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Labor markets during war time: Evidence from online job advertisements

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ABSTRACT

This study examines the short- and medium-term impacts of the ongoing Russia-Ukraine war on the labor market for Ukrainian workers. Using a unique dataset of 5.4 million online job advertisements for Ukrainian job seekers in Poland and Ukraine over the 2021–2022 period, we show a short-term surge in demand for Ukrainians to work in Poland, while the number of jobs available in Ukraine is relatively stable. Since February 2022, the demand for soft and analytical skills in Ukraine has increased, while the demand for such skills in Poland has remained the same. Moreover, the increase in Polish jobs available to Ukrainian workers is largest for medium/high-skilled jobs and female-oriented jobs. Further analysis suggests a persistent shift (to the left) in wage distribution driven by both the decline of wages within job titles and the change in the composition of jobs across Poland.

1. Introduction

On 24 February 2022, Russia further escalated the Russia-Ukraine war and began a full-scale invasion of Ukraine. This major offensive caused the largest refugee crisis since World War II, displacing around 7.9 million Ukrainians. As the evidence from historical conflicts suggests, the influx of forced migration could affect different aspects within both the sending and receiving countries, such as in relation to human capital, institutions and trust, and labor markets. Many studies have focused on examining the effects of forced migration on the labor market in receiving countries and have found both positive and negative effects (Braun and Mahmoud, 2014; Peters, 2017; Morales, 2018; Black et al., 2022). Wars, in general, and forced migration, in particular, could also negatively affect the sending country's labor market due to the human capital deficit (Akbulut-Yuksel and Yuksel, 2015; Huber et al., 2021). The existing evidence has often been produced using post-war data and examines the impacts on the labor markets in receiving and sending countries separately. However, little is known about the temporary impacts which could have long-term implications. In this study, we make a step forward and compare how the Russia-Ukraine war has affected labor demand for, and wages offered to, the Ukrainian workers who left Ukraine (forced migrants or refugees) and those who remained in Ukraine (stayers).

To undertake this analysis, we exploit a unique data set of more than 5.4 million job advertisements (hereafter ads) provided by Jooble.org, an international job search website covering January 2021 to November 2022. The data set used in the study is sourced from the Jooble Ukraine site, which contains job vacancies posted in Ukraine and provides detailed information about job locations.

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These features indicate that the job ads in our data are targeting job seekers in Ukraine, and also allow us to differentiate between jobs in Ukraine and Poland. Thus, using this data set, we can examine the change in labor demand for forced migrants and stayers simultaneously. At the same time, the data also allow us to compare the differences in labor demand (i.e., the number of vacancies) for, and wages offered to, Ukrainian job seekers to work in Poland before February 2022, which are mostly economic migrants, and after February 2022, which are mostly refugees.

Since the data are instantaneously updated, we are able to investigate the instant effects of the ongoing war on the labor markets. This data feature is especially important for two reasons. First, although our data cannot provide a complete picture of the labor markets, they are still a useful alternative source of data for understanding the impacts of war, given the lack of official statistics (e.g., the employment statistics provided by the State Statistics Service of Ukraine are available for the years up to 2021 only). Second, our results can provide some early indicators of persistent shifts in labor demand, which will benefit policy design for rebuilding Ukraine.

In the first part of our analysis, we document trends in demand for Ukrainian workers in Ukraine and Poland since January 2021. Since the onset of the full-scale war, there has been a significant increase in demand for Ukrainian workers to work in Poland. While this jump in labor demand is rather short-lived (i.e., observed over the first five months of the war), the number of Polish jobs offered to Ukrainian workers in month six onward is still higher than in the pre-war period, suggesting an overall improvement in the integration of Ukrainian migrants in the Polish labor market. In contrast, we do not find any clear difference between the number of job ads in Ukraine available before and after February 2022. However, there is a slight increase in vacancies in Ukrainian regions sharing borders with Eastern Europe. It should be noted that the new job ads do not necessarily indicate new jobs, e.g., the new ads are to replace workers for the jobs which already exist. In this sense, the findings are indirect evidence of firms losing workers, i.e., the human capital deficit of war. The results are also in line with recent surveys on the operations of small and medium businesses (SMEs) in Ukraine, which show that some firms have relocated to the areas that are less affected by the war.

Next, we examine whether there is any variation in labor demand across different levels of job skill and occupational gender segregation. Across three levels of job skill (i.e., jobs requiring no skills, jobs requiring some skills, and jobs requiring medium/high level skills), the largest increase in the number of ads in Poland is for the group of medium/high-skilled jobs. However, this substantial increase is only observed for the first five months. From month six onward, the demand for Ukrainian migrants to work in medium/high-skilled jobs in Poland returns to its pre-war level. At the same time, the number of Polish job ads in female-oriented occupations also significantly increases and stays higher than during the pre-war period. In contrast, there has been a moderate increase in gender-neutral and male-oriented jobs in Ukraine since the war escalated. The number of jobs requiring at least some skills or medium/high level skills also increases, although the magnitude of the change is small.

Further analysis indicates potential upskilling in hiring in Ukraine as Ukrainian employers are more likely to state soft and analytical skill requirements in their ads. However, the potential upskilling does not come with higher offered wages. We show that since the onset of the escalation, there has been a persistent decrease in the real wages offered to Ukrainian workers for both jobs in Ukraine and for jobs in Poland. This result is observed even when we restrict the estimation sample to include only job title–location cells that appear before and after February 2022. Thus, the reduction in real wages offered is not only driven by the shift in occupation distribution (i.e., shifting from the high-paid occupations to the low-paid ones), but is also driven by the within-occupation decline in offered wages caused by the war.

Our study contributes to several strands of literature. The first strand is the substantial body of literature on the labor market outcomes of forced migrants. One of the common findings is that refugees have lower earnings and lower employment rates, compared to, not only native workers, but also other migrants, e.g., economic migrants (e.g., Cortes, 2004; Ruiz and Vargas-Silva, 2018; Fasani et al., 2022). These gaps could be explained by several factors, including a skills mismatch (Dustmann et al., 2010) and differences in health status (Ruiz and Vargas-Silva, 2018). Further, how the disparities in labor market performance change over time is highly context-dependent. For example, Fasani et al. (2022) show that the gaps in labor market outcomes between forced migrants and other migrants across 20 European countries persist until around 10–15 years after immigration. Immigration policies at the point of entry could explain this finding: refugees who are exposed to the geographic dispersal policies suffer larger long-run losses in their economic integration, relative to non-dispersed refugees. In contrast, Cortes (2004) finds that the earning and employment gaps between refugees versus economic migrants who arrived in the US from 1975 to 1980 are closed and even reverse over time due to the higher rates of human capital accumulation for refugee immigrants. Contributing to this literature, we examine the labor market prospects for Ukrainian refugees in Poland from the perspective of local labor demand. Unlike the existing studies, which use historical data, using online vacancy data allows us to provide evidence of the near real-time and medium-run impacts of the ongoing war on the labor market for forced migrants, which can be used for policy recommendations for both immediate and longer-term intervention.

We also contribute to an important yet less understood aspect of literature on the impacts of wars and forced migrants in particular, that is on the labor market of the sending countries. The human capital deficit caused by wars has negative impacts on the labor market in the post-war economy due to the lower level of education and the skills depreciation as workers were out of work (Gorodnichenko et al., 2022). In addition, the issue of human capital deterioration could be amplified if a different skill set is required in the post-war economy. However, wars could have a positive impact on female labor force participation (FLFP), as is evident during World War II (see, e.g., Goldin, 1991; Acemoglu et al., 2004). While Acemoglu et al. (2004) document the permanent effect of war on FLFP in the US, Goldin and Olivetti (2013) find that the permanent effect is mostly for women who are more highly educated. We contribute to this limited body of literature in several ways. First, we document the temporary impacts of the ongoing war on the Ukrainian labor market, on which the evidence is limited due to the unavailability of official data. Second, we investigate whether there is any early indicator of the shift in skills demand since the full-scale invasion, which is important for the reintegration of workers into the post-war labor force.

Finally, our paper is related to a growing number of studies that utilize online vacancy data to answer various labor economics and macroeconomic questions, including changes in skills demand, labor market concentration, effects of job loss on earnings, or the wage-

unemployment relationship, among others (e.g., Hershbein and Kahn, 2017; Azar et al., 2020; Blair and Deming, 2020; Alekseeva et al., 2021; Faryna et al., 2022; Braxton and Taska, 2023). This data source has also proven useful for understanding any changes and shifts in labor markets when it is difficult to collect official statistics, e.g., during the COVID-19 pandemic. For instance, Gu and Zhong (2023) analyze the Burning Glass Technologies (BGT) data and find that the temporary stay-at-home orders during the pandemic have led to persistent shifts in skills demand with an increasing demand for general interpersonal skills and operational management skills. Complementing the existing studies, we show that online vacancy data can provide some insights into the impacts of the ongoing war between Russia and Ukraine, a temporary event, on labor markets. In particular, the up-to-date data allow us to examine the shifts in (1) the labor/skills demand and its heterogeneity, and (2) wage distribution caused by the war. Given that the equivalent official statistics are unavailable, our results will be valuable in drawing implications for rebuilding the Ukrainian labor market in the post-war period.

The rest of the paper is organized as follows. Section 2 is a discussion of the institutional background of the ongoing war and current trends in Ukrainian migrants in Poland. In Section 3 we will describe the data used for our analysis. We discuss our empirical analyses and results in Section 4. Finally, Section 5 concludes and discusses certain policy implications.

2. Institutional background

On 24 February 2022, Russia began a full-scale invasion of Ukraine. As of June 2022, Russia's invasion had caused over \$97 billion worth of physical damage¹ across a range of Ukrainian sectors. The resulting damage to the Ukrainian economy includes a drop of 30.4% in the gross domestic product² (GDP) in 2022, a soaring inflation rate of over 20%, and 19.8% of Ukrainians facing poverty (World Bank, 2022). The labor market has also been heavily affected, with 4.8 million job losses observed by May 2022, accounting for 30% of pre-war employment.³

In addition, the war has caused the largest refugee crisis since World War II: by January 2023, around 7.9 million Ukrainian refugees had been recorded.⁴ Most went to neighboring countries (e.g., Poland, Slovakia, and Moldova) as well as to Baltic countries, Germany, and the Czech Republic. Of these countries, Poland has been the most common destination because of the close and special Polish-Ukrainian links and relationship. Geographically, Poland is Ukraine's gateway to Europe. Economically, Poland is also one of the most developed neighboring countries (Wrona, 2019). Moreover, there are cultural and ethnic similarities between Ukraine, particularly Western Ukraine, and Poland. Thus Poland has naturally been a popular destination for economic migrants and now refugees from Ukraine.

Since 2014, several policy changes have helped to improve access to the Polish labor market for Ukrainians. First, in May 2014, Poland introduced a uniform temporary residence permit/work permit for Ukrainians, causing a large outflow of Ukrainian workers to Poland. Second, in June 2017, the European Council and the European Parliament decided to waive the visa requirements for Ukrainians wanting to enter the Schengen Area. Although this decision has a limited effect on the number of immigrants (Wrona, 2019), it allows for easier mobility of Ukrainians within the Schengen Area and, thus, enables them to seek employment in the Schengen countries, including Poland. Third, since January 2008, seasonal workers from Ukraine can work in certain agricultural and hospitality services in Poland without being restricted to a specific position, and the process of obtaining the work permit has also been simplified. Due to these policy changes, around 1.35 million Ukrainians were working in Poland before the Russian invasion in 2022 (Duszczek and Kaczmarczyk, 2022), and the number of Ukrainian migrants in Poland increased after this point.

However, there has been a shift in the composition of Ukrainian migrants in Poland before and since the war began. Before the start of the full-scale war, most Ukrainian migrants in Poland were working in low-skilled occupations (Dobroczycki et al., 2017). Since February 2022, the majority of adult Ukrainian migrants in Poland are women, of which a large proportion are of working age. Although the existing surveys provide mixed statistics on the skill level of Ukrainian refugees, one common observation is that almost 50% have tertiary education, around one-third are proficient in English, and almost 40% have some knowledge of Polish (Kowalski et al., 2022). As suggested by the OECD (2021), the language barrier could create skill mismatch problems where highly skilled refugees cannot utilize their skill set and have to work below their qualification level due to their lack of language skills.

The unexpected shock in the supply of Ukrainian workers could have both negative and positive impacts on the Polish labor market. On the one hand, there could be heightened competition between displaced workers and local workers (Braun and Mahmoud, 2014; Morales, 2018; Black et al., 2022). On the other hand, there could be complementary effects via skills/knowledge spillover from refugees to the local labor market (Peters, 2017; 2022; Black et al., 2022). While it is difficult to evaluate the exact effects in the current situation, historical evidence suggests that Ukrainian migrants could make positive contributions to the Polish economy generally and the labor market in particular. For instance, the influx of Ukrainian workers could help to reduce the labor shortages in certain sectors.⁵ Whether such positive contributions are temporary or long-term will depend on whether Ukrainian workers choose to stay in Poland permanently or return to Ukraine/move to a third country.

¹ See <https://tinyurl.com/2s3va4x2> (Accessed 15 February 2023).

² See <https://tinyurl.com/yeyrjvhe> (Accessed 15 February 2023).

³ See <https://tinyurl.com/5c22eck4> (Accessed 15 February 2023).

⁴ See <https://tinyurl.com/aps9yt8t> (Accessed 15 February 2023).

⁵ See <https://tinyurl.com/k94usv7h> (Accessed 25 February 2023).

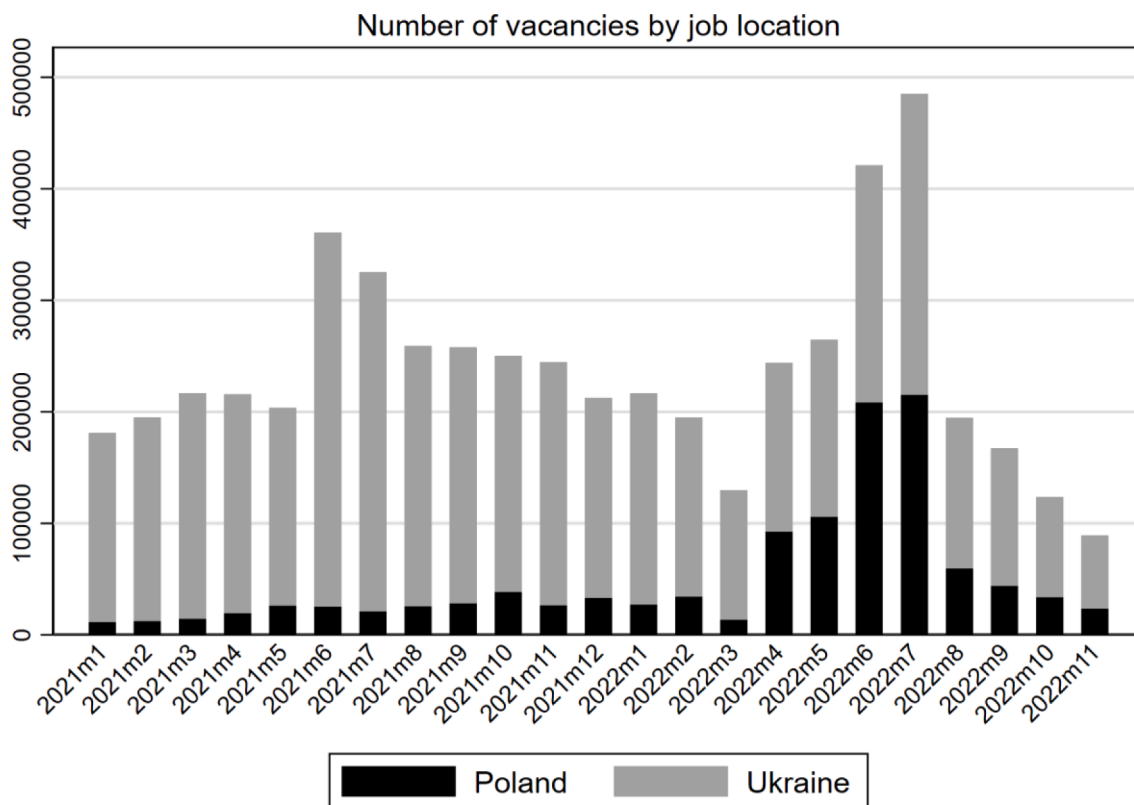


Fig. 1. Number of vacancies by locations. Notes: This figure shows the number of ads for jobs in Poland (black bars) and in Ukraine (gray bars) over the January 2021 – November 2022 period. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

3. Data

Data used in this study are provided by Jooble.org, an international job search website. Job vacancies from various internet sources, including corporate websites, online job boards, and social networks, among others, are aggregated, checked for duplication, and placed on Jooble.org. Thus, Jooble data provide a better representation of labor markets than data from an individual job board. In this study, we use the vacancies available on the Jooble Ukraine site (<https://ua.jooble.org/>), which are sourced from Ukrainian domains. In other words, this data set consists of job ads posted by Ukrainian and international employers targeting Ukrainian workers or, more broadly, job seekers in Ukraine. In the data, we can observe the following information: (1) posted date and expired date, (2) job title, (3) job description, (4) job location, and (5) offered maximum and/or minimum salary (if any). The information on job location allows us to differentiate between jobs in Ukraine and jobs in other countries. For this study, we focus on domestic jobs and jobs in Poland only.

It is worth noting that while online vacancy data can act as an indicator of employment demand (Carnevale et al., 2014), which is especially important given that the labor market data during the war are limited and lack granularity, there are several limitations. First, the online vacancies do not cover all sectors and/or industries, and also do not cover government jobs. In fact, the majority of jobs in our data set are jobs in the IT sector (e.g., programmer), service sector (e.g., cashier, cleaner), and jobs in the engineering and manufacturing industry (e.g., machine operator). Second, the number of jobs in Poland for Ukrainian workers will likely underestimate the true level as our data set does not contain jobs for Ukrainian workers posted on Polish job boards/domains. Finally, not all vacancies contain information on the offered wages.

Being aware of the limitations, a sample of more than 5.4 million vacancies covering the 2021–2022 period is used for the analysis.⁶ 11.47% of these of these ads post the maximum wage offered and 36.44% post the minimum wage offered. As can be seen in Notes: This table reports the estimated coefficients for Model (1). The number of observations is 62,615. The dependent variable is the number of ads. D_t^{war+k} is a series of time dummies that equal 0 for the January 2021 – July 2021 period and equal 1 if month t is k months ($k=[-6;9]$) from February 2022. Columns (1)-(2) report the raw estimates corresponding to Panel A of Fig. 5 while Columns

⁶ We exclude job ads posted in Crimea from the analysis as this part of Ukraine has been occupied by Russian forces since the beginning of the 2014 Russo-Ukrainian war.

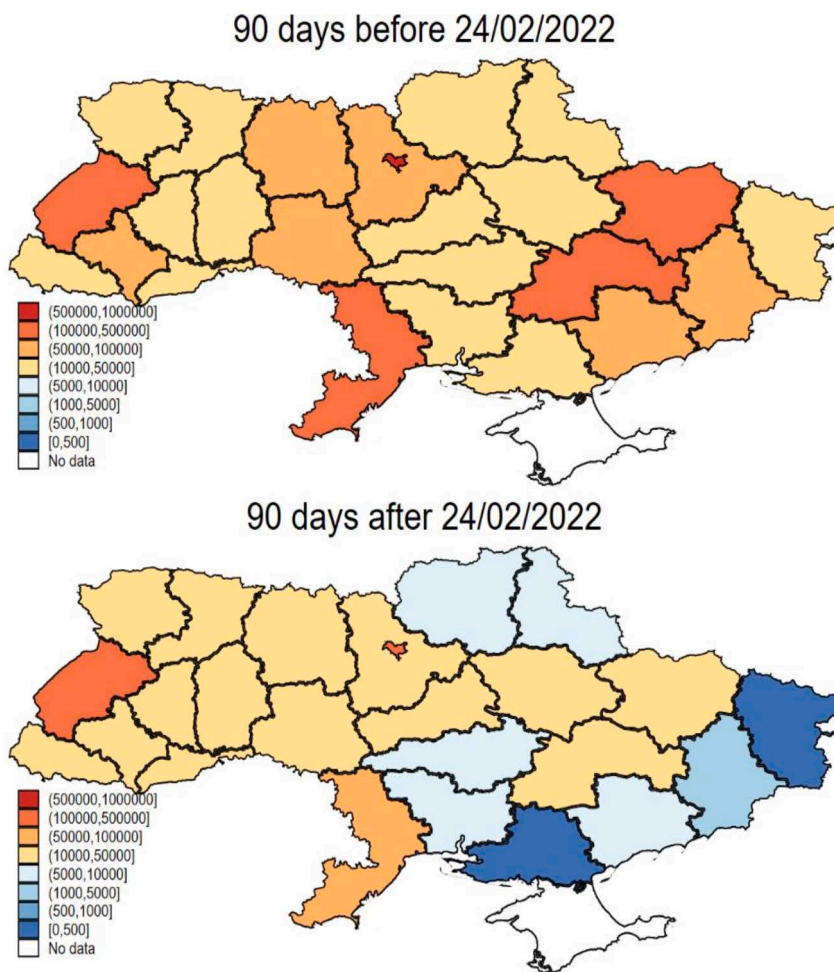


Fig. 2. Vacancies in Ukraine – 90 days before and after 24/02/2022. Notes: This figure shows the number of ads in Ukrainian regions over the 90 days before 24 February 2022 (top panel) and the 90 days after 24 February 2022 (bottom panel).

(3)-(6) report the raw estimates corresponding to Panel B of Fig. 5. *Ukraine* equals 1 if the job location is in Ukraine and 0 if the job location is in Poland. *Borders* equals 0 if the job location is in Poland, 1 if a region shares borders with Eastern Europe, 2 if a region shares borders with Russia, and 3 otherwise. *War intensity*, the share of populated areas in a region that is under Russian control or is a contested ground in a given month, is included but not reported. In all estimations, a constant term, as well as location, job title, and location \times title fixed effects, are included but not reported. ***, **, and * indicate the significance level at 1%, 5%, and 10%, respectively.

Fig. 1, the number of job ads increases significantly in April - July 2022 (i.e., months 2–5 after the full-scale invasion started), which is mainly driven by a jump in the number of jobs in Poland offered to Ukrainians. This increase in the number of Polish jobs available to Ukrainians is notable: the number of Polish jobs during May – July 2022 is around 1.8 times higher than the total number of Polish jobs available in the whole of 2021. Moreover, while the number of vacancies in Ukraine declines because of the war, the most affected regions are Eastern Ukraine, where the total number of ads over 90 days after the war broke out is below 10,000 (Fig. 2). This reflects the progress of the war: since April 2022, Eastern Ukraine has become the main battlefield with the heaviest fighting and casualties.

Given that the texts of each job description are unstructured and that they are written in different languages, text analysis is carried out to extract the useful and relevant information. First, we use paraphrase-multilingual-mpnet-base-v2, a sentence-level transformer model trained on 50+ languages, to generate a 768-dimensional embedding vector for each description in the sample. The same language model is also used to create the embedding vectors for bigrams, trigrams, and fourgrams within each description.⁷ Next, we generate the cosine similarity score for each description pair and its n-grams ($n=[2;4]$). For each description, the top 30 phrases which (1) have the highest similarity scores and (2) appear in at least 500 ads are retained as the keywords of the description. In doing so, we create a list of nearly 35,000 phrases that best represent the descriptions in the sample. Finally, these extracted phrases are manually

⁷ An example of this process is illustrated in Appendix Fig. 1.

Table 1
Summary statistics.

	Share of ads (%)
Post maximum salary	11.47
Post minimum salary	36.44
Request team working skills	1.88
Request analytical skills	9.80
Request language skills	36.30
Language skills not required	0.34
Request communication skills	14.72
Specify experience needed	8.03
No experience needed	0.24

Notes: This table shows the description of the sample for analysis.

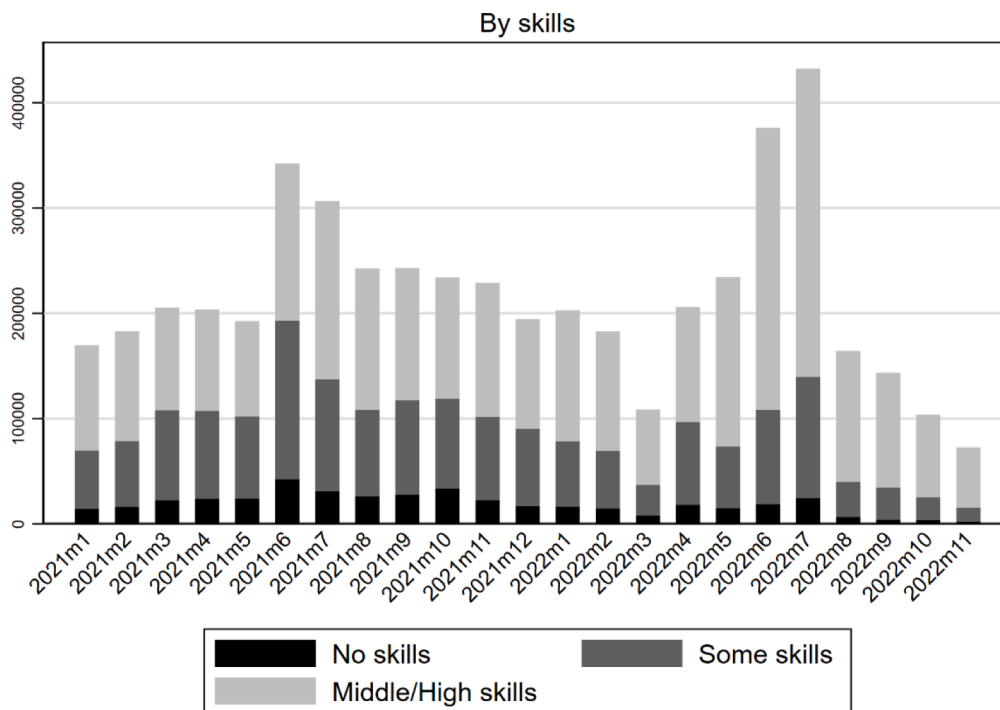


Fig. 3. Number of vacancies by skills categories. Notes: This figure shows the number of ads for jobs by 3 skills categories: no skills (black), some skills (dark gray), and middle/high skills (light gray). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

coded to generate the keywords representing skill requirements, including languages, teamwork, analytical skills, communication skills, and experience. Across all ads, 36.3% require candidates to be fluent in foreign languages, and 14.72% of ads request candidates with good communication skills. In contrast, less than 10% specify a requirement for teamwork skills, analytical skills, or experience (Table 1). The indicators of teamworking, analytical, communication, and language skills are later grouped into one variable, namely *Skills*, which equals 1 if an ad requires one of these skills, and 0 otherwise.

We also clean the full text of job titles and group similar titles together. In total, 467 normalized job titles are generated, of which 275 titles (58.87%) appear both before and after 24 February 2022 (continuing titles), 41 titles (8.76%) appear in the pre-war period only (exit titles), and 148 titles (31.68%) are new job titles which enter the sample after February 2022 (enter titles). As shown by Marinescu and Wolthoff (2020), job titles can provide useful information about job/worker heterogeneity, thus, we also make use of normalized job titles in several ways. First, we match the job titles in our data with the closest job titles in O*NET. We then use O*NET’s Job Zone indicator⁸ to classify jobs according to their skills level. Specifically, the variable *Skill* will take the value of 1 (no skills) if the relevant O*NET job zone is One (Little or No Preparation Needed); 2 (some skills) if the job zone is Two (Some Preparation Needed); and 3 (medium/high skills) if the job zone is Three, Four, or Five (Medium/Considerable/Extensive Preparation Needed). Out of 467

⁸ See <https://tinyurl.com/ysseht6k> (Accessed 15 February 2023).

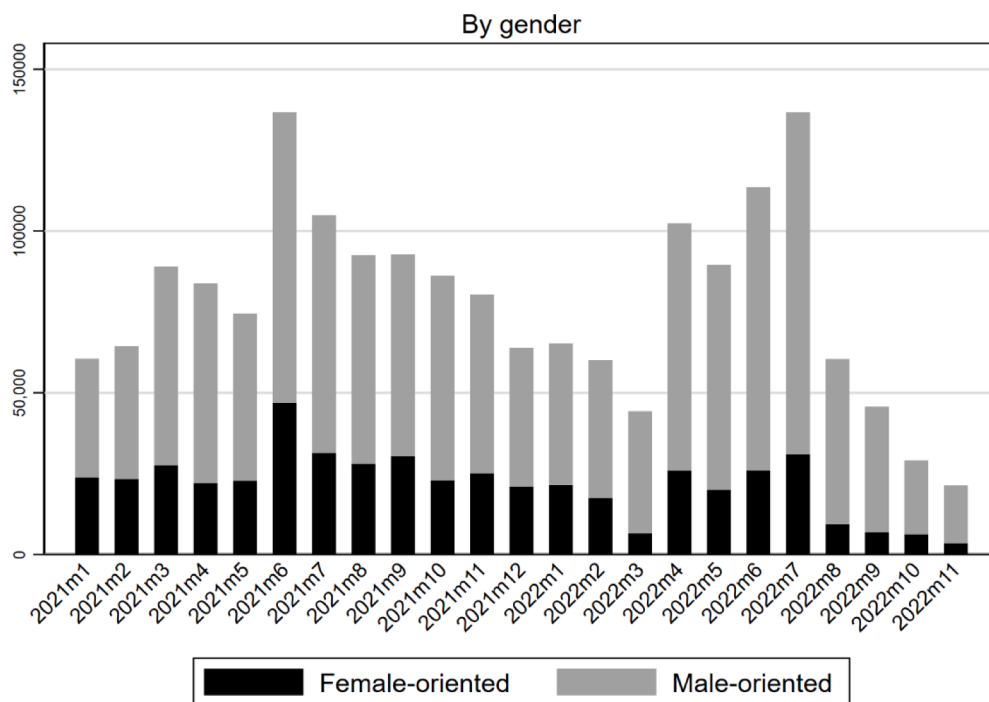


Fig. 4. Number of vacancies by occupational gender segregation. Notes: This figure shows the number of ads by occupational gender segregation: female-oriented (black) and male-oriented (gray).

job titles in our data set, we are able to match and classify 26 titles into skill group 1 (6.48%), 98 titles into skill group 2 (24.44%), and 277 titles into skill group 3 (69.08%). As seen in Fig. 3, before February 2022, the number of ads for the some-skills jobs is comparable to that of ads for the medium/high-skills jobs. However, since May 2022, the number of medium/high-skilled jobs has increased significantly.

Second, the existing literature suggests that the content and context of jobs, combined with gender differences in skills, could affect gender sorting/segregation. For example, it is argued that women have an advantage in terms of their interactional social skills, hence, jobs that involve social contact are likely to be female-dominated jobs. In contrast, jobs that demand physical skills are more likely to be dominated by men (Baker and Cornelson, 2018; Lordan and Pischke, 2022). In the spirit of Cortes and Pan (2017), we use O*NET’s Work Context data⁹ to classify jobs into female vs. male-oriented. A title is considered to be male-oriented if the scale of “Spend Time Climbing Ladders, Scaffolds, or Poles” or “Spend Time Using Your Hands to Handle, Control, or Feel Objects, Tools, or Controls” is at least 80. A title is considered to be female-oriented if the scale of “Contact With Others” is at least 80. Any titles that (1) cannot be matched with O*NET titles or (2) are not mutually exclusive of the female versus male category are considered undefined (or gender neutral in a loose sense). In other words, for each normalized job title, the Gender variable will be equal to 0 if female-oriented, 1 if undefined, and 2 if male-oriented. Fig. 4 shows that there is not much difference in the composition of male-oriented versus female-oriented jobs available before and since the start of the full-scale war. That is, the number of male-oriented jobs is always higher than female-oriented ones. There is, in fact, a drop in the number of female-oriented jobs in the second half of 2022.

In the data, we also observe the minimum offered wages for 36.77% of ads. Wages are listed in either Ukrainian Hryvnia (UAH), US dollars (USD), or Euro (EUR), and the wage rate could either be hourly, daily, monthly, or annual. To create a consistent wage measure, we perform several steps to transform and to clean the data. First, we convert wages listed in USD or EUR to UAH rates using daily foreign exchange rates released by the National Bank of Ukraine. Second, the wage rate is then converted to an hourly rate by assuming eight working hours per day and five working days per week. Third, based on the job locations, nominal wages are deflated using the monthly consumer price index (CPI) in the corresponding countries, with January 2020 as the base month. Finally, we trimmed our wage data at the 1st and 99th percentiles to remove outliers, which left us with more than 1.85 million ads. On average, the minimum real hourly wage offered over the 2021–2022 period is around 1254 UAH (34 USD).

4. Empirical analysis

To understand the impact of the ongoing war on the demand for Ukrainian workers, we will first show some trends in the labor demand for Ukrainian workers to work in Ukraine and Poland during the January 2021 – November 2022 period. Next, we will

⁹ See <https://tinyurl.com/ysseht6k> (Accessed 15 February 2023).

Table 2
Baseline results.

	(1) D^{war+k}	(2) $D^{war+k} \times \text{Ukraine}$	(3) D^{war+k}	(4) $D^{war+k} \times \text{Borders}^{\text{Eastern Europe}}$	(5) $D^{war+k} \times \text{Borders}^{\text{Russia}}$	(6) $D^{war+k} \times \text{Borders}^{\text{Others}}$
$k = -6$	0.270*** (0.091)	-0.231** (0.093)	0.270*** (0.091)	-0.025 (0.109)	-0.259*** (0.096)	-0.264*** (0.094)
$k = -5$	0.373*** (0.101)	-0.351*** (0.103)	0.373*** (0.101)	-0.305*** (0.112)	-0.335*** (0.107)	-0.363*** (0.103)
$k = -4$	0.669*** (0.158)	-0.729*** (0.159)	0.669*** (0.158)	-0.612*** (0.168)	-0.680*** (0.168)	-0.762*** (0.160)
$k = -3$	0.303*** (0.076)	-0.333*** (0.079)	0.303*** (0.076)	-0.259*** (0.090)	-0.458*** (0.084)	-0.318*** (0.081)
$k = -2$	0.547*** (0.148)	-0.767*** (0.152)	0.547*** (0.148)	-0.780*** (0.155)	-0.847*** (0.154)	-0.747*** (0.155)
$k = -1$	0.350*** (0.105)	-0.518*** (0.110)	0.350*** (0.105)	-0.420*** (0.119)	-0.615*** (0.124)	-0.513*** (0.114)
$k = 0$	0.555** (0.269)	-0.905*** (0.271)	0.555** (0.269)	-0.766*** (0.276)	-1.294*** (0.331)	-0.928*** (0.272)
$k = 1$	-0.376 (0.377)	-0.296 (0.388)	-0.376 (0.377)	-0.006 (0.399)	0.021 (0.471)	-0.717* (0.403)
$k = 2$	1.463*** (0.343)	-1.880*** (0.347)	1.463*** (0.343)	-1.410*** (0.350)	-1.772*** (0.422)	-2.123*** (0.348)
$k = 3$	1.596*** (0.335)	-1.933*** (0.357)	1.596*** (0.335)	-1.579*** (0.343)	-2.462*** (0.394)	-1.964*** (0.377)
$k = 4$	2.281*** (0.316)	-2.289*** (0.342)	2.281*** (0.316)	-2.008*** (0.322)	-3.548*** (0.362)	-2.225*** (0.356)
$k = 5$	2.316*** (0.287)	-2.087*** (0.304)	2.316*** (0.287)	-1.709*** (0.292)	-3.223*** (0.340)	-2.052*** (0.314)
$k = 6$	1.190*** (0.405)	-1.156*** (0.411)	1.190*** (0.405)	-0.544 (0.412)	-1.821*** (0.481)	-1.257*** (0.415)
$k = 7$	0.919** (0.416)	-0.968** (0.425)	0.919** (0.416)	-0.474 (0.424)	-1.857*** (0.453)	-1.004** (0.429)
$k = 8$	0.913*** (0.279)	-1.236*** (0.289)	0.913*** (0.279)	-0.801*** (0.287)	-2.072*** (0.296)	-1.260*** (0.296)
$k = 9$	0.580** (0.285)	-1.209*** (0.296)	0.580** (0.285)	-0.618** (0.297)	-2.046*** (0.316)	-1.279*** (0.301)

Notes: This table reports the estimated coefficients for Model (1). The number of observations is 62,615. The dependent variable is the number of ads. D_t^{war+k} is a series of time dummies that equal 0 for the January 2021 – July 2021 period and equal 1 if month t is k months ($k=[-6;9]$) from February 2022. Columns (1)-(2) report the raw estimates corresponding to Panel A of Fig. 5 while Columns (3)-(6) report the raw estimates corresponding to Panel B of Fig. 5. *Ukraine* equals 1 if the job location is in Ukraine and 0 if the job location is in Poland. *Borders* equals 0 if the job location is in Poland, 1 if a region shares borders with Eastern Europe, 2 if a region shares borders with Russia, and 3 otherwise. *War intensity*, the share of populated areas in a region that is under Russian control or is a contested ground in a given month, is included but not reported. In all estimations, a constant term, as well as location, job title, and location \times title fixed effects, are included but not reported. ***, **, and * indicate the significance level at 1%, 5%, and 10%, respectively.

examine the heterogeneity in the changes in labor demand. Finally, we will study the changes in offered wages since the onset of the full-scale invasion.

4.1. Trends in the labor demand

We employ a simple specification as follows to document how the demand for Ukrainian workers has changed since the start of the war:

$$Ads_{i,j,t} = \alpha + \sum_{k=-6}^9 D_t^{war+k} \beta_1^k + \sum_{k=-6}^9 D_t^{war+k} \times \text{Ukraine}_j \beta_2^k + \beta_3 \text{War intensity}_{j,t} + FEs + \varepsilon_{i,j,t} \tag{1}$$

where $Ads_{i,j,t}$ is the number of ads for job title i in location j (a region in Ukraine or Poland) in month t . D_t^{war+k} is a series of time dummies that equal 0 for the January 2021 – July 2021 period, and equal 1 if month t is k months ($k=[-6;9]$) from February 2022. *War intensity* $_{j,t}$ is the share of populated areas in a region that is under Russian control or is contested ground in a given month.¹⁰ *FEs* is a set

¹⁰ Data on controlled areas are obtained from Zhukov (2022).

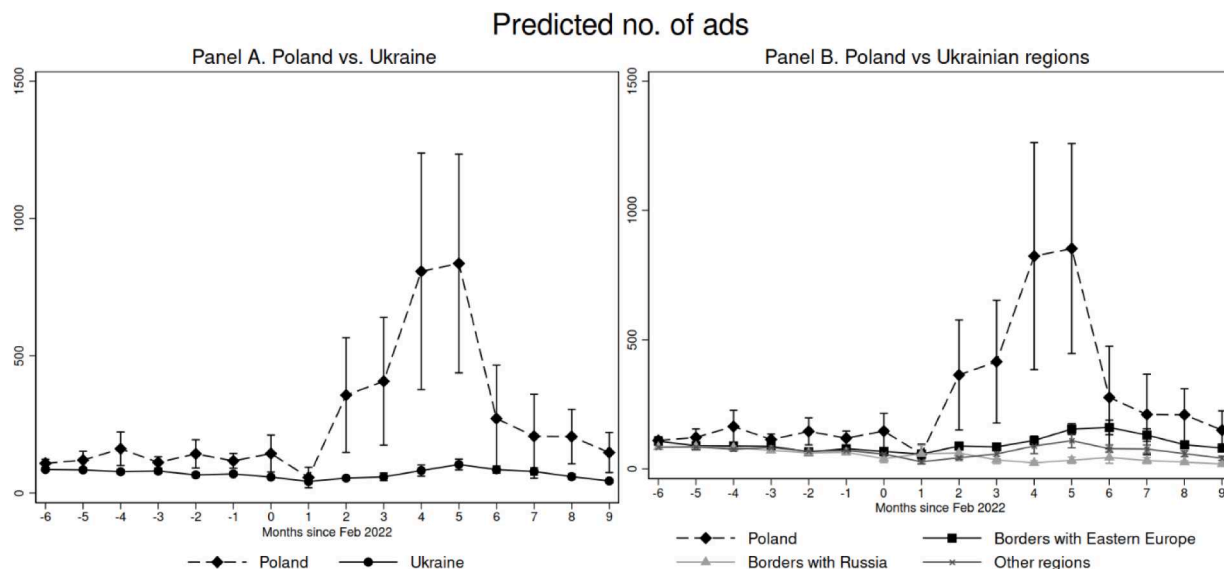


Fig. 5. Effects on the number of vacancies. Notes: This figure shows the predicted number of vacancies by job location. The adjusted predictions with 95% confidence intervals are reported.

of different fixed effects, including (1) *location* fixed effects, (2) *job title* fixed effects, and (2) *location × title* fixed effects.¹¹

In the baseline specification, *Ukraine_{it}* equals 1 if the job location is in Ukraine, and 0 if the job location is in Poland. In the alternative specification, we replace *Ukraine* with *Borders*, which equals 0 if the job location is in Poland, 1 if a region shares borders with Poland, Slovakia, or Hungary (i.e., Eastern Europe), 2 if a region shares borders with Russia, and 3 otherwise. Model (1) is estimated using the Poisson pseudo-maximum likelihood (PML) estimator (Correia et al., 2020). Standard errors are clustered by *location × title*.

The estimated results are reported in

Table 2 where the positive estimates of D^{war+k} ($k=[-6;9]$) indicate an upward trend in the number of Polish jobs for Ukrainian job seekers since August 2021. On average, the number of Polish jobs advertised during the 6 months leading up to February 2022 is around 1.5 times greater than the number observed in the pre-August 2021 period. This number has increased since February 2022, with the largest increase observed in June – July 2022 (i.e., months 4–5 since the onset of the full-scale war). In particular, the number of Polish jobs in June and July 2022 is around 10 times higher than is observed during the January – July 2021 period. If one were to refer to these estimates as the effect of war on Polish jobs for Ukrainians in June – July 2022, then the estimates of the interaction terms would indicate that the effect of the war in June – July 2022 for jobs in Ukraine is only 0.1–0.12 times ($e^{-2.3} = 0.1$; $e^{-2.1} = 0.12$) that for jobs in Poland.

For further interpretation of the results, we report the average adjusted predicted number of ads each month during the August 2021 – November 2022 period for jobs in Poland and Ukraine in Fig. 5.¹² The level of demand for Ukrainian workers was relatively stable before February 2022 in both Ukraine and Poland, i.e., there is no pre-war trend in the labor demand. However, since the onset of the escalation, there has been a sizeable increase in the demand for Ukrainian workers to work in Poland. Specifically, before the war, the average predicted number of jobs in Poland available to Ukrainians in a month is 100, which increases to around 350–400 in April–May 2022, and then rises to 800–840 in June–July 2022. Since August 2022, the number of Polish jobs has decreased to around 150–200 jobs a month, which is still higher than the pre-war level. The surge in the number of vacancies in June–July coincides with the timing of a special law introduced by the Polish government which allows Ukrainian refugees to work in Poland without a work permit or a unique personal identifier.¹³ Thus, to some extent, our results are evidence of refugees’ labor market integration assisted by this new law.

Somewhat unexpectedly, there is no significant difference in the predicted number of job ads in Ukraine before and after February 2022. Zooming into the labor demand in different areas of Ukraine (Panel B), in the post-February 2022 period, the predicted number of job ads is highest for jobs in Ukrainian regions sharing borders with Eastern Europe and lowest for jobs in regions sharing borders

¹¹ In the baseline specification, we do not explicitly control for the quarter-of-year fixed effects (seasonality effects) due to the collinearity between the war dummies and the high-dimensional fixed effects. As a robustness check, we report the results when the quarter-of-year fixed effect are included in Appendix Figs. 2, 3, 4. The results are similar to the baseline results.

¹² The predictions are adjusted to the distributions of the covariates across the entire sample. For example, the predicted number of ads in Ukraine in February 2022 is computed by treating an observation as though it is a job in Ukraine posted in February 2022 and leaving other variables as they are.

¹³ See <https://tinyurl.com/2p9byn97> (Accessed 15 February 2023).

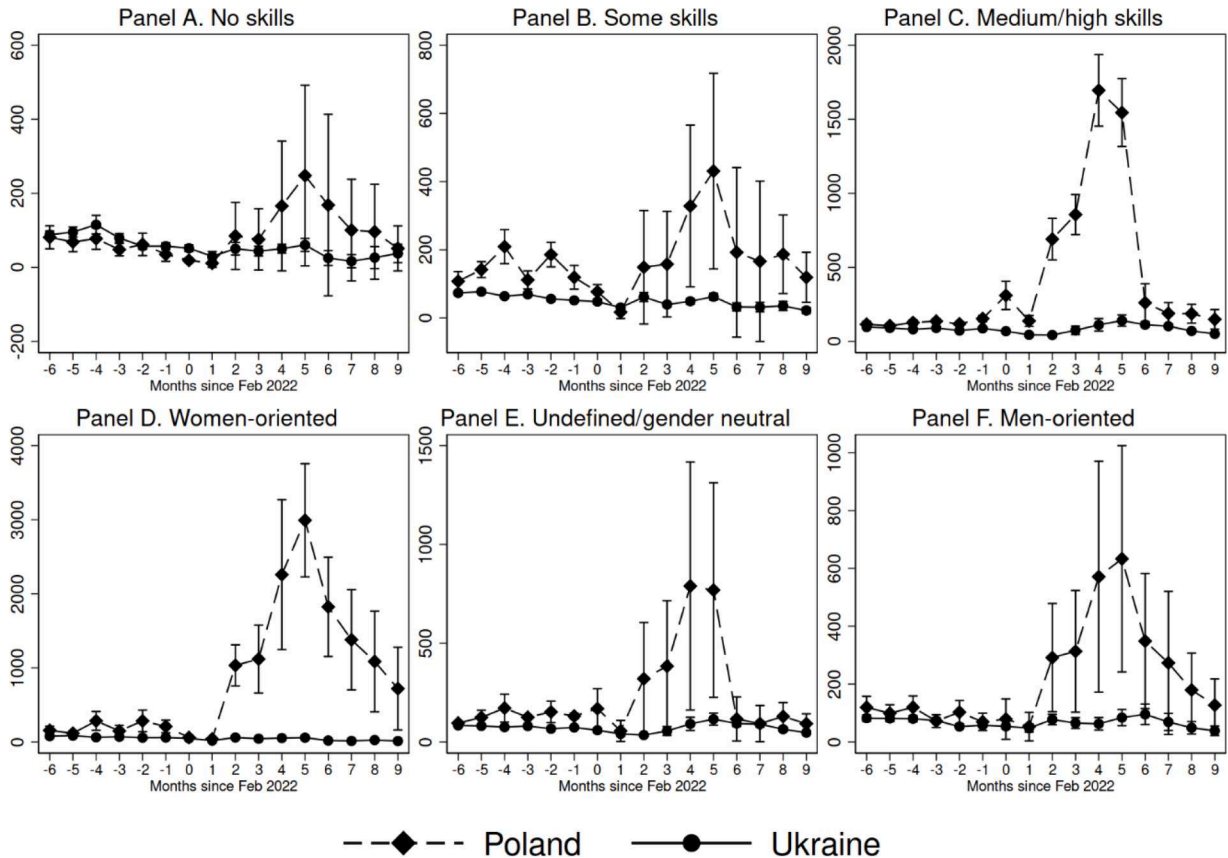


Fig. 6. Effects on the number of vacancies – Heterogeneity. Notes: This figure shows the predicted number of vacancies by skills categories (Panels A-C) and occupational gender segregation (Panels D-F). The dashed line represents the results for jobs in Poland while the solid line represents the results for jobs in Ukraine. The adjusted predictions with 95% confidence intervals are reported.

with Russia. In addition, the number of jobs available in Ukrainian regions sharing borders with Eastern Europe after February 2022 is slightly higher than in the pre-February 2022 period. This finding, however, may not be counterintuitive for several reasons. First, the outflux of working-age Ukrainians to neighboring countries has left the existing jobs vacant. Second, although almost 50% of small and medium enterprises (SMEs) in Ukraine had to cease their operations completely at the beginning of the war, the situation slowly improved as the war continued.¹⁴ For example, by July 2022, a small proportion (4–5%) of SMEs even reported an increase in the volume of work compared to the pre-war period, while around 35–40% of firms reported the volume of work being at least 70% of the pre-war level. Third, by July 2022, 14% of SMEs had relocated within Ukraine, most likely to Eastern Ukraine. Taken together, new vacancies could be posted to either (1) replace the workers who left Ukraine or (2) to meet the small increase in labor demand in a small number of firms. This, coupled with the fact that the labor market in Ukraine was already weak even before the war (Anastasia et al., 2023), could explain the “stable” number of job ads in Ukraine.

4.2. Heterogeneity in labor demand

We next examine whether there is any variation in labor demand depending on occupational gender segregation and job skills. To do this, we modify specification (1) by adding the indicator of job heterogeneity as follows:

$$\begin{aligned}
 Ads_{i,j,t} = & \alpha + \sum_{k=-6}^9 D_t^{war+k} \beta_1^k + \sum_{k=-6}^9 D_t^{war+k} \times Ukraine_j \beta_2^k + \beta_3 Ukraine_j \times Job\ heterogeneity_i + \sum_{k=-6}^9 D_t^{war+k} \times Job\ heterogeneity_i \\
 & \times Ukraine_j \beta_4^k + \beta_5 War\ intensity_{j,t} + FE_s + \varepsilon_{i,j,t}
 \end{aligned}
 \tag{2}$$

where *Job heterogeneity* is a series of skills dummies or gender dummies. Skills dummies include *No skills*, *Some skills*, and *Medium/High skills*, which indicate the level of skill required for an occupation. Gender dummies include *Women*, *Undefined/Neutral*, and *Men*, which

¹⁴ See <https://tinyurl.com/yn974b2u> (Accessed 15 February 2023).

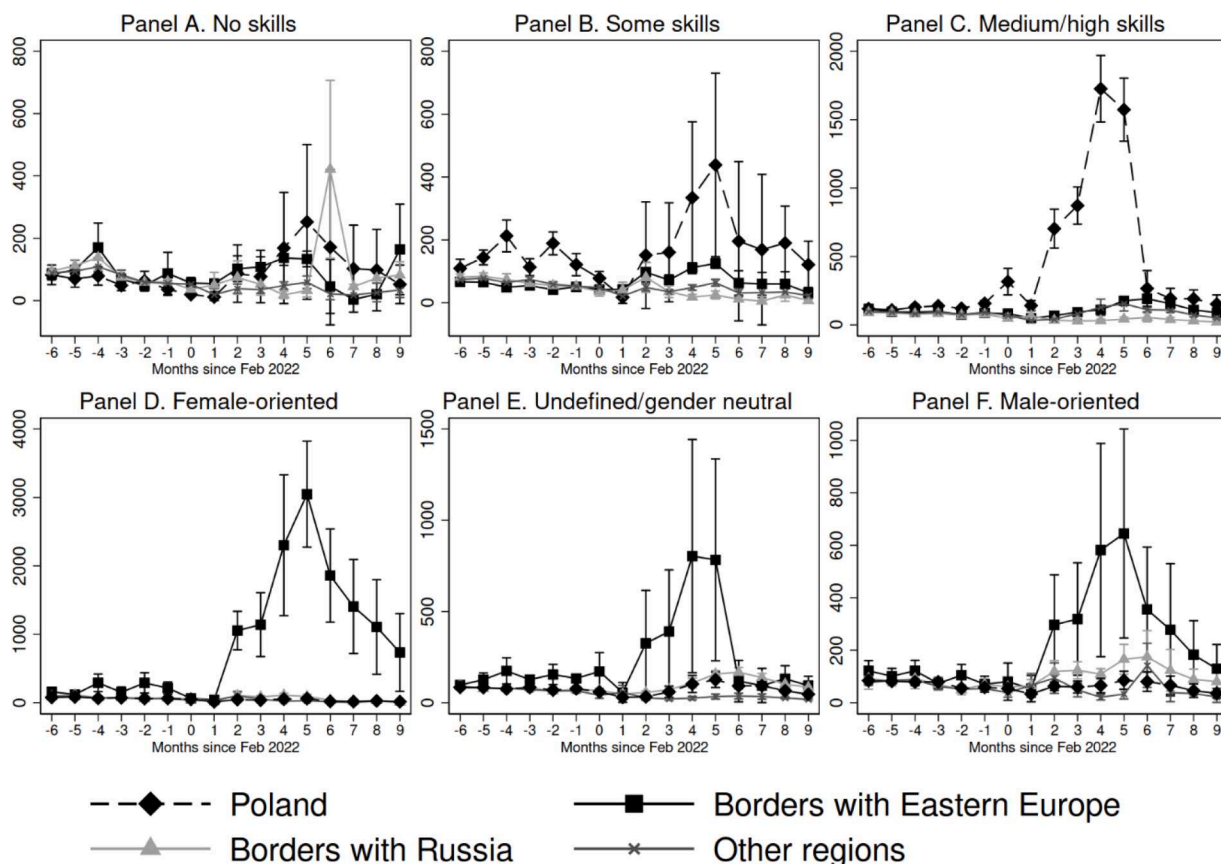


Fig. 7. Effects on the number of vacancies by location – Heterogeneity. Notes: This figure shows the predicted number of vacancies by skills categories (Panels A-C) and occupational gender segregation (Panels D-F). The dashed line represents the results for jobs in Poland. The solid lines with square markers and with triangle markers represent the results for jobs in Ukrainian regions sharing borders with Eastern Europe and with Russia, respectively. The solid line with cross markers represents the results for jobs in other Ukrainian regions. The adjusted predictions with 95% confidence intervals are reported.

indicate whether a job is female-oriented, undefined, or male-oriented, respectively. Other variables are defined in Section 4.1.

As seen in Panels A-C of Fig. 6, although there is an increase in the number of jobs available in Poland across occupations, the scale of changes is different between occupations that require no skills versus those that require some or medium/high level skills. For example, the predicted number of vacancies for no-skills occupations is 35 in January 2022 and peaks at 248 in July 2022, which is translated into an increase of 609%.¹⁵ The similar statistics for occupations that require some skills and those requiring medium/high level skills are 261% and 1001%, respectively. After the peaks in July-August 2022, the predicted number of jobs across different skill levels slowly decreases and returns to the pre-war level by November.

On the one hand, the pronounced increase in the number of medium/high-skilled jobs over the first few months after the start of the full-scale war could temporarily raise concerns as to the lack of access to higher-skilled, thus higher-paid, jobs for war-caused migrants. This, coupled with the suggestive evidence by the OECD¹⁶ that the majority of Ukrainian refugees are relatively highly educated, could potentially have a spillover effect on the local labor market in Poland through a skills and knowledge transfer (Hornung, 2014; Murard and Sakalli, 2018). On the other hand, the immediate reversal to the pre-war level is worrying and suggests that more support is needed to skills match forced migrants with Polish firms.

Panels D-F show that the magnitude of changes in the number of jobs available in Poland also varies with the levels of gender segregation. That is, the difference between the number of ads in the peak months and the number in January 2022 is 1332%, 507%, and 817% for women-oriented occupations, neutral occupations, and male-oriented occupations, respectively. The results suggest a temporary shift in labor demand (i.e., the jump in the number of female-oriented jobs) which is driven by the shift in labor supply (i.e., 90% of refugees are women and children). At the same time, our findings also hint at another potential issue that could hinder the

¹⁵ It should be noted that this number is likely to be an underestimate of the demand for no-skills labor as online job ads are predominantly higher-skilled jobs.

¹⁶ See <https://tinyurl.com/3t7he8ch> (Accessed 15 February 2023).

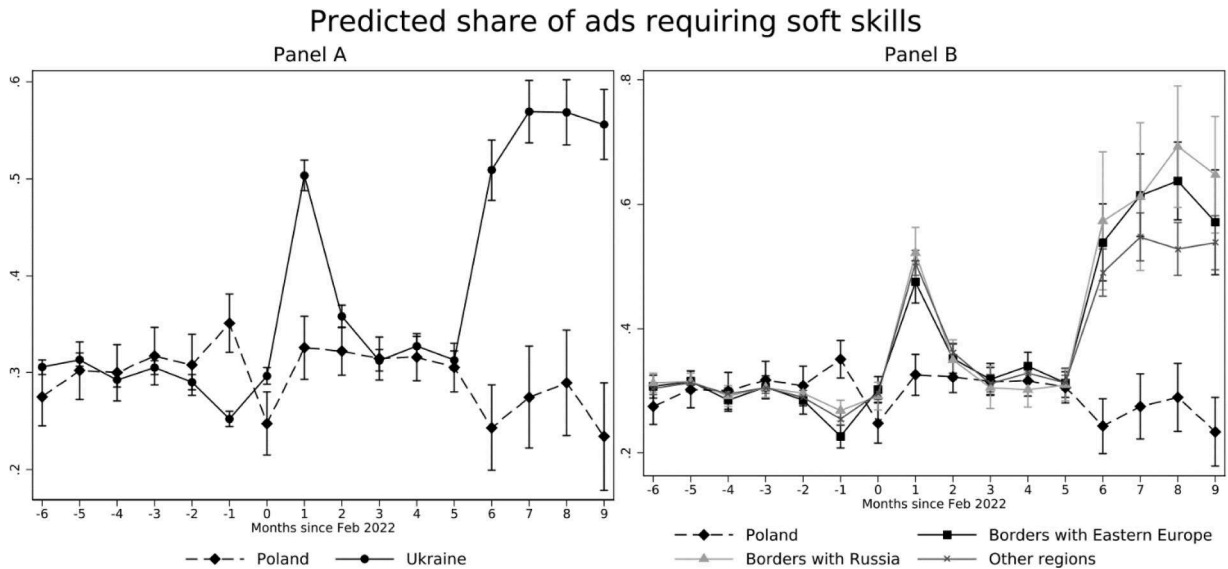


Fig. 8. Effects on the share of ads requiring soft skills. Notes: This figure shows the predicted share of vacancies requiring soft skills. The adjusted predictions with 95% confidence intervals are reported.

effort to improve the inclusion of Ukrainian migrants in Poland. Specifically, despite the abundance of traditionally male-oriented jobs, female refugees may not apply for those jobs because of a skills mismatch (e.g., the women do not possess the skills needed for the jobs) and/or gender norms (e.g., women are discouraged from applying for a job because it is not a “woman’s job”).

We do not observe any clear difference in the level of job ads before and after February 2022 in Ukraine across occupations with different skills categories and different levels of gender segregation. However, there are some variations depending on the specific job locations (Fig. 7). Since March 2022, the predicted number of jobs requiring at least some skills and the jobs that are either male-oriented or gender-neutral in regions sharing borders with Eastern Europe is higher than the pre-war level. While the slight increase in the number of male-oriented and neutral jobs is likely to be supply-driven (i.e., the shortage of women of working age since the full-scale invasion began), the increase in vacancies for skilled jobs could be because of both supply- and demand-side factors. On the supply side, skilled workers are forced to leave their jobs because of the ongoing war. On the demand side, firms only have incentives to fill the skilled positions but not the ones which require no skills. This is somewhat in line with the existing studies on the labor costs of financial constraints (e.g., Caggese et al., 2019; Baghai et al., 2021), which show that firms do not fire high-skilled workers, even when facing financial distress or negative shocks to firm productivity.

The inclusion of Ukrainian refugees in the host countries’ labor market (in this case, Poland) not only relates to job availability, but also to certain barriers, such as languages, that could prevent Ukrainian migrants from taking up those jobs for which they are otherwise qualified. To explore this issue, we further examine whether the demand for skills has changed since the full-scale invasion began by employing the below specification:

$$Share_{i,j,t}^{Skills} = \alpha + \sum_{k=-6}^9 D_t^{war+k} \beta_1^k + \sum_{k=-6}^9 D_t^{war+k} \times Ukraine_j \beta_2^k + \beta_3 War\ intensity_{j,t} + FEs + \varepsilon_{i,j,t} \tag{3}$$

where $Share_{i,j,t}^{Skills}$ is the share of ads of occupation i in location j in month t , which require either language, communication, analytical, or teamworking skills. The predicted shares plotted in Fig. 8 suggest that, although Polish employers do not lower their demands for language, communication, analytical, or teamwork skills, they also do not increase their demand for such skills. Interestingly, Ukrainian firms tend to specify these skills in their ads more often in the post-February 2022 period. In other words, operating in abnormal and challenging conditions appears to prompt firms to increase their demand for soft and analytical skills. This, to some extent, supports the argument that the post-war economy may demand a different skill set (Gorodnichenko et al., 2022).

To this end, our results provide evidence of the impacts of war on both the local labor market and the labor market for forced migrants. First, the ongoing war is positively correlated with the degree of Ukrainian refugee integration into the Polish labor market, but the effect is short-lived. Second, the short-term improvement in labor market integration is most prevalent for medium/high-skilled occupations and for female-oriented occupations. Finally, the effect of war on labor demand in the already-weak Ukrainian labor market is insignificant in the short term. Yet, the long-term effect is expected to be substantial due to the destruction and loss of human capital (Anastasia et al., 2023). At the same time, there is suggestive evidence of the positive link between the war and upskilling in hiring within Ukrainian firms.

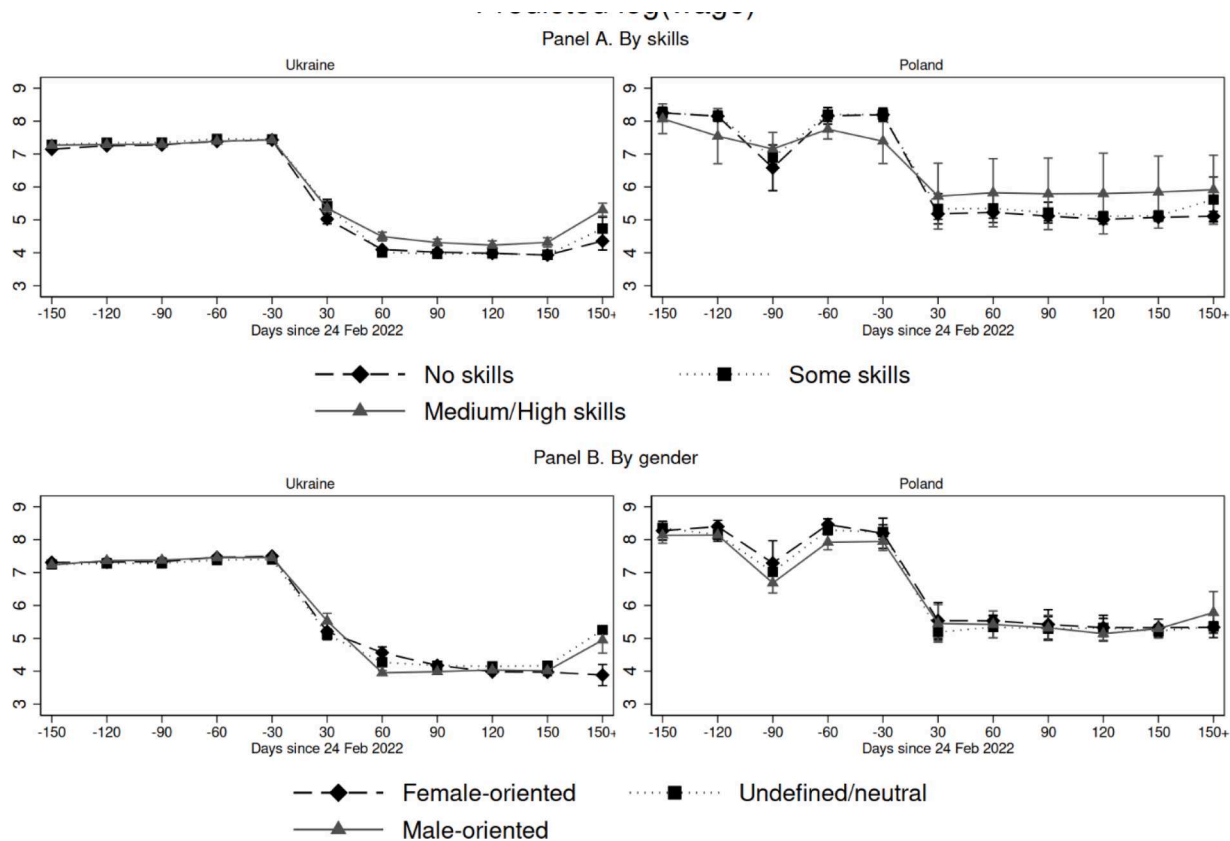


Fig. 9. Effects on real wages offered. Notes: This figure shows the predicted real offered wages by skills categories (Panel A) and occupational gender segregation (Panel B). The adjusted predictions with 95% confidence intervals are reported.

4.3. Effects on offered wages

To empirically examine the impacts of war on real wages, we estimate the following models:

$$\ln(wage)_{i,j,l,d} = \alpha + \sum_{k=-150}^{150} D_d^{war+k} \beta_1^k + \sum_{k=-150}^{150} D_d^{war+k} \times Job\ heterogeneity_{j,d} \beta_2^k + \beta_3 War\ intensity_{l,d} + FE_s + \varepsilon_{i,j,l,d} \tag{4}$$

where $\ln(wage)_{i,j,l,d}$ is the natural log of real minimum wage offered in vacancy i , occupation j , location l on date d . D_d^{war+k} is a series of time dummies that indicate if date d is in the period between k to $k + 30$ days ($k = [-150; 150]$) with a time step of 30 days) since the full-scale war start date (24 February 2022). For instance, $D_d^{war-150}$ equals 1 if date d is in 120 – 150 days before 24 February 2022. The omitted base is the January 2021 – 27 September 2021 period. $War\ intensity_{j,d}$ is the share of populated areas in a region under Russian control or on contested ground on a given date. Other variables are defined as before. Specification (4) is estimated for the sub-samples of jobs in Ukraine and Poland separately.¹⁷ We use the OLS (ordinary least squares) estimator and cluster the standard errors at the $location \times title$ level.

Due to the incomplete information on wages, the reported results in Fig. 9 should be taken as suggestive evidence of the impacts of war on wages. Nevertheless, we find the negative effects on the real wages offered to Ukrainian workers, regardless of work location and job profiles. In comparison, the persistent drop in offered wages is greater in Ukraine, relative to the wage decline in Poland, and the decrease is slightly reduced for medium/high-skilled occupations. Similar results are observed when we restrict the sample to only continuing job title–location cells (Appendix Fig. 5). Thus, the decrease in offered wages is driven, not only by the shift in the distribution of low-paid versus high-paid jobs, but also the reduction within job title–location cells.

Given that Ukrainian migrants to Poland before February 2022 are mostly economic migrants, while Ukrainian migrants after February 2022 are predominantly refugees, the decline in the wages offered for Polish vacancies after February 2022 could be interpreted as follows. Relative to Ukrainian economic migrants before the full-scale war begins, Ukrainian refugees are offered (1) lower-paid jobs and/or (2) lower wages for similar jobs. Hence, to some extent, our results are consistent with the existing evidence

¹⁷ War intensity is excluded when we estimate the results for the sub-sample of jobs in Poland.

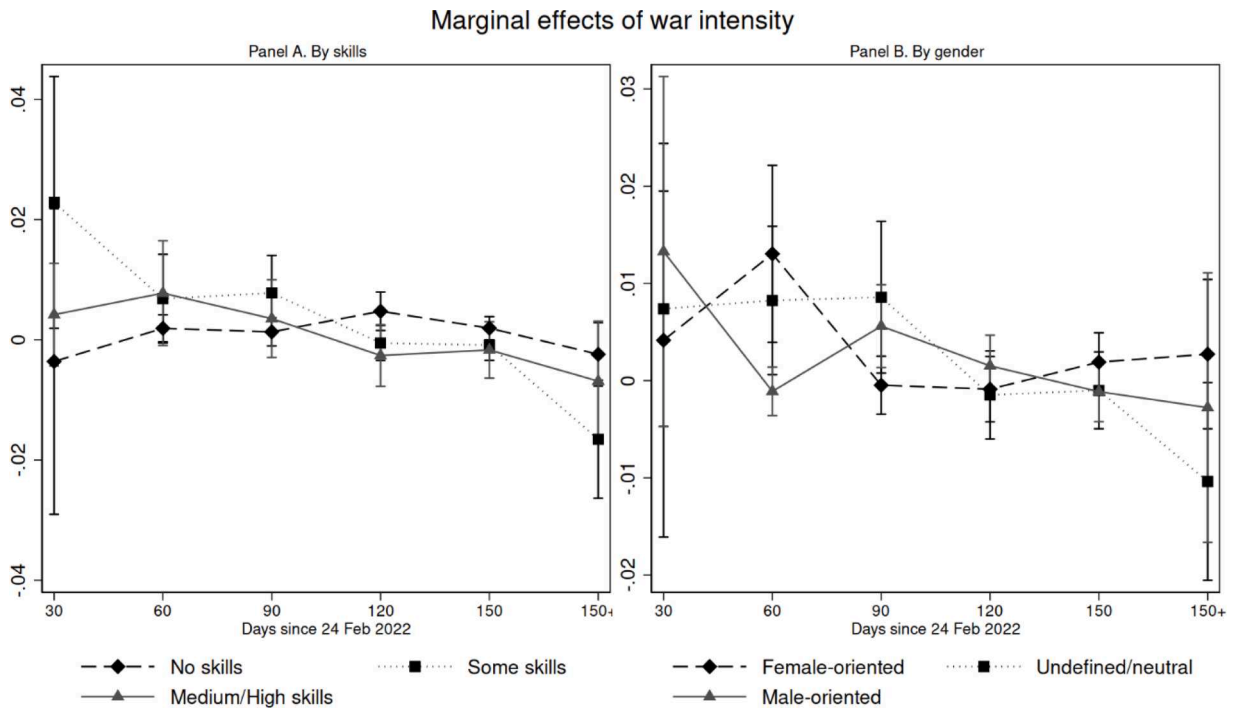
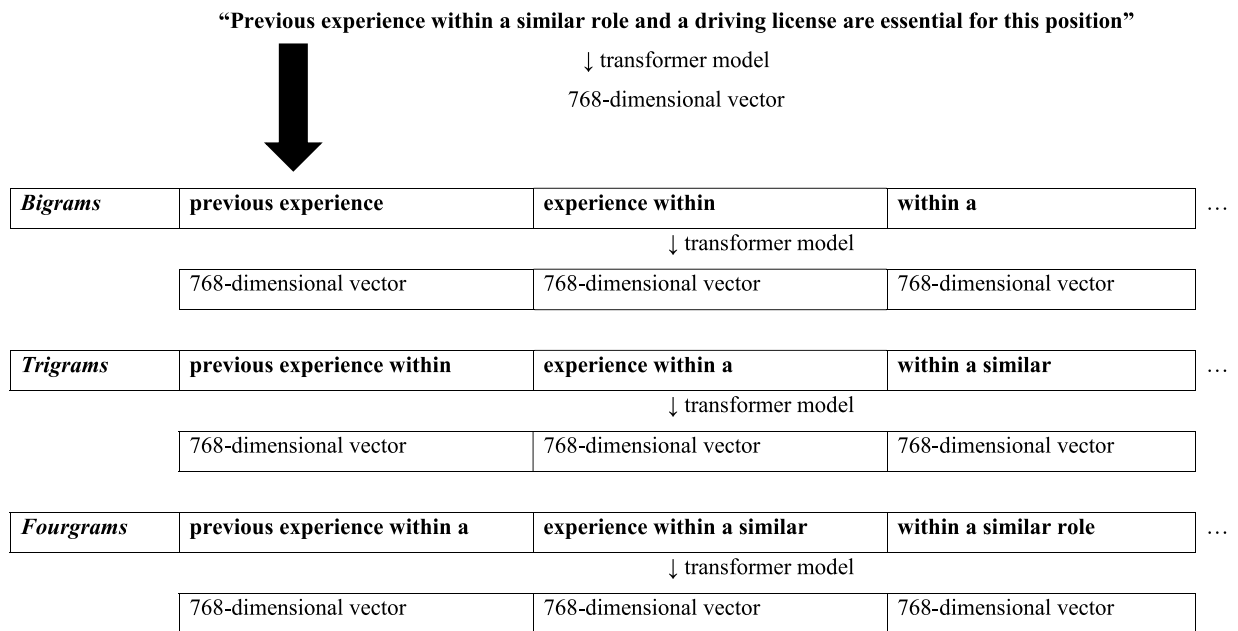


Fig. 10. Effects of war intensity on wages. Notes: This figure shows the marginal effects of war intensity on real offered wages by skills categories (Panel A) and occupational gender segregation (Panel B). The marginal effects with 95% confidence intervals are reported.

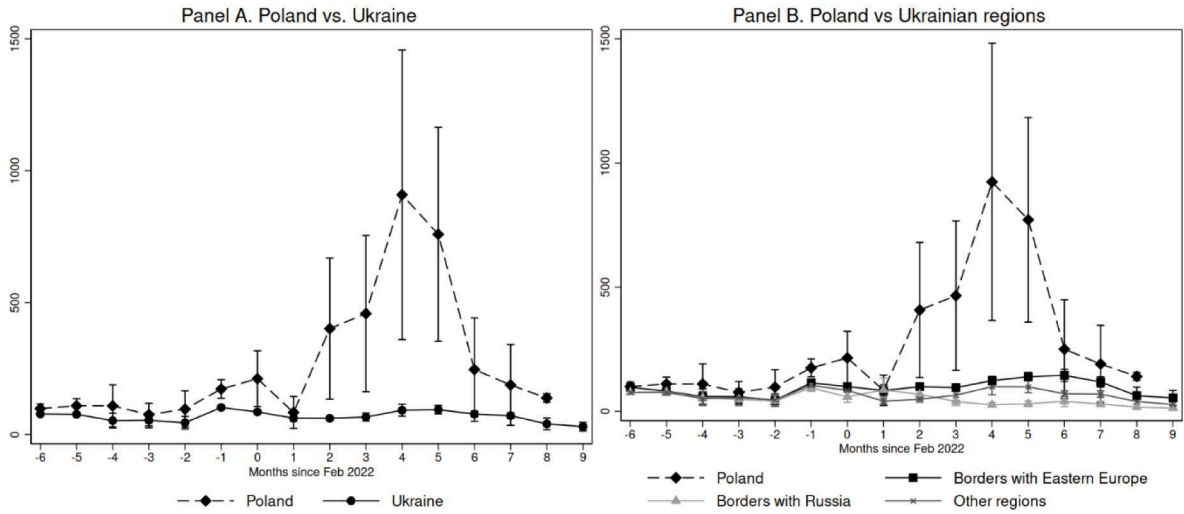


Appendix Fig. 1. Text analysis example.

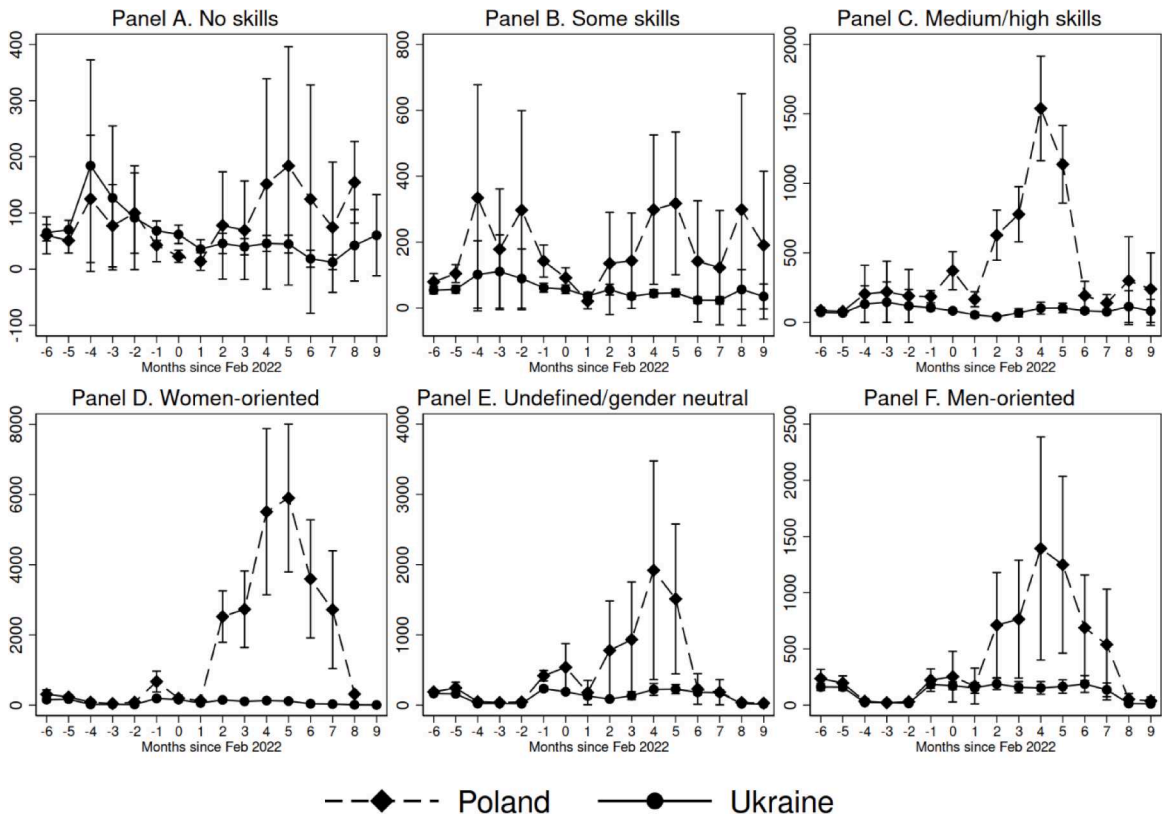
showing worse labor market outcomes (e.g., lower wages) for refugees, compared to economic migrants in other contexts (e.g., [Dustmann et al., 2017](#); [Brell et al., 2020](#)).

While the war has an overall impact on wages in Ukraine, the effect may be different across Ukrainian regions due to the varying levels of war exposure. To test this possibility, we re-estimate model (4) by introducing a triple-interaction term between D_d^{war+k} ($k=[30;150]$ with a time step of 30 days), *Job heterogeneity* (*Skill* or *Gender*), and *War intensity*, and then report the marginal effects of *War*

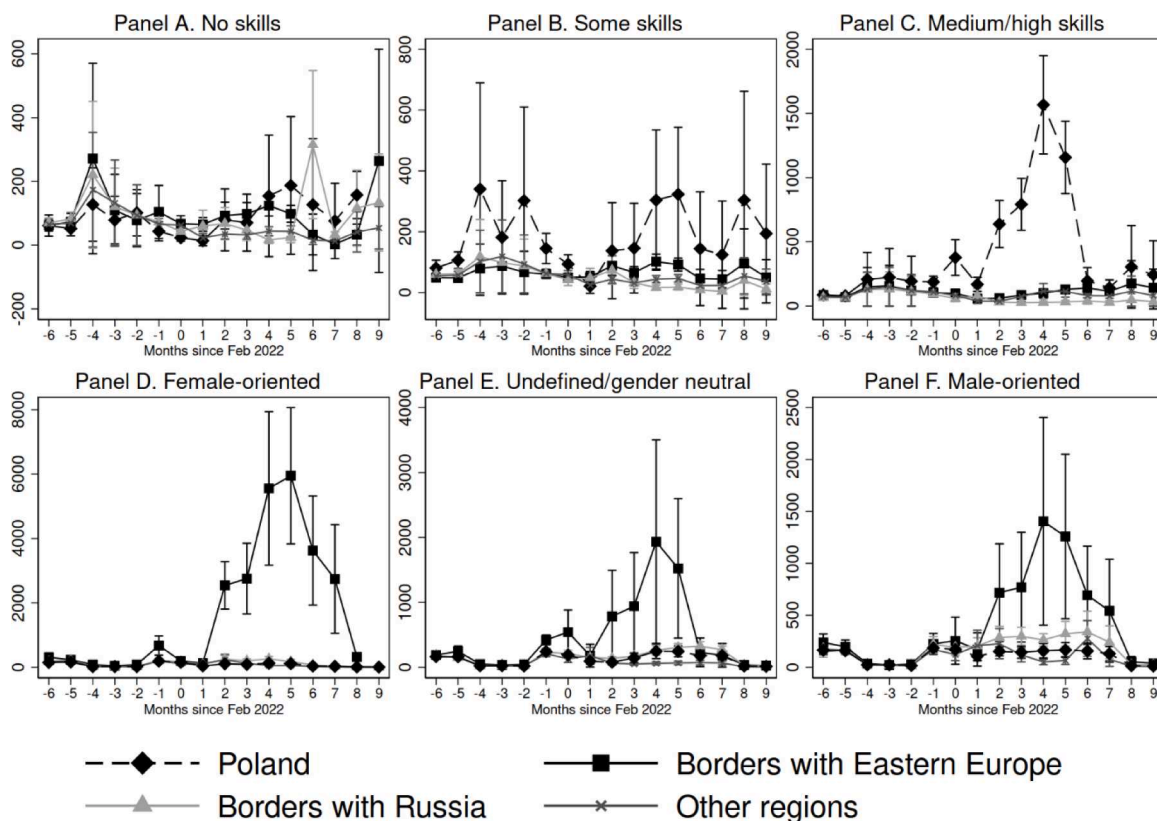
Predicted no. of ads



Appendix Fig. 2. Effects on the number of vacancies (control for seasonality). Notes: This figure shows the predicted number of vacancies by job location. In the estimations, quarter-of-year fixed effects are controlled for. The adjusted predictions with 95% confidence intervals are reported.



Appendix Fig. 3. Effects on the number of vacancies – Heterogeneity (control for seasonality). Notes: This figure shows the predicted number of vacancies by skills categories (Panels A-C) and occupational gender segregation (Panels D-F). The dashed line represents the results for jobs in Poland while the solid line represents the results for jobs in Ukraine. In the estimations, quarter-of-year fixed effects are controlled for. The adjusted predictions with 95% confidence intervals are reported.



Appendix Fig. 4. Effects on the number of vacancies by location – Heterogeneity (control for seasonality). Notes: This figure shows the predicted number of vacancies by skills categories (Panels A-C) and occupational gender segregation (Panels D-F). The dashed line represents the results for jobs in Poland. The solid lines with square markers and with triangle markers represent the results for jobs in Ukrainian regions sharing borders with Eastern Europe and with Russia, respectively. The solid line with cross markers represents the results for jobs in other Ukrainian regions. In the estimations, quarter-of-year fixed effects are controlled for. The adjusted predictions with 95% confidence intervals are reported.

intensity in Fig. 10. Panel A shows that in the first three months from the onset of the escalation, a greater level of exposure to the war could even lead to an increase in the real offered wages of skilled jobs, which is possibly firms’ attempt to retain skilled workers. As the war progresses, leading to more business disruption and forced immigration, the increased level of war exposure is negatively related to the offered wages. However, the fighting intensity does not directly impact the real wages of jobs requiring no skills. Similarly, the estimates based on occupational gender segregation (Panel B) are noisy and do not show any clear patterns.

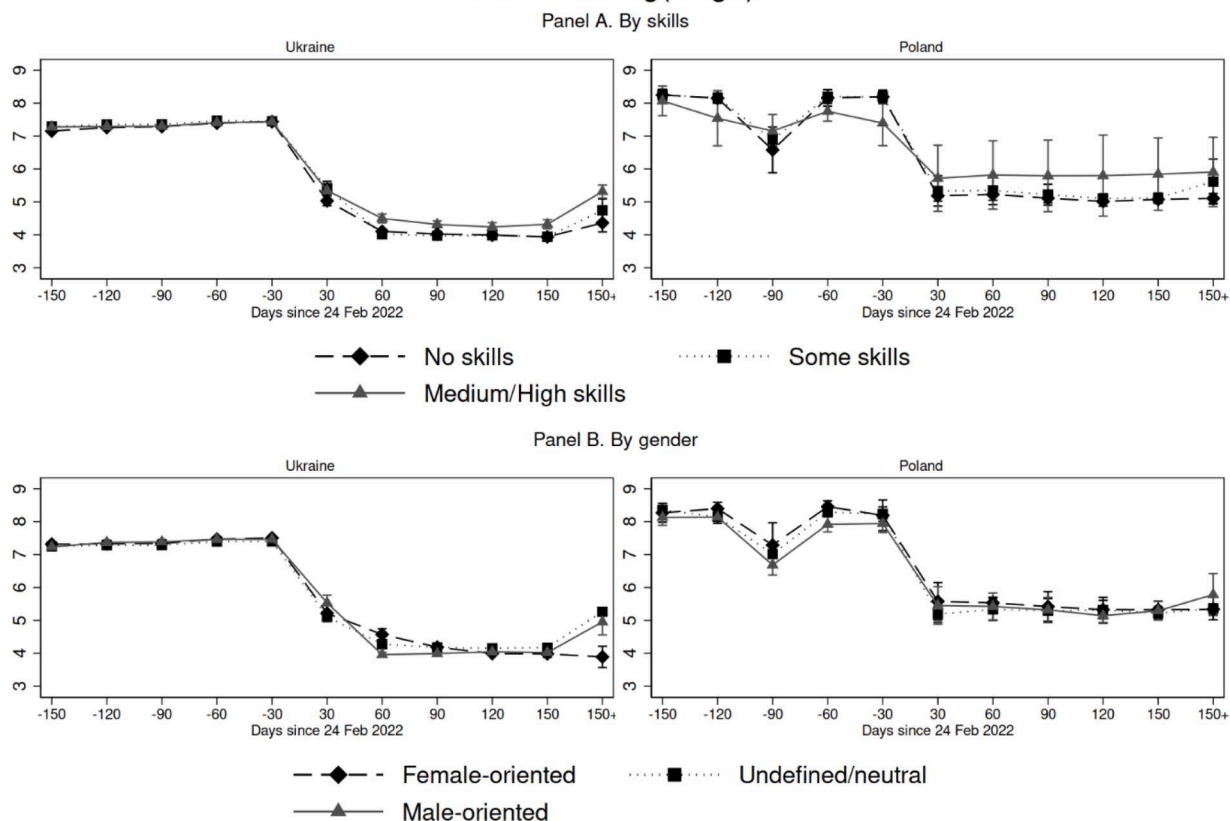
5. Conclusion

This study employs the unique data set of online vacancies targeting Ukrainian workers to examine the impacts of the ongoing Russia-Ukraine war on the labor markets for forced migrants and internally displaced workers. We find a dramatic increase in the former over the first five months of the full-scale war. Since August 2022, the number of Polish job ads has decreased, but remains at a level higher than in the pre-war period. However, the scale of changes is not the same for all occupations. The increase in demand is largest for medium/high-skilled jobs, as well as for jobs in female-oriented occupations. However, the soar in demand for medium/high-skilled Ukrainian migrants is rather short-lived as the number of ads for such positions reverses to the pre-February 2022 level from month 6 of the full-scale war.

In contrast to the increase in the number of Polish jobs, the overall number of vacancies in Ukraine has been relatively stable since July 2021, except for the slight rise in the number of jobs in regions sharing borders with Eastern Europe. Further, there is suggestive evidence of the upskilling in hiring in these regions as firms state the requirement for soft skills and analytical skills more often since the start of the full-scale war. Yet, the higher demand for soft skills and analytical skills is not translated into higher returns for those skills, i.e., higher offered wages. We observe the persistent decline in the real wages offered to Ukrainian workers in both Poland and Ukraine, although the drop in Poland is smaller. In addition, the decrease in offered wages of higher-skilled occupations in Ukraine is intensified by the war intensity, while a similar effect is not found for wages of the no-skills jobs.

While the results from our analysis cannot provide a complete picture of labor markets for Ukrainian workers, they can still offer some insights into the impacts of the ongoing war on labor market prospects for forced migrants in Poland and the future of the Ukrainian labor market. First, despite the short-lived improvement in the inclusion of Ukrainian refugees into the Polish labor market,

Predicted log(wage)



Appendix Fig. 5. Predicted log wage - restricted sample. Notes: This figure shows the predicted real offered wages by skills categories (Panel A) and occupational gender segregation (Panel B) for the sub-sample of continuing job title–location cells. The adjusted predictions with 95% confidence intervals are reported.

more needs to be done to improve their labor market outcomes. For example, being equipped with language skills would allow Ukrainian refugees to apply for all suitable vacancies, not only those targeted at them specifically. Training programs such as transfer learning may be necessary to help refugees to (1) transfer their existing skills which are no longer in demand, i.e., skills needed for jobs that have disappeared since the war escalated, to other jobs, and/or (2) to learn new skills required for the new jobs that are in demand since the onset of the war. Job searching assistance is also important to match Ukrainian refugees with local employers.

Second, the loss of human capital is a major challenge for rebuilding the Ukrainian labor market in the post-war era. As discussed in Gorodnichenko et al. (2022), the human capital of adults who lose their jobs could deteriorate because (1) they are out of work and, hence, are not able to maintain their skill set or (2) the skill set in the post-war economy is different. In this study, we find suggestive evidence for the latter. In this context, a continuously updated analysis of the demand for skills will be beneficial for policy and intervention design. For example, an understanding of the skills which are in high demand or the new skills which are now in demand will help policymakers to design specific training courses to help individuals to acquire such skills. To this end, analyzing online vacancies such as those used in this study would provide an early indicator of the shift in skills demand which then could be fed into policymaking.

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Appendix

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