

MODELING CHANGES IN THE ACTIVITY OF UKRAINIAN DOMESTIC BUSINESS IN TIMES OF WAR

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The article examines the effects of changes in the activity of domestic business during the war, as a result of the system of unfavorable factors. The authors analyze the possibilities of using different types of mathematical models to reproduce the dynamics of business activity at the level of a particular country, and selects the most successful one. A phenomenological model describing the dynamics of the process was proposed, which uses the business activity index as the main variable and is based on an ordinary heterogeneous second-order differential equation with a source term. Using a three-component production function, a transition to a system of differential equations describing the dynamics of various components of the business activity index was made, which, in the absence of a source term responsible for the impact of external stimulating factors, is conservative. The modeling results are compared with empirical data, which indicates a good ability of the model to reproduce real processes in the economy under the influence of powerful negative factors, including the restoration of business optimism caused by the return of territories in September-October 2022 and overcoming the consequences of attacks on energy infrastructure in November 2022-January 2023. It is shown that the involvement of other equations describing the dynamics of business activity in the system leads to a loss of conservatism. The frequency and phase-frequency analysis of the dynamics of Ukrainian business activity during the war allows us to conclude that business activity will recover fairly quickly after the cessation of negative depressing factors. Based on the descriptive data, the article clusters the negative factors that suppress domestic business during hostilities and compares them with the parameters that determine the ease of doing business, an internationally recognized indicator that allows assessing obstacles to business activity. Based on the research of recognized foreign experts, a retrospective analysis of obstacles to the development of Ukrainian business was conducted. An empirical study of a number of enterprises from the Dnipropetrovsk region belonging to various business sectors was implemented, which proves that the main problems that emerged during the war are not much more severe than the problems that domestic business experienced before the aggression. The «classical» factors associated with hostilities are reduced to ensuring uninterrupted supply of electricity and preventing the outflow of human resources through conscription and forced migration. It is concluded that an interesting direction for further research on this problem is the use of the Granger model, which will allow for joint analysis of time series and take into account hidden relationships.

References

Diia. Biznes (2021, February 19). *Prezentatsiia rezultativ doslidzhennia Ukrainian Business index*. [Presentation of the Ukrainian Business index study results] Retrieved March 12, 2023, URL: https://export.gov.ua/news/3145-ukrainian_business_index_report

Diia.Biznes (2022, December 5). *Stan ta potreby biznesu v umovakh viiny: rezultaty opytuvannia v lystopadi 2022 roku* [State and needs of business in times of war: results of the November 2022 survey]. Retrieved March 12, 2023. URL: <https://business.diia.gov.ua/cases/novini/stan-ta-potrebi-biznesu-v-umovah-vijni-rezultati-opituvanna-v-listopadi-2022-roku>

Diia. Biznes (2022, October 21). *Stan ta potreby biznesu v umovakh viiny: sektoralnyi rozriz, veresen 2022*. [State and needs of business in times of war: Sectoral breakdown,

September 2022]. Retrieved March 12, 2023. URL: <https://business.diia.gov.ua/cases/novini/stan-ta-potrebi-biznesu-v-ukraini-sektoralnij-rozriz-veresen-2022>

NBU (2021) *Richnyi zvit Natsionalnoho banku Ukrainy za 2020 rik*. [Annual Report of the National Bank of Ukraine for 2020]. National Bank of Ukraine. Kyiv.

NBU (2022) *Richnyi zvit Natsionalnoho banku Ukrainy za 2021 rik*. [Annual Report of the National Bank of Ukraine for 2021]. National Bank of Ukraine. Kyiv.

NISS (2019). *Vplyv viiny na ekonomiku Ukrainy. Analitychna dopovid* [The impact of the war on the Ukrainian economy. Analytical report]. National Institute for Strategic Studies. Kyiv.

CID (2023, February 28). *Stan ta potreby biznesu v umovakh viiny: rezultaty opytuvannia v v sichni 2023 roku*. [The state and needs of business in times of war: survey results in January 2023]. Retrieved March 12, 2023. URL: <https://cid.center/the-state-and-needs-of-business-at-war-results-of-the-january-2023-survey/>

Anderson J. (1979). A Theoretical Foundation for the Gravity Equation. *American Economic Review*, 69 (1), 106-116.

Black F., & Scholes M. (1973). The pricing of options and corporate liabilities. *Journal of Political Economy*, 81(3), 637-654. doi:10.1086/260062

Doingbusinessguide (2019). Doing business in Ukraine. Retrieved April 13, 2023. URL: <http://www.ukraine.doingbusinessguide.co.uk/the-guide/what-are-the-challenges/>

GfK (2016) *Вплив конфлікту на бізнес в Україні*. Аналітичний огляд. Retrieved April 13, 2023. URL: <https://www.gfk.com/insights/the-war-impact-on-the-economy-of-ukraine-dec-2016>

González-Rivera G. (2016). Forecasting with autoregressive (AR) processes. *Forecasting for Economics and Business*, 160-201. doi:10.4324/9781315510415-9

IMF (2022, March 17). *Как война в Украине отражается на разных регионах мира*. Retrieved April 12, 2023. URL: <https://www.imf.org/ru/Blogs/Articles/2022/03/15/blog-how-war-in-ukraine-is-reverberating-across-worlds-regions-031522>

Kochnev A. (2020). *Requiem for Donbas: Three Essays on the Costs of War in Ukraine*. Doctoral dissertation. Universität Linz. URL: <https://epub.jku.at/obvulihs/download/pdf/5295005?originalFilename=true>

North D.N. (1955). *Location theory and regional economic growth*. Chicago: University of Chicago Press.

Teece D.J., Pisano G., & Shuen A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, 18(7), 509-533. doi:10.1002/(sici)1097-0266(199708)18:7<509::aid-smj882>3.0.co;2-z

Van Slyke R., & Wets R. (1965). Programming under uncertainty and Stochastic Optimal Control. doi:10.21236/ad0618201

Wang W., & Siau K. (2022). Artificial Intelligence, Machine Learning, automation, robotics, future of work and future of humanity. *Research Anthology on Machine Learning Techniques, Methods, and Applications*, 1460-1481. doi:10.4018/978-1-6684-6291-1.ch076

Wolfram S. (2023, March 23). *Chatgpt gets its "Wolfram superpowers"!* Retrieved April 14, 2023. URL: <https://writings.stephenwolfram.com/2023/03/chatgpt-gets-its-wolfram-superpowers/#:~:text=And%20today%E2%80%94just%20two%20and,of%20as%20%E2%80%9Ccomputational%20superpowers%E2%80%9D.>

World Bank. (2019, October 24). *Doing business 2020*. Retrieved March 12, 2023. URL: <https://archive.doingbusiness.org/en/reports/global-reports/doing-business-2020>

World Bank. (2022). *Business enabling environment*. Retrieved March 12, 2023. URL: <https://www.worldbank.org/en/programs/business-enabling-environment>

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