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Labor Migration and Its Causes for Governance: Modeling the Intensity of Threat Impact through a Proposed Methodological Approach: The Example of Ukraine, Within the Periods Before and During COVID-19 and Military Operations

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Abstract. The conducted research is characterized by the originality and complexity of the approach due to the initial consideration of the phenomenon of labor migration from the position of one that has a global nature, significantly affects the dynamics of the world economy and increases in scale and is determined by a number of advantages and threats, and subsequently the generalizations made were used for mathematical modeling. It is proved that labor migration should be considered at least at two levels, that is, the state and each individual who is forced to participate in such processes under certain circumstances. It is specified that we are talking about a number of advantages, but also threats that arise and change due to the influence of key factors at each of the indicated levels. It is substantiated that it is the threats that require attention, the impact of which can become significant, and therefore harm the achievement of a positive effect. The modeling conducted on the basis of real data on Ukraine, which occupies a leading position among labor-exporting countries, over three time periods, i.e. before 2019, from 2019 to 2021, when COVID-19 dominated, and from 2022, as the beginning of a new phase of the military conflict with the Russian Federation, generally made it possible to track the change in the level of impact of threats associated with labor migration. The results obtained can serve as the necessary information basis for making changes in state policy not only in Ukraine, but also in other countries, as well as for each labor migrant to take action to reduce current threats.

Keywords: Labor migration, Threat, COVID-19, Military operations, Labor Force.

1. INTRODUCTION

When considering labor migration as a phenomenon that increasingly has an impact on the economic and demographic processes of a significant number of countries, preference is given to two quantitative characteristics. The first is the number of participants in such a process, that is, labor migrants. According to the World Migration Report 2024, there is a clear trend towards an increase in people who, for certain reasons, prefer to carry out their work outside the country of permanent residence. If in 1990 there were 128 million such people, then in 2020 their number increased to 281 million, that is, more than twice in relative terms. We would also like to emphasize that in the aforementioned 2020, the indicated number of such a group was 3.6% of the world's population, and therefore the circumstances that determine labor migration and its consequences cannot be ignored. As part of the study, we made certain generalizations and carried out mathematical modeling using information on changes in the intensity and results of labor migration in relation to Ukraine, in particular under the dominant influence of COVID-19 and military operations, which makes such a situation unique and serves as the basis for making changes in state policy and personal intentions of labor migrants in any country. Therefore, we emphasize that in 2000, Ukraine ranked fifth in the world in terms of the number of migrants. Although in 2017, Ukraine ranked eighth, it is necessary to take into account the specifics of labor migration, when every fourth citizen of working age had some experience of such a process, and labor activity itself took place with different time intensity. The second characteristic is the amount of remittances from labor migrants, which in general in the world economy increased in 2022 to 831 billion USD, when in 2000 it was 128 billion USD. In Ukraine, this indicator until 2022 was characterized by purely positive dynamics (2015 - 7.0 billion USD, 2020 - 12.0 billion USD, 2021 - 14.0 billion USD), which proves the leading position of this country in the world ranking of labor-exporting countries. We believe that the above characteristics are key, but it is also important to take into account the threats that arise in the course of increased labor migration, which concern both the exporting country and each labor migrant. This approach is different from the traditional one, but its application allows you to create the necessary information basis for further adjustments at the state level and consideration by persons resorting to labor migration to avoid losses and enhance the positive effect. The lack of a timely, thoughtful response can not only negate all the benefits of labor migration at both of these levels, but also provoke negative consequences in the form of economic decline and a deepening demographic crisis.

2. LITERATURE REVIEW

The complexity of labor migration and its causes within the governance framework is a multidimensional issue that has drawn increasing academic attention. In exploring the modeling of threat intensity due to labor migration, it is essential to ground the discussion within the existing literature on economic security, corporate governance, crisis management, and regional development. Shynkar et al. (2020) provided a foundational approach to assessing

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the economic security of enterprises by emphasizing theoretical and methodological aspects, which is crucial for understanding the economic impacts of labor migration. This approach is complemented by Szewczyk (2012), who discusses the transfer of information within industries, particularly how corporate security offerings can influence market dynamics, potentially exacerbated by labor shifts. Kotlyarevsky et al. (2016) focus on the information sphere in Ukraine, identifying factors that either hinder or stimulate its development. These insights are particularly relevant when considering the informational aspects of labor migration, such as the dissemination of knowledge and skills across borders. The literature also points to the need for effective corporate governance and communication strategies in times of crisis, as highlighted by McKenzie-Skene (2019) and Knight & Nurse (2020). These studies provide a framework that can be adapted to manage the corporate implications of labor migration, especially in securing corporate assets against the backdrop of workforce instability. Moreover, Chapple (2014) and Shyra et al. (2021) delve into the implications of corporate security and governance in mitigating threats to business operations, which are closely related to the fluctuations in labor markets due to migration. Sylkin et al.'s works (2019a, 2019b) further elaborate on anti-crisis strategies and financial security, providing a methodological approach that can be applied to manage and model the economic risks associated with labor migration. Kryshtanovych et al. (2021, 2023) contribute to this body by focusing on the development of creative thinking and effective public administration interaction, which are critical in formulating responses to the challenges posed by migration.

3. METHODOLOGY

To determine the list of threats caused by labor migration and model the intensity of their impact, the following methods were used: induction and deduction, comparison and systematization – to identify and characterize threats that arise due to increased labor migration; synthesis and analysis – to prove the significance of the impact of labor migration on demographic and economic security, in particular, Ukraine and the EU countries, as well as the personal security of each labor migrant; morphological analysis – to group threats and clarify intra-group relationships and interdependence; pairwise comparisons by the preference of options – to calculate an integral indicator that determines the magnitude and characterizes the change in the impact of the set of threats caused by labor migration; graphical – for qualitative presentation of research results; abstract-logical – to form theoretical generalizations and conclusions of the study.

4. REASERCH RESULTS

Labor migration has a diverse impact on two interconnected levels: the state and each labor migrant personally. The situation in Ukraine is a confirmation of this thesis, in particular over a long period of time with significant changes, in particular in 2019-2021 due to COVID-19 and further from 2022 as a result of a new stage of military aggression by the Russian Federation. Therefore, in the following we will present a generalized description of the benefits and threats caused by labor migration with the following modeling, which was carried out to obtain reliable results in terms of three periods: before 2019, 2019-2021 and from 2022. In general, such an approach will give a general idea of the depth of the problem not only in relation to Ukraine as a labor-exporting country, EU countries that are interested in qualified labor, but also each labor migrant personally. Attention will be focused on the threats arising from increased labor migration to create the necessary analytical basis for the subsequent development of measures to stabilize the situation and reduce the negative impact on the level of demographic and economic security of the country. Initially, we consider it necessary to start by establishing the reasons for the increase in the intensity of labor migration, in particular in Ukraine. We emphasized above that one of the key characteristics of such a process, and in fact the advantage for the exporting country, is the funds that labor migrants transfer to their homeland. In Ukraine, this advantage is especially important, because a comparison of the amount of foreign investment in the economy and the activity of labor migrants indicates that it is the latter that provide the necessary resources to stabilize the economic situation in the country. For foreign investors, investments in Ukraine have a high level of risk due to political imbalance and a long-term military conflict, the beginning of which was laid back in 2014. According to the data above, labor migrants until 2022 constantly increased the amount of transfers to financially support their family members in Ukraine. In relative terms, such a comparison is manifested in two indicators: the volume of transfers is 17 times greater than the amount of foreign investment; the contribution of labor migrants in 2021 reached 6% of GDP. Since we chose the format of considering the advantages and threats at two levels (the state and each labor migrant personally), at the individual level, interest in labor migration is determined by the difference in the level of wages. For example, the average wage in 2021 in Ukraine was 530 USD, while in Poland it was 2871 USD and in Germany it was 4660 USD. Accordingly, such a significant difference was and remains a determining incentive for the employment of Ukrainians in the EU countries.

We previously emphasized that along with the advantages, it is necessary to identify, distinguish and take steps regarding the threats that exist regarding labor migration. Therefore, we detail the key threats with specifics regarding Ukraine and its citizens who are participants in labor migration. In general, the briefly described threats constitute the integrity that determines the content of a complex problem. It is wrong to understand labor migration as a purely positive process, when it is a source of no less significant threats. Positive moments should develop at the level of the individual and the state, but there should also be active actions regarding threats in order

to prevent their influence from increasing to the level when the resulting crisis will become. Therefore, in the future, we will resort to modeling by applying the method of pairwise comparisons by the advantage of options to establish the priority of applying measures to reduce the impact of key threats. This method can be used for a wide class of assessment tasks. Its essence is as follows. For the object being assessed, a set of parameters {a and} is determined. Next, the parameters are compared with each other using convolution matrices to obtain a comprehensive assessment. Using convolution matrices of the next level, the obtained data are again compared with each other. The procedure is repeated until there is only one characteristic left, which will be a comprehensive assessment of the object. To implement such a procedure, it is necessary to determine the pairs of characteristics that will be compared, as well as the convolution matrices that characterize them. It is also necessary to construct the convolution matrices in such a way that from the estimates at the lowest level it is possible to obtain estimates of all characteristics at all levels. The advantage of such a binary structure is that it allows solving the problem of complex assessment with N criteria by means of a multi-step aggregation procedure. It should be noted that at each step, aggregation is carried out by only two criteria. This simplifies the task of choosing aggregation rules, since it corresponds to the real capabilities of a person in issuing consistent stable information. After all, with a binary criterion structure, the most accurate formulation of the problem for the decision-maker is possible, using the convolution procedure and a sufficiently wide class of complex criteria, which are provided in the form of a binary structure. Thus, to determine the integral assessment of the impact of threats, a binary convolution tree is constructed (Figure 1), in which each non-intersecting vertex is a logical convolution matrix that accumulates information from the matrices of the previous level.

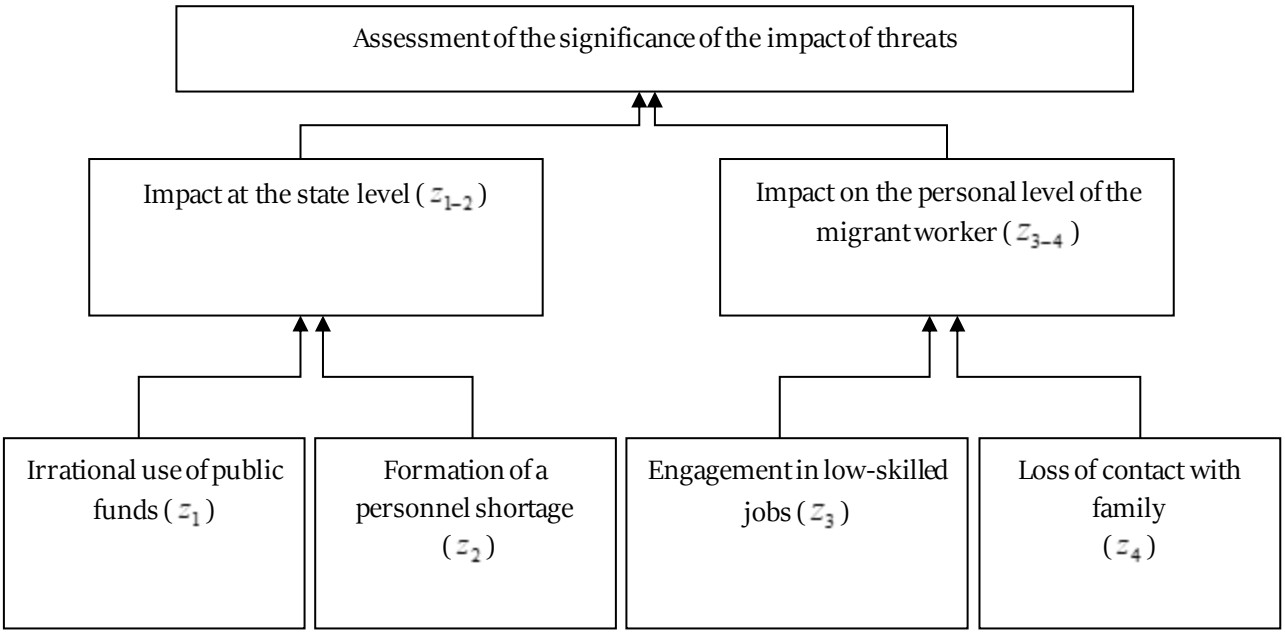


Figure 1: Grouping of threats associated with labor migration.

For the purposes of our study, an ordinal scale was used, each ordinal value of which corresponds to some qualitative characteristic of the analyzed phenomena. Each qualitative value of the evaluated phenomenon corresponds to a certain interval of quantitative threat values (Table 1).

Table 1: Scale of evaluated threats.

Points	Threat	Explanation of the Nature of the Threat
1	Absent	Minimum
2	Significant	Medium
3	High	Maximum

For each of the analyzed periods and identified threats, we construct logical convolution matrices. The first three convolution matrices (Tables 2–4) provide a generalized assessment of threats implemented at the state level. For example, let's take 2022 (Table 2).

Table 2: Logical matrix of the convolution by threats and in the period from 2022.

		z_1		
		1	2	3
z_2	1	1	1	2
	2	1	2	2
	3	1	2	3

The following convolution matrices are presented below (Table 3) providing a generalized assessment of the

threats that directly affected each migrant worker.

Table 3: Logical matrix of convolution by threats z_3 та z_4 in 2022.

		z_3		
		1	2	3
z_4	1	1	1	1
	2	1	2	2
	3	2	3	3

Logical convolution matrices determine the procedure for aggregating threats, the change of which can in some way affect the level of security at certain levels and thereby allow us to determine what needs to be responded to first of all in order to ensure the economic security of the state. Each level of threat occurrence is characterized by the probability distribution of their possible values. The task is to determine the probability distribution of possible values of the integral assessment of the degree of threats to economic security based on these data. We will assume that the values of the levels of threat occurrence by functional components are independent random variables.

The probability distribution of possible values of internal threats that can create problems for economic security is given in Table. 4.

Table 4: Probability distribution of values μ_{ij} possible threats to the country's economic security within established periods.

μ_{ij}	**Periods**								
	2019			**2019–2021**			**2022**		
	μ_{i1}	μ_{i2}	μ_{i3}	μ_{i1}	μ_{i2}	μ_{i3}	μ_{i1}	μ_{i2}	μ_{i3}
μ_{1j}	0,2	0,3	0,5	0,2	0,3	0,5	0,2	0,3	0,5
μ_{2j}	0,5	0,3	0,2	0,2	0,3	0,5	0,2	0,3	0,5
μ_{3j}	0,5	0,3	0,2	0,5	0,3	0,2	0,3	0,4	0,3
μ_{4j}	0,2	0,3	0,5	0,5	0,3	0,2	0,3	0,4	0,3

Let us denote the probability of threats to the country's economic security as λ_{ij}^{**}. For clarity, based on the logical convolution matrix (Table 4), we will show in tabular form the probability of certain threats occurring at a selected level in a certain period (Table 5).

Table 5: Threats to the country's economic security at the state level.

	Characteristics	λ_{ij}^{**}	μ_{ij}
1	rrational use of public funds, and staff shortage, minimal j = 1	λ_{31}^{**}	$\mu_{11} \times \mu_{21}$
	Increase in irrational use of public funds, minimum j = 1, and staff shortage, significant j = 2		$\mu_{11} \times \mu_{22}$
	Increase in irrational use of public funds, minimum j = 1, and staff shortage, maximum j = 3		$\mu_{11} \times \mu_{23}$
2	Increase in irrational use of public funds, significant j = 2, and staff shortage, y2 minimum j = 1	λ_{32}^{**}	$\mu_{12} \times \mu_{21}$
	Increase in irrational use of public funds, and staff shortage, significant j = 2		$\mu_{12} \times \mu_{22}$
	Increase in irrational use of public funds, maximum j = 3, and staff shortage, minimum j = 1		$\mu_{13} \times \mu_{21}$
	increased irrational use of public funds, significant j = 2, and shortage of personnel, maximum j = 3		$\mu_{12} \times \mu_{23}$
3	increased irrational use of public funds, maximum j = 3, and shortage of personnel, significant j = 2	λ_{33}^{**}	$\mu_{13} \times \mu_{22}$
	increased irrational use of public funds, and raw material shortage of personnel, maximum j = 3		$\mu_{13} \times \mu_{23}$

By substituting the values from Table 3, we will obtain threat assessments at the personal level of a labor migrant from 2022, which we will enter into Table 6.

Table 6. Distribution of threat probabilities at different levels.

λ_{ij}^{**}	**Periods**								
	2019			**2019–2021**			**2022**		
	λ_{i1}^{**}	λ_{i2}^{**}	λ_{i3}^{**}	λ_{i1}^{**}	λ_{i2}^{**}	λ_{i3}^{**}	λ_{i1}^{**}	λ_{i2}^{**}	λ_{i3}^{**}
λ_{3j}^{**}	0,100	0,590	0,310	0,310	0,380	0,310	0,260	0,490	0,250

λ^{**}_{4j}	0,400	0,500	0,100	0,100	0,590	0,310	0,420	0,370	0,210

Substituting the values and from table 6, we obtain the results, which we enter in Table 7.

Table 7: Distribution of the probabilities of threats.

λ^{*}_{ij}	**Periods**								
	2019			**2019–2021**			**2022**		
	λ^{*}_{i1}	λ^{*}_{i2}	λ^{*}_{i3}	λ^{*}_{i1}	λ^{*}_{i2}	λ^{*}_{i3}	λ^{*}_{i1}	λ^{*}_{i2}	λ^{*}_{i3}
λ^{*}_{2j}	0,621	0,348	0,031	0,252	0,652	0,096	0,466	0,389	0,145

The results obtained (Table 7) allow us to: firstly determine the level of threats, and secondly, compare them by periods.

The integral threat R will be the average value of the integral estimates of direct losses from the implementation of threats λ^{*}_{ij}:

$$R = 1 \times \lambda^{*}_{21} + 2 \times \lambda^{*}_{22} + 3 \times \lambda^{*}_{23}.$$

Substituting the values λ^{*}_{ij} obtained above (Table 14), we obtain:

$$R_{до\ 2019} = 1 \times 0{,}612 + 2 \times 0{,}348 + 3 \times 0{,}031 = 1{,}410.$$

$$R_{2019-2021} = 1 \times 0{,}252 + 2 \times 0{,}652 + 3 \times 0{,}096 = 1{,}844.$$

$$R_{з\ 2022} = 1 \times 0{,}466 + 2 \times 0{,}389 + 3 \times 0{,}145 = 1{,}679.$$

The results of the modeling should be interpreted as follows. First, according to the scale taken as a basis, the threats arising from labor migration have a significant impact, since the quantitative value is greater than 1 and approaches 2, in particular during COVID-19, i.e. such processes cannot be ignored, and the modeling carried out is a necessary information basis that updates the application of measures at the state level and each labor migrant personally.

5. DISCUSSIONS

In discussing the methodological approach to model the intensity of threats posed by labor migration, it is imperative to synthesize the reviewed literature into a coherent framework that addresses both the economic and social dimensions of migration. Firstly, the economic security assessments by Shynkar et al. (2020) can be integrated with Szewczyk's (2012) insights on information transfer to model how labor migration affects corporate strategies and market stability. The hierarchical ordering of information-related factors by Kotlyarevsky et al. (2016) further aids in understanding the barriers and enablers in the context of migrant labor integration. Secondly, the frameworks suggested by McKenzie-Skene (2019) and Knight & Nurse (2020) for corporate security in crises are particularly applicable here, where labor migration can be seen as a potential crisis trigger. These frameworks can guide the development of strategic communication and governance adjustments needed in response to the dynamic challenges posed by labor migration.Lastly, the discussion should also encompass strategies for resilience and strategic management as discussed by Alkema et al. (2024), especially in the context of long-term impacts such as those seen in Ukrainian enterprises. This would involve looking at both macroeconomic policies and individual enterprise strategies to safeguard against the threats posed by labor migration, ensuring both economic and social security.In conclusion, integrating these diverse perspectives from the literature provides a robust base for modeling the impact of labor migration on economic security and corporate governance, which is essential for developing comprehensive management and policy responses.

6. CONCLUSIONS

Both the scale of labor migration and its impact on the world economy have a clear tendency to grow. Such changes have an economic basis, which is most evident for labor-exporting countries in the ability to receive financial resources in the form of remittances to stabilize national economies, labor migrants - the ability to sell their own experience and skills on the labor market at a higher price, importing countries - covering the deficit in the labor market, saving on the necessary resources for training qualified specialists, increasing the pace of economic development due to additional labor resources. All these advantages are combined with threats that are significant for each party, and by their impact not only reduce the positive effect, but, in the absence of a timely and effective response, can provoke crisis processes. For modeling purposes, two levels were taken into account: the state (this is the importing country) and the personal level of each labor migrant. The dynamics of processes over the past five years, which were provoked in Ukraine by COVID-19 and military actions, made it possible to

demonstrate an actual change in the significance of the total impact of all threats at two related levels. Despite the importance of the impact of key factors, the threats accompanying labor migration do not disappear, and their impact is somewhat modified in the tactical dimension, but is strengthened in the strategic one. An example of this is Ukraine, where the high growth rates of labor migration over the past thirty years have exacerbated the demographic crisis (delayed birth of children, families with small children, industrial injuries and loss of working capacity due to physical exhaustion and the inability to obtain necessary medical care). The lack of a response at the state level provoked an increase in the scale of labor migration, in particular during the COVID-19 period due to the shortage of qualified labor in the labor market of EU countries. Military actions changed the trends due to the presence of two oppositely directed flows: women refugees to EU countries and men who returned to participate in hostilities on the territory of Ukraine. Despite this, in the perspective of the cessation of military actions, it is possible to predict not only the restoration, but also the intensification of labor migration, including with the assistance of EU countries. Therefore, it is the concept of the conducted study that provides primary information material for the development of proactive measures to reduce the significance of the impact of threats.

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