REACTION OF UKRAINIAN IT COMPANIES TO RUSSIAN 2022 INVASION: RELOCATION AND REMOTE OPERATIONS

by

Roman Tsyolkovskyi

A thesis submitted in partial fulfillment of the requirements for the degree of

MA in Business and Financial Economics

Kyiv School of Economics

2022

Thesis Supervisor: _____ Professor Olga Kupets

Approved by _____
Head of the KSE Defense Committee, Professor [Type surname, name]

_____

_____

_____

Date _____

ACKNOWLEDGMENTS

I would like to convey my gratitude to my thesis advisor, professor Olga Kupets, for her invaluable expertise and crucial support while writing this thesis. Also, this paper would not be possible without the input of Djinni and personally Olha Lukianova, who shared their data about Ukrainian IT hiring.

Along with that, I what to thank all of the KSE faculty members and staff for their hard work during my studies. I also need to highlight the input from my groupmates, who helped me get valuable insights into various fields, especially Angelina Danyleiko, Kateryna Stuzhuk, Mariia Atamaniuk, and Valerii Kulalaiev.

Finally, I am profoundly thankful to the community and contributors of the Ampersand Foundation for their financial support, as well as to Alexander Kutovyi and Mariia Tsokol for their irreplaceable mentorship and support.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

IT Information Technologies

UN United Nations

HR Human Resources

USSR Union of Soviet Socialist Republics

GDP Gross Domestic Product

US United States

ISO International Organization for Standardization

BCP Business Continuity Planning

OLS Ordinary Least Squares

VIF Variance inflation factor

CHAPTER 1. INTRODUCTION

In recent years, with the evolution of computing technologies, algorithms, and applications Information Technologies developed into one of the fastest-growing industries. Nowadays, almost all of the everyday activity in business and personal life is handled with or assisted by software. Therefore, work in IT has become a prestigious occupation with salaries higher than average both in Ukraine and worldwide.

Between 2014 and 2021 Ukrainian IT industry experienced fast growth, with an average growth of around 25% in revenues, export figures, and the number of employees. Recent reports stated that more than 250 thousand professionals work in the sector and represent a significant share of the Ukrainian urban middle class.

The coronavirus pandemic of 2020 and 2021 caused a significant shift in consumer preferences and interaction between businesses and employees. The vast majority of IT professionals could work remotely to comply with social distancing procedures. According to a 2021 survey from DOU.ua, more than 90% of polled specialists regularly worked from home.

On the 24th of February, 2022 Russian Federation started a full-scale invasion of Ukraine. The eastern, southern, and northern regions had the most significant impact, with severe human losses, infrastructure destruction, and drastic economic activity decline. At the time of writing, Kharkiv, Luhansk, Donetsk, Zaporizhzhia, Kherson, and Mykolaiv regions still suffer from military hostilities. The war resulted in the largest refugee crisis in Europe after World War II, with more than 7 million people fleeing from Ukraine, according to the UN Refugee Agency. Most of them evacuated inside Ukraine, predominantly in central and western regions. A wave of relocation also impacted businesses, resulting in a relocation campaign from affected regions to more stable locations.

The present paper aims to highlight the actions undertaken by Ukrainian IT sector businesses as a response to invasion in the context of location. In general, three possible strategies for companies are separated which can be implemented solely or mixed:

- Business as usual, agents continue operations with little change in comparison to the pre-war period
- Switch to remote operation, which includes lightening requirements for work from the office and hiring new employees from different locations to work remotely
- Relocation to establish operations in a different city or region while maintaining a high degree of business localization

There are two research questions to cover in this paper.

Research question 1: Is there a regional differentiation in the decision-making about switching to remote operations or relocation?

While observing the efforts of both government and non-government organizations to relocate Ukrainian businesses, the hypothesis emerged that a significant number of IT companies from affected regions have relocated to the central and western regions of Ukraine.

Research question 2: What non-location factors affected the decision to switch to remote operations or relocate?

The hypothesis is that some observable variables, including company size, the market in which firm operates, and business model (in the form of average employee requirements), could explain the decision about a change in operations.

The dataset from the job advertisements website, which specializes in IT-related businesses in Ukraine, was used to examine the hypotheses above. It covers both the

pre-war period of 2021 and early 2022 and the postwar period up to July 2022. In this research, several original econometric models have been built based on available data on public vacancies to analyze researched companies and their strategies. Additional data sources include industry studies about the relocation of Ukrainian IT firms due to war: an employee-level poll conducted by DOU.ua in June 2022 and firm-level research made by IT Ukraine Association and law firm Sayenko Kharenko published in August 2022.

The present paper demonstrates that the reaction to the war outbreak was different across regions. Companies from southern and eastern regions more often relocated and switched to remote operations compared to their peers from central and western regions. In contrast, firms from northern regions preferred switching to remote work without organized relocation. Other significant factors affecting remote operation decisions include average required experience, English proficiency, and company size.

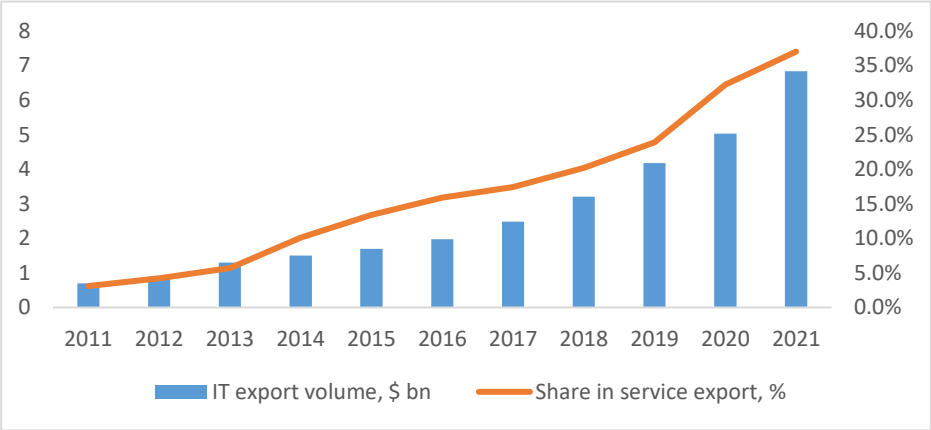
This paper proceeds with the following structure. Chapter 2 describes an overview of the Ukrainian IT sector and related studies. In Chapter 3, the research methodology is presented. Chapter 4 contains the outline of the data used in the research. Subsequently, Chapter 5 focuses on the results obtained and presents the findings. Finally, Chapter 6 conclusion and ideas for further research are discussed.

CHAPTER 2. INDUSTRY OVERVIEW AND RELATED STUDIES

2.1 Industry overview

Since 2014, Information Technologies has become the fastest-growing industry in Ukraine. According to the report by IT Ukraine Association, IT export quadrupled between 2015 and 2021, reaching $6.8 billion in revenues with a 24.7% average growth rate. Through this period, the share of Informational and Communicational Technologies export as a part of national service export increased from 13.4% to 37% (Figure 1). The biggest export partners are the USA (40% of volume), Great Britain (10%), and the European Union.

Figure 1. Information Technologies export revenues in 2011-2021



Source: Ukraine IT Report 2021, IT Ukraine Association

The rapidly growing IT industry generates a significant demand for specialists in different areas, including software engineering, quality assurance testing, project management, analytics, and others. This tendency resulted in a significant increase in the Information Technology workforce, with more than 250 thousand talent in 2021. According to the leading professional website, DOU.ua, the median age of Ukrainian IT professionals is 29 years, with more than 95% of employees younger than 40. For

most positions, gender proportion is highly skewed to the males, who account for three-quarters of the workforce. Notable exceptions to this rule are HR, marketing, design specialists, project managers, and business analysts.

Geographically Ukrainian IT companies are unevenly distributed across the country. According to 2021 data, 80% of IT specialists are located in the five largest cities of Ukraine: Kyiv (42% of specialists), Lviv (14%), Kharkiv (13%), Dnipro (6%), and Odesa (5%). These hubs combine business environments with access to capital investments, office infrastructure, international airports, and extensive educational capabilities in the form of the largest universities, best technical schools, and non-formal education.

The workforce of the Ukrainian IT industry includes professionals in different fields. According to the DOU.ua poll, the most widespread specialties are software engineering (46% of employees), quality assurance engineering (16%), HR, and project management (both are 5%). Other prominent positions include designers, user experience and interface engineers, analytics, data scientists, sales managers, marketing, DevOps, and technical support specialists. Due to extensive cooperation with international colleagues and clients, the knowledge of English is highly regarded and often required skill, with 85% of poll respondents reporting an intermediate level of English proficiency or higher. Among all respondents, more than half have between 2 and 5 years of experience.

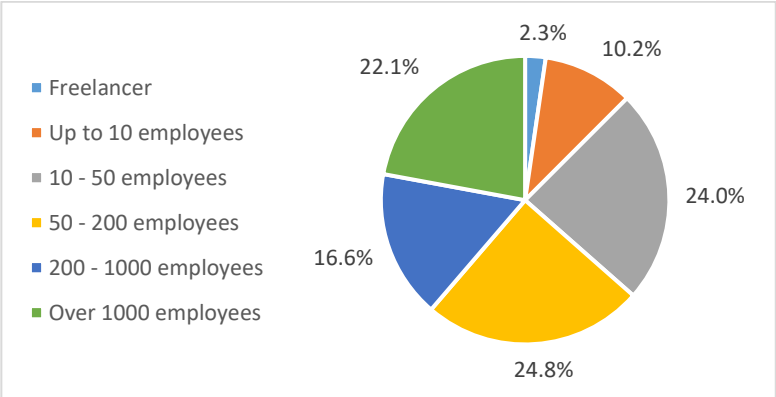
The environment of the IT industry as a whole can be described by various business models of companies in the market. Generally, these four types of companies by the business model are distinguished:

- Outsourcing companies – IT consulting companies which assist other businesses on the project base, from smaller short-term projects with up to 5 professionals assigned to extensive collaborations with more than 1000 employees.

- Outstaffing companies – IT consulting companies with a staff-on-demand model, usually with individual assignments into the client's firm.
- Product companies – full-cycle companies that develop applications or services for other businesses or final consumers.
- Startup companies – product companies in the early stage of their existence, often unprofitable or reinvesting all revenues into company growth.

The Ukrainian IT industry historically was highly influenced by the first two types of business models; in 2021, outsourcing companies hired 56% of all IT specialists. The share of employees hired by product companies grew to 35% in 2020 from 28% in 2019, according to DOU.ua polling. Figure 2 demonstrates the division of respondents by the size of the company they are employed.

Figure 2. Distribution of company sizes in the Ukrainian IT industry (in number of employees)



Source: Survey of Ukrainian IT professionals 2020, DOU.ua

Since the early years of the IT industry development, several business leaders have emerged. All of the biggest companies in the market are consulting companies, the most prominent of which include:

- EPAM Ukraine is the largest IT employer in Ukraine, with more than eleven thousand employees as of summer 2021. The Ukrainian representative is the largest across all countries, contributing 20% of all delivery specialists. EPAM's mother company became a part of the SNP 500 list in December 2021, having a solid position in the market and long-term relationships with some of the largest companies in the world.
- GlobalLogic is one of the top 3 largest companies in the industry. In July 2021, GlobalLogic was acquired by Hitachi, the Japanese conglomerate, with a market evaluation of $9.6 billion. In 2021 company had more than seven thousand employees and offices in 15 Ukrainian cities.

Along with outsourcing companies, some of the product companies became significant market players. Their business model combines full development, marketing, and sales cycle, allowing higher profit margins for these firms. The most noticeable of them are:

- Genesis is a conglomerate of product companies and a venture investment firm. The portfolio of their products includes Jiji (one of the largest African online marketplaces), BetterMe (a healthcare app publisher with over 100 million downloads), and Headway (an application with non-fiction bestseller summaries).
- Reface is an artificial intelligence startup in the computer vision field. In 2020, Reface got $5.5 million seed-stage financing from the Andreessen Horowitz investment fund. In August 2020, the first Ukrainian app became the top 1 application in the AppStore marketplace.

The COVID-19 world pandemic became a major social and economic event that significantly impacted the IT industry. Despite an initial significant disruption caused by quarantine restrictions, the IT industry was the first to adapt to such changes transforming business processes into a remote format. It resulted in the wide

acceptance of remote jobs in the industry. According to the poll of Ukrainian IT specialists conducted by DOU.ua in June 2021, 80% of respondents primarily worked from home, and 88% positively related to remote work. Half respondents reported increased leisure time and a 31% increase in productivity, two significant factors of employee satisfaction.

2.2 Enterprise response to crises and war – business continuity management

Historically, the first organized effort of firm relocation in response was the evacuation of military production factories in the Soviet Union between June and November 1941. Later researchers, including Linz (1984), reported that during that time, 1523 industrial enterprises and 6 million people were moved from Belarus, Ukraine, and western Russia to the Volga and Ural regions. Even though the military output of the USSR returned to 1940 figures by March 1942, industrial capabilities and GDP figures had not recovered until 1950.

As Hebrane (2010) describes in his review, the modern methodologies of an enterprise crisis response can be traced back to the 1970s when the first risk management legislation emerged in the form of the US Flood Disaster Protection Act of 1973. Most of the risk mitigation practices between the 1970s and early 1990s were forced by legislation. For example, since 1983, US banks must have had disaster recovery planning and appropriate testing. One of the most important additions to crisis response procedures regarding potential war outbreaks was the *Joint service publication 503 – business continuity management*, published by the British Ministry of Defense in 2000. It provided detailed recommendations and best practices in multiple areas and laid the ground for further standardization of business continuity methodologies.

The 9/11 terrorist attacks caused a significant impulse for the sphere of business resilience to crises, which may include intended human action as well as major

physical and human losses. In this period, business continuity practices and requirements emerged in most developed economies and were internationalized with the development of several ISO standards. The most related to the topic of potential war response are ISO 22301 Security and resilience — Business continuity management systems — Requirements and ISO 22313 Security and resilience – Business continuity management systems – Guidance on the use of ISO 22301 with the latest revisions in 2019-2020. Recent developments include standards such as ISO 22317, 22318, 22330, 22331, and 22332, some of which were updated recently in response to the coronavirus pandemic. These documents provide the general framework for business continuity management and are a base for firms' wartime response scenarios.

Most present crisis and business continuity management studies cover methodological aspects of BCP frameworks and implementation. A significant theoretical input for the IT sector was made by Snedaker and Rima (2007), which compiled best industry practices in BCP development and emergency response, updated later in 2014. However, several studies cover the practical usage of BCP in disaster response. Hatton et al. (2018) examine the experience of five New Zealand firms after the 2010-2011 Canterbury earthquakes. Despite the small sample of firms, the research provided empirical evidence for BCP process advantages and found room for the further development of traditional methodologies, especially in employee relationships.

Beyond the scope of business continuity frameworks, the issue of business relocation under external factors of non-economic nature, mainly in the context of past and projected extreme climate change and weather events. Wasileski et al. (2010) used a multivariate model to analyze which factors impact business closure and relocation after natural disaster events. They found that significant factors for business relocation were the business property ownership (whether the business owned or rented its facilities), type of building (a proxy for how much disasters affected property), and damage to physical infrastructure and inventory. Felbermayr et al. (2020) connect infrastructure connectivity to an impact of potential weather disruption. Authors

suggest that significant transport infrastructure plays a crucial role in relocation decisions.

It is a fact that no modern economy with well-organized private enterprises faced a major homeland war prior to the Russian invasion of Ukraine. Consequently, no theoretical or practical studies are devoted to business crisis management in a wartime economy. First, efforts have been made to build the relocation framework for affected Ukrainian firms by the Ukrainian government and non-governmental organizations, including the Kyiv School of Economics. The present paper is meant to be one of the first studies to address the topic of enterprise relocation under war circumstances.

2.3 Research of IT business relocation after the invasion.

After the initial months of the invasion and the first wave of relocation, it became an actual topic among Ukrainian businesses, the government, and the public. Despite no government-led or academic studies concentrating on IT companies' relocation, the industry professional community has conducted polls and studies on business relocations since the start of full-scale warfare.

The first important industry source is a series of employee-level questionnaires conducted by the Ukrainian IT website DOU.ua. The latest edition took place in June 2022 and was published between the 4th and 18th of July 2022. During it, 15136 Ukrainian IT professionals were polled, around 5% of all Ukrainian IT employees. In this poll, respondents were asked about their demographical characteristics, professional specialization, experience, salary, and whether they relocated after the start of the invasion. Among all surveyed, 27% of respondents reported that they relocated within Ukraine, and 12% moved abroad since February.

IT specialists' geographical distribution also significantly changed compared to the pre-invasion period. The share of respondents who live in Kyiv decreased from 45% in 2021 to 26% in June 2022. The most significant change was in Kharkiv: the share of respondents diminished from 13% to 2%, while Lviv demonstrated growth in its share from 14% to 19%.

The second source of industry research is a survey of Ukrainian IT firms conducted by the IT Ukraine Association and Sayenko Kharenko law firm conducted in July 2022 and published 25th of August that year. According to this study:

- 30% of firms have not relocated and partially reintroduced work from the office
- 25% of companies have not relocated but remain in a full-remote operations regime
- 19% relocated partially within Ukraine
- 26% relocated partially within Ukraine, partially abroad
- None of the companies entirely abandoned their pre-invasion location

This research does not include any relationship data to independent pre-war variables, which might affect relocation decisions. However, respondent firms reported factors that deterred companies from relocation, including an inability to relocate IT professionals outside of Ukraine (31% agreed), willingness to pay taxes in Ukraine (25%), the unwillingness of employees to relocate (20%) and higher operational costs after relocation (20%).

CHAPTER 3. METHODOLOGY

For all the steps below, the firm-level dataset has been used. It is based on the vacancy data between January 2021 and July 2022. All of the processing stages and descriptive statistics of this dataset are given in chapter 4. Here it is essential to mention that the dataset and subsequent models have no time variable and describe the change in firms' behavior since the start of the invasion.

Two econometric models are used to determine factors that affect decisions about relocation and switching to remote. First is multinomial logistic regression, which associates a company's dominant (based on vacancies data) location strategy with different pre-war factors, such as:

- The primary location of the firm
- Company type: outsource, outstaff, product, other
- Number of posted vacancies in 2021 – early 2022
- Dominant policy toward remote work
- Median expected salary of the vacancies
- Average required experience of the vacancies
- Requirements of English proficiency: none, intermediate or advanced

The second model is the multivariate OLS regression, which examines relationships between the factors above and the share of relocated vacancies at the firm level. This model specifies previous findings and supports the evidence about determining factors of relocation decisions.

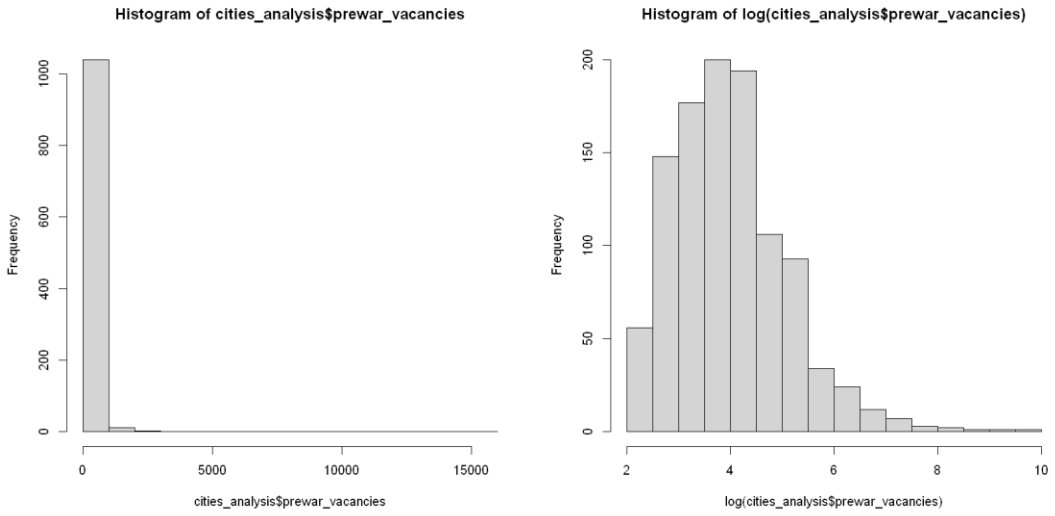
As the first step, the correlation matrix of all quantitative variables has been built. Variables with high correlation coefficients cause degradation of model quality as they are too interdependent. Based on this assumption, it is necessary to eliminate one of such variables from the model. Average required experience and median expected salary have

the largest correlation of 0.86, which means high interdependency. Due to the reasons above, the median salary has been excluded. Compared to average experience, it has a more skewed distribution, higher correlation with other variables, and generally demonstrated worse performance in test models.

Table 1. Correlation matrix of quantitative variables

	Number of pre-war vacancies	Average required experience	Median expected salary
Number of pre-war vacancies	1	0.21	0.24
Average required experience	0.21	1	0.86
Median expected salary	0.24	0.86	1

Figure 3. Histograms of the number of posted vacancies and log(number of posted vacancies)



The second step addresses the homoscedasticity issue, which is crucial regarding the usage of OLS regression. The number of posted vacancies is highly skewed due to

different company sizes and hiring activity. Hence, the decision was made to use this variable in logarithmic terms. Such a change also increased its significance in both models.

The third step is checking all the variables for potential multicollinearity, as it is also one of the conditions for building an OLS regression. In order to do it, the variance inflation factor method has been used. VIF quantifies the degree of multicollinearity of the model. The values of VIF above 5 are considered to have a high degree of multicollinearity. Variables with such values are usually excluded from the analysis. All present variables have VIF values less than 3; hence they are eligible to be used in the modeling.

Table 2. VIF multicollinearity index for model variables

Variable	VIF
Log(number of pre-war vacancies)	1.197
Average required experience	1.427
Region	2.539
English requirements	1.361
Remote policy	2.605
Company type	1.532

After all the steps above are performed, two models' equations are obtained. In both models ε_i represents the error term.

Model 1, multinominal logit for location strategy:

$$[\text{strategy}] \sim \beta_0 + \beta_1 * \ln(\text{pre} - \text{war vacancies}) + \beta_2 * [\text{avg experience}] + \beta_3 * [\text{region}] + \beta_4 * [\text{English requirements}] + \beta_5 * [\text{remote policy}] + \beta_6 * [\text{company type}] + \varepsilon_i \quad (1)$$

In the context of the present paper, the "strategy" term is used as a combination of firms' actions, which are undertaken in response to the war outbreak and reflected in wartime job advertising activity. The three possible strategies are described as follows:

1. The "Business as usual" strategy means that the company has not changed its location job advertisement patterns. Hence, the primary city of operations is the same before and after the start of the war. If the company primarily had remote vacancies before the war, which has not changed since the war started, it is considered a "business as usual" strategy.
2. The "Switch to remote" strategy means that firm had a primary location in the pre-war period. However, after the invasion, it started advertising predominantly remote positions and allowed candidates from all over Ukraine.
3. The "Relocation" strategy means that the company had a primary location before the invasion, but as the war outbreak, it started to advertise vacancies mostly in different cities.

For convenience, the conservative "business as usual" strategy was chosen as the base strategy. Hence, positive coefficients represent a higher probability of using active strategies such as relocation or switching to remote operations.

Model 2, OLS for a share of relocated vacancies:

$$\begin{aligned}[\text{relocation share}] \sim \beta_0 + \beta_1 * \ln(\text{pre} - \text{war vacancies}) + \\ \beta_2 * [\text{avg experience}] + \beta_3 * [\text{region}] + \beta_4 * [\text{English requirements}] \\ + \beta_5 * [\text{remote policy}] + \beta_6 * [\text{company type}] + \varepsilon_i\end{aligned} \quad (2)$$

The following results are expected:

1. The coefficient before the number of vacancies variable (β_1) is expected to be positive as the larger companies are expected to have more resources to perform relocation or other organizational changes.

2. The coefficient before the average experience variable (β_2) is expected to be higher than zero. It can be explained that companies are more willing to protect experienced professionals compared to junior personnel and relocation costs per employee value are lower.
3. The coefficient before the region variable (β_3) is expected to be positive for the East, South, and North. The magnitude of the coefficient should correlate with an impact from the war; thus larger coefficient for East and South in comparison with North is expected.
4. The coefficient before the English proficiency level (β_4) is expected to be positive. Since the base category is the absence of English skills in requirements, other categories mean that the company has foreign offices or clients. Hence, such companies have more resources to relocate specialists and incentives (pressure from clients).
5. The coefficient prior to the policy of remote work (β_5) is expected to be higher than zero for the remote strategy since the basic category is an office-only job advertisement. Logically, firms that adopt remote practices are more capable of returning to such operations.
6. The coefficient before the company business model (β_6) is projected to be around zero. It is assumed that the business model does not play a crucial role in relocation decisions since relocation is an inner company issue and does not correspond with client interactions.

CHAPTER 4. DATA

As this paper's primary data source, the archive from Djinni.co is used. Djinni is one of the biggest job advertisement platforms specializing in Ukrainian IT specialists. The dataset contains information about 245 thousand unique vacancies advertised between 1st January 2021 and 4th July 2022. Hence, it allows a detailed comparison between the period prior to and after the start of the invasion.

It is essential to underline that the used dataset is not entirely representative of all of the Ukrainian IT industry. Despite that, Djinni.co is still a popular formal path to finding a job. According to the poll conducted in September 2022, 21% of IT professionals found their job via Djinni; that is the second most popular option after friends or colleague recommendations. Also, a high level of attrition in the industry should be taken into account: according to June 2021 poll from DOU.ua, average tenure equals approximately 2 years; thus, to operate at a constant scale, companies are forced to employ new staff actively. Combining the two factors above, while the dataset in question cannot be considered a full population, it is still a significant proportion of operating companies and professionals.

4.1. Data processing and aggregation

As mentioned earlier, the primary data source for this thesis is a dataset of vacancies. Since Djinni is protecting the privacy of its clients, the acquired dataset is anonymized, and it is nearly impossible to associate the data entry with vacancy at the website. However, all the crucial information about the job opening is available. Table 3 shows variables contained in the dataset and an example of a dataset record.

In order to make practical use of gathered data, additional variables were created based on vacancies observation. First is locational data, associating cities with Ukrainian socioeconomic regions, as demonstrated in Table 3. The second step is converting vacancy

salary expectations into a single variable. After that, the average between minimal and maximum figures was calculated.

Table 3. Example of record from Djinni.co source dataset

Variable	Example of value
Unique company ID	6527
Vacancy ID	242759
Category (specialty or programming language)	JavaScript
Locations in which opening is available	Kyiv or remote
Minimal expected salary (in US dollars)	2000
Maximum expected salary (in US dollars)	3000
Experience requirements (in years)	3
English proficiency requirements	Intermediate
Date of vacancy posting	21.02.2022
Policy towards remote work	Candidate choice
Company type	Product

Table 4. Association between administrative and socioeconomic regions of Ukraine

Socioeconomic regions	Regions of Ukraine
North	Zhytomyr, Kyiv, Chernihiv, Sumy
Center	Vinnytsia, Kropyvnytskyi, Cherkassy, Poltava, Dnipro
West	Lviv, Volyn, Rivne, Ternopil, Zakarpattia, Ivano-Frankivsk, Chernivtsi, Khmelnytskyi
East	Kharkiv, Luhansk, Donetsk
South	Zaporizhzhia, Kherson, Mykolaiv, Odesa, Crimea

After that, the information regarding vacancies was aggregated into firm-level data. In Table 5 example of a record from the firm-level dataset is represented.

Table 5. Example of record from firm-level data

Variable	Example of value
Unique company ID	6527
Pre-war primary region of operations	North
Post-war primary region of operations	remote
Number of pre-war vacancies	24
Number of post-war vacancies	14
Company type	product
Median expected salary of a vacancy before the war	4750
Average required experience (in years) before the war	3.29
Share of engineering vacancies before the war	64.3%
The most often level English requirements before the war	Intermediate
The most often company relocation policy before the war	Candidate choice
Strategy type according to methodology	went remote
Share of vacancies outside of the pre-war primary region of operations	14.3%

Here it is essential to clarify how aggregations were made:

- The primary region is considered as one in which the largest number of vacancies have been posted (only the first mentioned city is used) in the respective period. If the majority of vacancies use a remote-first policy when the region of operations is regarded as "remote."
- The pre-war period is from 01.01.2021 to 23.02.2022; the post-war period is from 24.02.2022 to 04.07.2022.

- The expected vacancy salary is considered average between the minimum and maximum mentioned in the vacancy posting. Median salary aggregation has been chosen to represent company salary policies better.
- The share of engineering vacancies is a quantifiable proxy variable for a company's business model. Lower share means that a company has competence in adjacent fields like marketing, design, technical and customer support, sales, or business consulting.
- The possible values of the English requirements are "none," "intermediate," and "advanced."
- The possible values of company relocation policy are "candidate choice," "full remote," "office," "partly remote," and "quarantine remote."
- The strategy utilized by a company is described in Chapter 3.
- The share of vacancies outside the pre-war primary region of operations does not include remote vacancies.
- For further analysis, only companies have been chosen that (or which subsidiaries) operated primarily in Ukraine and had more than 10 vacancies before and after the war outbreak.

4.2. Descriptive statistic of aggregated firm-level data

After all the steps are performed, the dataset of 713 Ukrainian companies under the above requirements is obtained. On average, these companies had 190 vacancies before and 56 after the war outbreak.

All company types are represented in the final dataset. There are 301 product companies, 300 outsourcing development firms, 86 outstaff companies, and 26 firms outside these three groups (such as HR agencies for IT specialists and others).

Companies in the dataset are located around half of the Ukrainian regions, though most companies are from Kyiv, Kharkiv, and Lviv. The detailed geographical distribution is demonstrated in Table 6.

Table 6. Pre-war geographical distribution of researched firms

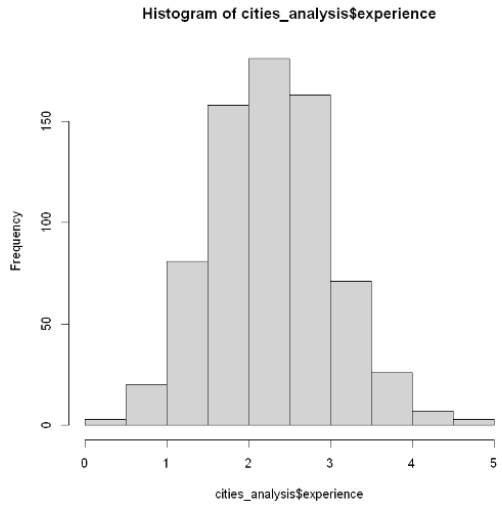
Primary city prior to the invasion	Firms
remote	94
Vinnytsia	6
Dnipro	16
Zaporizhzhia	3
Ivano-Frankivsk	4
Kyiv	397
Lviv	78
Mykolaiv	3
Odesa	8
Kharkiv	100
Cherkassy	2
Chernivtsi	1
Chernihiv	1

The average monthly salary across all companies equals 2591 US dollars, with a minimum median salary of 400 and a maximum of 6375 dollars. It shows the high variability of business models in different Ukrainian IT companies: a company can hire a lot of relatively low-paid junior employees or has a high bar of professional development in their requirements with respective salary grades.

The average required experience in vacancies varies between 0.1 and 4.96 years, with an average of 2.29 years. It is important to highlight that distribution of average required experience is close to normal distribution. The most often level of required English proficiency is intermediate: 368 companies (52%) have this level as dominant in

vacancies against 264 firms (37%) with advanced English requirements and 81 firms (11%) without English requirements.

Figure 4. Histogram of the average required experience for IT firms

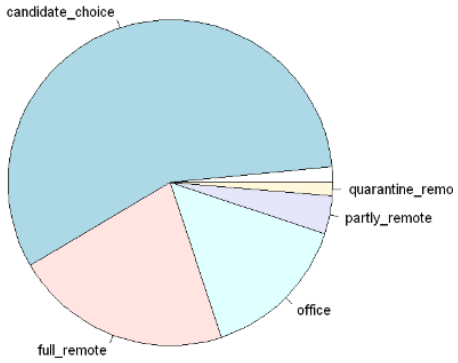


A share of engineer vacancies in the companies also has a high degree of variability with a minimum value of 18.8% and a maximum of 100%; the average value is 55%. Thus, it can be said that companies from different sub-fields are represented: from entirely focused on IT engineering to the product with a low share of software engineering positions.

The policies of remote operations have significantly changed in the last three years due to the impact of the COVID-19 pandemic. Dataset data shows that five popular types of such policies existed before the invasion. The leading is "candidate choice," which means that office attendance is optional and not required; 406 companies (57%) prefer this type. The second most popular choice is a full remote mode; for 154 firms (22%), this policy is dominant. 106 firms (15%) required office attendance in their vacancies. Other typical policies include partial remote – 27 firms (4%) and remote operations during official

quarantine only – 9 firms (1%). The distribution of policies is demonstrated on a pie chart in Figure 5.

Figure 5. Chart of remote and office operations policies by firms



Another crucial statistic is a distribution of strategies across the companies. According to the methodology used, among 713 companies, 433 (or 61%) stuck to the "business as usual" strategy, 217 (30%) firms switched to remote operations, and 63 (9%) of firms relocated. The average share of relocated vacancies in the postwar period equals 14.9% out of all postwar vacancies.

CHAPTER 5. RESULTS

5.1. Dependence of firms' postwar activity on geographical factor

The regression model has been built using Equation 1 to find the dependence of firm location on primary strategy. All control variables follow the description previously provided in Chapter 3.

In accordance with the results provided in Table 7, there is statistically significant differentiation in chosen strategy by the region in which the company operated prior to the war. Note that the base region is West, and all other regions are compared with it. The first region is the Center, which has not had any frontline military actions but still suffered from rocket shelling. Even though there is no evidence of active relocation from central regions, the odds of a firm choosing a remote strategy go up 317% compared to the western regions. A similar pattern is observed for companies in the northern regions. Here companies' odds of going remote increased by 554% compared to the western firms.

Different behavior is discovered in eastern and southern regions. Here is the epicenter of military hostilities, and the civilian population is largely endangered; some of the territories are occupied by the Russian invasion force with the destruction of infrastructure and a significant halt in economic activity. Hence a predominant majority of companies relocated or switched to remote operations. For the East, such odds increased by 375% and 1292%, respectively, for the South – 601% and 608%.

Model 2 validates previous findings. On average, firms from southern and eastern regions have 22 p.p. and 8 p.p. more relocated vacancies than their western peers. It is important to highlight that firms with remote operations before the war also relocate some of their vacancies, 12% on average.

Table 7. Model 1 (odds values) and Model 2 regression results

Independent variables	Model 1		Model 2
	Relocation	Remote	Relocated vacancies share
ln(pre-war vacancies)	0.862	0.853*	0.024***
s.e.	(0.150)	(0.092)	(0.008)
experience	1.423	1.744***	0.030**
s.e.	(0.221)	(0.163)	(0.014)
region = Center	1.311	4.017**	0.010
s.e.	(0.858)	(0.635)	(0.052)
region = East	4.475***	13.920***	0.080**
s.e.	(0.514)	(0.475)	(0.034)
region = North	0.939	6.539***	-0.030
s.e.	(0.486)	(0.427)	(0.028)
region = remote	1.093	-	0.118***
s.e.	(0.680)	-	(0.043)
region = South	7.006**	7.080**	0.217***
s.e.	(0.774)	(0.823)	(0.065)
english_req = Advanced	0.923	2.718***	0.013
s.e.	(0.551)	(0.372)	(0.031)
english_req = Intermediate	1.322	2.116**	0.023
s.e.	(0.511)	(0.363)	(0.030)
remote_type = candidate_choice	1.152	1.625	-0.012
s.e.	(0.472)	(0.306)	(0.027)
remote_type = full_remote	2.006	3.029***	-0.011
s.e.	(0.620)	(0.395)	(0.036)
remote_type = partly_remote	1.243	0.975	-0.030
s.e.	(0.880)	(0.522)	(0.049)
remote_type = quarantine_remote	2.111	0.862	-0.042
s.e.	(1.179)	(0.908)	(0.078)
company_type = other	1.119	0.366	0.003
s.e.	(0.844)	(0.843)	(0.061)
company_type = outstaff	0.536	0.954	-0.068**
s.e.	(0.500)	(0.319)	(0.028)
company_type = product	0.799	1.377	0.003
s.e.	(0.347)	(0.232)	(0.021)
Constant	0.070***	0.015***	-0.034
s.e.	0.919	0.700	(0.053)

5.2. Non-geographic factors of firms' relocation decisions

Alongside geographic factors, models 1 and 2 demonstrated that other factors also play a significant role in making decisions about relocation or switching to remote operations. The first factor is the number of vacancies before the war outbreak, which is considered a proxy of company size. Model 1 demonstrates that an increase in company size is associated with an increased probability of utilizing a conservative strategy, but Model 2 suggests a significant increase in relocated vacancies. These results can be interpreted as follows. Larger companies usually have multiple offices across Ukraine; hence they can hire personnel in locations that have been less affected by the war.

A second significant factor is the average required experience across company vacancies. As hypotheses suggested, companies with experienced employees are more frequently relocated businesses or switched to remote operations. Quantitively, the additional year of experience is associated with a 74% increase in odds of remote strategy and a 3 p.p. increase in the share of relocated vacancies.

The third variable which impacted decisions about switching to a remote regime is the average required proficiency in English. Intermediate and advanced English requirements are associated with a 112% and 172% increase in odds for remote strategy compared to the absence of such requirements. It indicates that companies which work with international clients (a reason why English skills are required) are more willing to hire employees for remote work.

Decisions about switching to remote work were also dictated by previous practice. Companies that reported a full remote schedule in their openings before the war have 203% higher odds of switching to remote operations than office-first companies. However, firms with other regimes, like partial remote or which gave a choice to candidates, have no significant difference in their behavior compared to primarily office firms.

The last observable significant factor is company type. The outstaff firms, on average, had 6.8 p.p. fewer relocated vacancies compared to outsourcing companies. For all other types of companies, there is no evidence of a difference in behavior.

5.3. Comparison with other sources of information about relocation

To validate the results of this paper, they have been compared with external industry sources, which reported on the relocation of Ukrainian IT professionals and companies between February and August 2022. The first source is the June 2022 questionnaire from DOU.ua, which took more than 15 thousand specialists. The second is a poll of IT firms conducted in July 2022 by the Ukraine IT Association and Sayenko Kharenko law firm. Both sources are covered in detail in Chapter 2.

From these sources, it can be validated that, first of all, the relocation of IT firms and employees has indeed happened. Both employees and firms reported a significant scale of relocation: 39% of professionals and 45% of companies relocated at least partially from their pre-invasion locations. However, it is important to note that no company in the second survey reported full relocation. It means the company remains at least part of its operations and workforce in its original location. It explains the difference in numbers in Table 8 regarding relocation share.

Table 8. Comparison of relocation and switching to remote figures from this paper data and Ukraine IT Association survey

	This paper dataset, based on Djinni.co data	Ukraine IT Association survey
Switching to a full-remote regime	30%	25%
Relocation within Ukraine	9%	19%

The second result can be validated that relocation has happened unequally in different locations. From the DOU.ua data, it can be seen that Kharkiv is the biggest IT hub, from which companies relocated at a grand scale. The share of employees who answered the DOU.ua poll dropped from 13% to 2%: a tenth of all Ukrainian IT workforce left Kharkiv, which confirms the results of this paper of a 375% increase in odds for a company to relocate in comparison to firms from western regions.

CHAPTER 6. CONCLUSIONS AND RECOMMENDATIONS

Russian 2022 invasion of Ukraine became the most disruptive event in the history of Ukraine and a unique example of a modern industrialized economy facing homeland war. In the present study, the response of the Ukrainian IT sector to the war is examined in the context of relocation and switching to remote operations. To examine this, the dataset from Djinni, the online job advertisement platform, has been used following the activity of 713 Ukrainian IT firms between January 2021 and July 2022. Two research questions of this study are:

Research question 1: Is there a regional differentiation in the decision-making about switching to remote operations or relocation?

Research question 2: What non-location factors affected the decision to switch to remote operations or relocate?

Previous studies in the field of business crisis response provided evidence that one of the most critical factors for relocation decisions is the amount of damage inflicted on the company. In case of extreme weather events, Wasileski et al. (2010) the construction type of the building was a proxy for such damage. In the context of the Russian invasion of Ukraine, the amount of loss dealt can be linked to the firm's location.

Researchers pointed out that other crucial determinants for relocation decisions include relocation costs and damage caused to infrastructure. Unfortunately, with available data, it is impossible to account for such factors and analyze firms that stopped operations entirely. However, this paper examines other factors, including the size of the firm, business model, and operating market.

Using the well-known methodology of linear and multinominal logit regressions, significant evidence has been obtained to support the hypothesis about alternating response patterns in different regions. While central and western regions

maintained similar operations, firms from the East, South, and North opted to relocate to safer locations or switch their operations to a remote regime.

All of the non-geographic factors examined impacted the business relocation decisions to some extent. The size of company variable demonstrated that larger companies relocate and hire new employees in safer locations, in which they operated prior to the war. Additionally, companies with higher requirements for experience and proficiency (English requirements proxy variable has been used) personnel are significantly more often advertised vacancies with remote schedules and in new locations. Also, findings provided evidence that companies knowledgeable in remote processes more often switch to remote operations in response to the crisis.

These results will facilitate efforts to help relocate companies within Ukraine, formalizing the framework for business relocation in the IT sector and providing a crucial example for possible similar situations in the future.

Taking into account the unique circumstances of the Ukrainian economy and businesses now dealing with, there are multiple directions for further research. The first is to expand results of present paper on different sectors of the Ukrainian economy, especially those which cannot be switched into remote operations regime. Second, try to reproduce the Hatton et al. (2018) study and find how Ukrainian companies have used business continuity planning after the war outbreak. Both of these topics, if researched, can benefit the knowledge of crisis response from a practical perspective greatly; hence help establish better methodologies of BCP and relocation frameworks to help businesses hit by the crises.

REFERENCES

DOU.ua. Quarantine survey results. Published on June 22, 2021. https://dou.ua/lenta/articles/ukrainian-it-during-quarantine-results-2021/

DOU.ua. Salary survey of Ukrainian developers, testers and other IT specialists. Published between July 4 and July 18, 2022.
https://dou.ua/lenta/articles/salary-report-devs-summer-2022/
https://dou.ua/lenta/articles/salary-report-qa-summer-2022/
https://dou.ua/lenta/articles/salary-report-tech-nontech-summer-2022/

Djinni, Ukrainian IT hiring website. Statistical data provider. https://djinni.co/

Felbermayr G., Gröschl J., Sanders M., Schippers V., and Steinwachs, T. 2022. The economic impact of weather anomalies. *World Development*. 151. 105745.

Hatton T., Grimshaw E., Vargo J., Seville E. 2018. Lessons from disaster - creating a business continuity plan that really works. *Journal of Business Continuity & Emergency Planning*. Autumn/Fall 2016, Vol. 10 Issue 1: 84-92.

Herbane Brahim. 2010. The evolution of business continuity management: A historical review of practices and drivers. *Business History* Vol. 52, No. 6, (October 2010): 978–1002.

IT Ukraine Association. Relocation. The new IT landscape of Ukraine. Published on August 25, 2022. https://itukraine.org.ua/en/nove-dosl%D1%96dzhennya-ponad-50-%D1%96t-kompan%D1%96j-ne-provodili-relokacz%D1%96yu.html

IT Ukraine Association. Ukraine IT Report 2021. Published on January 23, 2022. https://reports.itukraine.org.ua/en

International Organization for Standardization. 2019. ISO 22301:2019, Security and resilience – Business continuity management systems – Requirements.

Linz Susan J. 1984. *World War II and Soviet economic growth 1940-1953*.

Snedaker Susan, and Rima Chris. 2007. *Business Continuity and Disaster Recovery Planning for IT Professionals*.

The UN Refugee Agency. Ukraine Refugee Situation. Data used as of October 10, 2022. https://data.unhcr.org/en/situations/ukraine

UK Ministry of Defence. 2000. Joint services publication 503 (JSP 503) - MoD Business Continuity Management.

Wasileski Gabriela, Rodríguez Havidán, and Diaz Walter. 2011. Business closure and relocation: A comparative analysis of the Loma Prieta earthquake and Hurricane Andrew. *Disasters*. 35: 102-129.