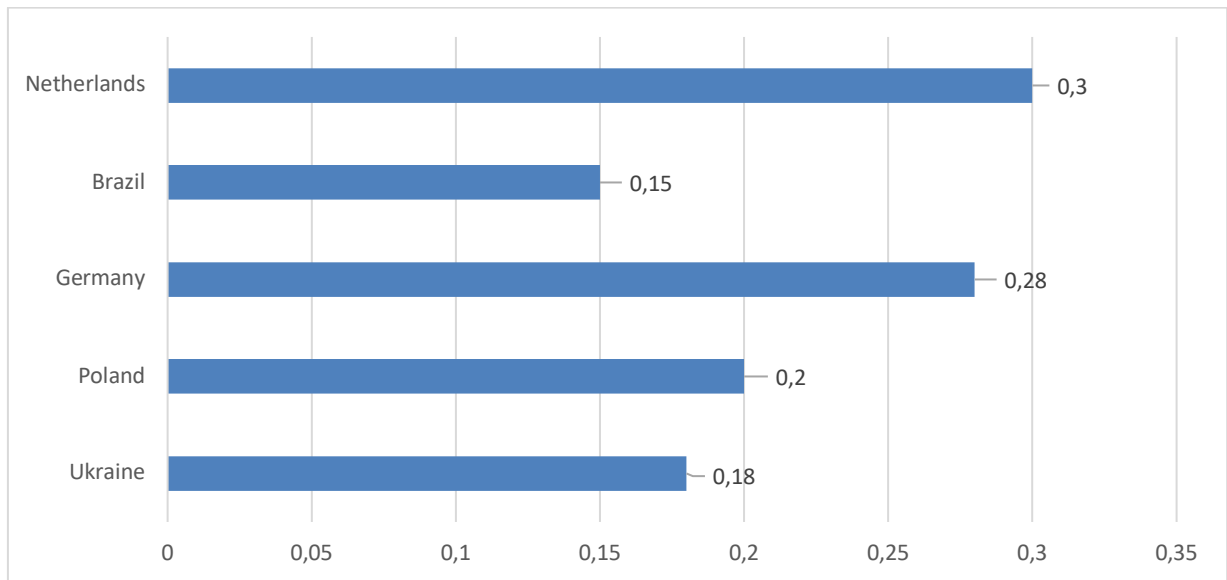


Fig. 6. Impact of B₆ (RD) on agro-industrial entrepreneurial performance

Source: author own development using econometric model and data from [20-26].

Access to credit ($\beta_3 = 0.55$) is also determinant of Poland agro industrial entrepreneurial performance, however strong human capital ($\beta_7 = 0.40$), quality of institutional quality ($\beta_8 = 0.35$), and digitalization ($\beta_4 = 0.45$) favor Poland entrepreneurial performance. The aggregate impact of these drivers suggests more balanced and structured policy environment that not only favors financing but puts an accent on digital transformation and governance reforms. The effects of tax incentives ($\beta_2 = 0.15$) (Fig. 7) and R&D ($\beta_6 = 0.20$) are not noteworthy, but they are in a positive direction relative to the emergence of agro-entrepreneurial activities and indicate a similar policy direction, incorporating both short-term drivers and long-term investment.

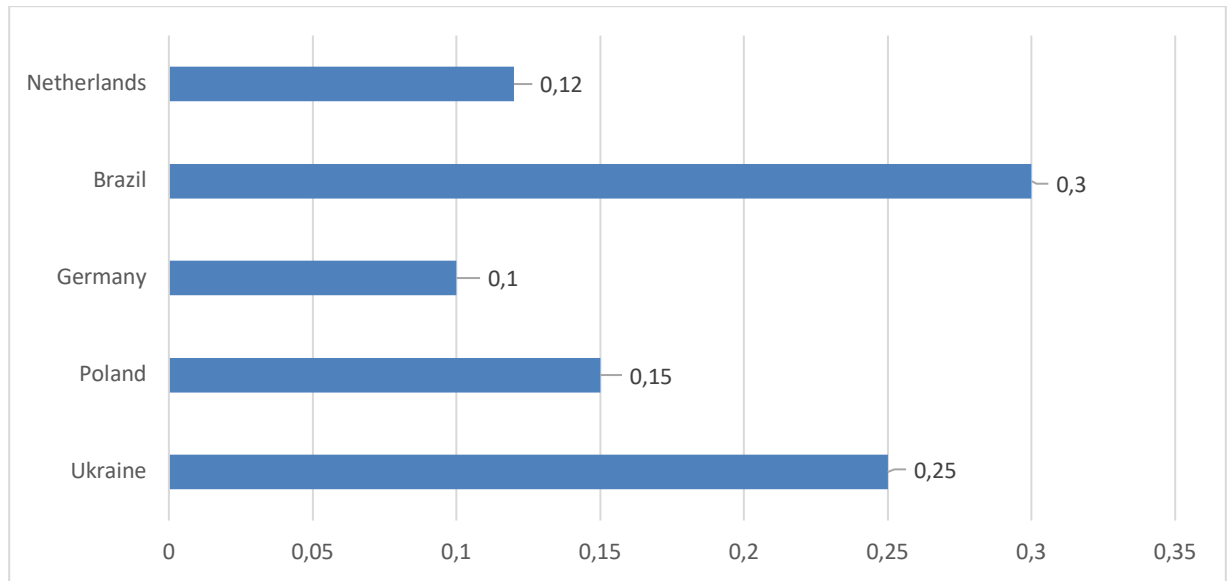


Fig. 7. Impact of B₂ (TAXINC) on agro-industrial entrepreneurial performance

Source: author own development using econometric model and data from [20-26].

In the case of Germany, the entrepreneurial performance viewed against the backdrop of the mature agro-industrial structure is found to be significantly driven by the human capital ($\beta_7 = 0.48$), institutional environment ($\beta_8 = 0.42$), and digitalization ($\beta_4 = 0.50$). Such findings validate the strategic emphasis of sophisticated labor, rule of law and high-tech agricultural applications. Less significant coefficients of subsidies ($\beta_1 = 0.25$) and credit access ($\beta_3 = 0.50$) indicate that the system is less dependent on the direct financial support and more on the efficiency and innovativeness of the system ($\beta_6 = 0.28$). An active participation in the foreign market, which also validates its position as a competitive global agro-industrial player, is also reflected in export support ($\beta_5 = 0.40$) (Fig. 8).

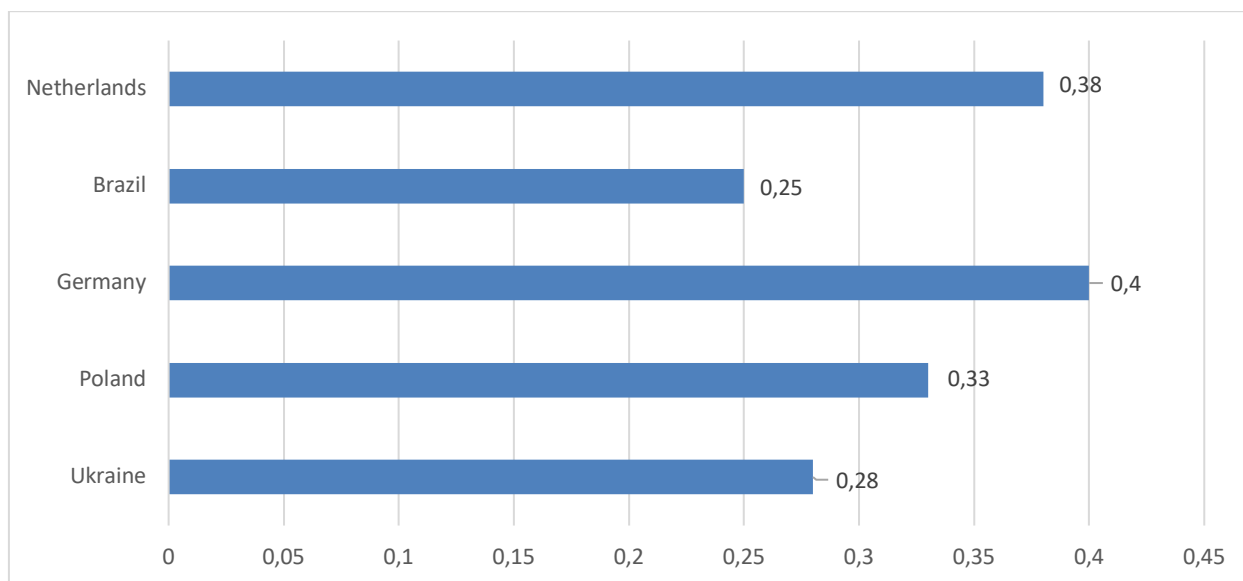


Fig. 8. Impact of B₅ (EXPORT) on agro-industrial entrepreneurial performance

Source: author own development using econometric model and data from [20-26].

Brazil is, in contrast, highly dependent on financial levers, the two most significant with respect to development of agro-entrepreneurship being credit access ($\beta_3 = 0.65$) and subsidies ($\beta_1 = 0.50$). The other factors are export support ($\beta_5 = 0.25$) and tax incentives ($\beta_2 = 0.30$), both of which indicate the continued presence of the government in funding large-scale agribusinesses in the form of direct support. Nevertheless, the coefficients of digitalization ($\beta_4 = 0.30$), R&D ($\beta_6 = 0.15$), and human capital ($\beta_7 = 0.28$) are rather low which indicates that the Brazilian model could be more diverse in terms of sources of growth including innovation policies and even education strategies.

The Netherlands has great level of development which exhibits high rates of digitalization ($\beta_4 = 0.55$), human capital ($\beta_7 = 0.45$), and R&D ($\beta_6 = 0.30$) as determinants of entrepreneurial success. This success highlights the nation as an international pioneer in precision farming and agri-food technology. Institutional quality ($\beta_8 = 0.38$) and export support ($\beta_5 = 0.38$) also play a significant role, as the Netherlands soundly integrates market access and business support. In comparison



to other countries, the role of subsidies ($\beta_1 = 0.20$) and credit ($\beta_3 = 0.48$) are lesser implying that the business environment is mature and self-sustaining.

Comparative analysis shows that all the countries enjoy access to credit (β_3), however, Ukraine and Brazil are contingent on direct financial assistance like subsidies (β_1). The opposite is the case in Germany and the Netherland where there is a structural transition in the field of knowledge-based growth where by its main components are digitalization (β_4), human capital (β_7), and institutional efficiency (β_8). Poland is in an intermediate rank between financial incentives and moderate improvements in terms of governance and education. The relatively low coefficients of institutional quality (β_8), human capital (β_7), and R&D (β_6) economic factors by Ukraine brings out significant short-comings as well as opportunities of policy adjustment, as well as investment.

In conclusion, the model offers recommendation that to develop entrepreneurial development in the agro-industrial complex, it is necessary to provide not only a financial contribution. Credit and subsidies (credit (β_3) and subsidies (β_1)) always play a role, in particular in so-called transition economies such as Ukraine, but the success of competitiveness in the long run will ultimately rest on the synergy of digitalization (β_4), skilled human capital (β_7), strong institutions (β_8), and investment in innovation (β_6). To bring Ukraine closer to structural efficiency that is observed in Germany or the Netherlands, there is a strong need to improve the institutional framework, increase the availability of digital tools, and have tailored programs focused both on agrarian education and applied research. Not only will such initiatives curtail direct financial aid, but also lead to the creation of a robust and innovative agro-industrial sector that will attract success even in an environment full of competition.

Conclusions. It is the importance of economic mechanisms in the formation of the performance and the stability of the entrepreneurial structures in the agro-industrial complex, which has been confirmed by the research. Depending on a



comparative econometric analysis of five countries Ukraine, Poland, Germany, Brazil, and the Netherlands, the paper has recognized the major policy instruments that affect the agro-industrial entrepreneurship substantially, namely access to credit, government subsidies, digital transformation, institutional quality, human capital and innovation-support.

As the analysis has established, Ukraine, even in contrast to agro-industrial economies that are more developed, has to depend strongly on direct financial assistance methods like subsidies and credit. Meanwhile, with relatively less impact, there are such factors as digitalization, investment in R&D, and institutional efficiency, which also introduce structural gaps and unsolved potential. Conversely, the policy mix of countries, such as Germany and the Netherlands include more balanced policy mix characterized by close integration of entrepreneurial success with knowledge-based growth and technological modernization. Poland exhibits smooth evolution of reforms in institutions and educational policies whereas Brazil provides the model that responds to monetary inducements and export-friendly conditions.

The findings are entirely congruent with those elaborated at the outset of the research. The multidimensional effect of economic mechanisms on the performance of agro-entrepreneurs was accurately reflected in the econometric model, and allowed comparing the results. The objectives of the study, which included formulating a definition and evaluation of the main drivers of entrepreneurial development in the AIC, comparing Ukraine to international standards, and providing policy recommendations, have achieved in a complete way.

Nevertheless, it remains to be studied how the regional disparities of Ukraine differ more closely, as well as how the processes of the organization of public-private partnerships in the sphere of agro-entrepreneurship work and how the changes initiated by digital and green transition affect in the long-term perspective. A survey regarding the behavioral and motivational specifics of agro-entrepreneurs



should also be conducted and an assessment of the adaptive potential of small and medium-sized businesses in the conditions of external shocks and volatility of world markets should be done in future studies.

This study is limited by the short time span of the panel data (2022–2024), which may constrain the identification of long-term trends. Additionally, behavioral and micro-level dynamics of agro-entrepreneurship were not considered due to data availability. Future research should examine regional disparities within Ukraine, incorporate qualitative interviews or survey data, and explore the effects of public-private partnerships and green transition on entrepreneurial sustainability in the agro-industrial sector.

In conclusion, the research also highlights a paradigm change that should take place in the Ukrainian agro-industrial policy, i.e., an increasing focus should be made on a more comprehensive and innovation-based agro-industrial policy rather than a straight-forward financial support one. Improving institutional capacity, education and technology and creating a healthy entrepreneurial environment are key pillars to create a competitive and sustainable agro-industrial sector able to respond to contemporary economic demands.

Thank you notes. None

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