INTERNATIONAL PEER SPILLOVERS IN HIGHER EDUCATION: THE IMPACT OF UKRAINIAN-BORN STUDENTS ON THE SALARIES OF POLISH UNIVERSITY GRADUATES

by

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Date _____

Kyiv School of Economics

Abstract

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Prior to the full-scale Russian invasion of Ukraine, almost 3,000 more Ukrainian-born master's students enrolled in Polish universities in 2021/22 academic year relative to the previous years' trend.

In this work, I used three models based on university-level data for about 290 Polish higher education institutions and found no evidence of either positive or negative spillover effects of this inflow on master's graduate salaries during first year after graduation.

Nevertheless, from descriptive analysis, I found several patterns in the 2021/22 cohort that significantly differ from cohorts of other years: the increase was concentrated among male students, mostly above 30 years old; most of the net inflow was absorbed by private universities; and most enrolled students in the 2021/22 academic year appear to withdraw or drop out after the first year without completing a master's degree.

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AI USE DECLARATION

During the preparation of this thesis, Generative AI (ChatGPT 5.2) was used as a supplementary tool to support grammar correction and improve sentence clarity in all chapters. I prompted the model beforehand using my own draft text and prior writing examples. The AI-corrected text was then processed in chunks with my review and edits. I take full responsibility for the originality, validity, and academic integrity of the work presented in this thesis.

Chapter 1

INTRODUCTION

After Russia's full-scale invasion of Ukraine in early 2022, many Ukrainians fled homes and started new lives abroad. Poland has been a key destination for Ukrainian youth over the past two decades and, since 2022, has hosted over 100,000 foreign students annually, around 45% of whom are Ukrainian-born (Figure 1). Given these magnitudes, Ukrainian students in Polish universities may generate spillover effects on peers, as documented across countries and comparable circumstances in the literature. In this research, I use graduates' wages as the outcome to capture such effects.

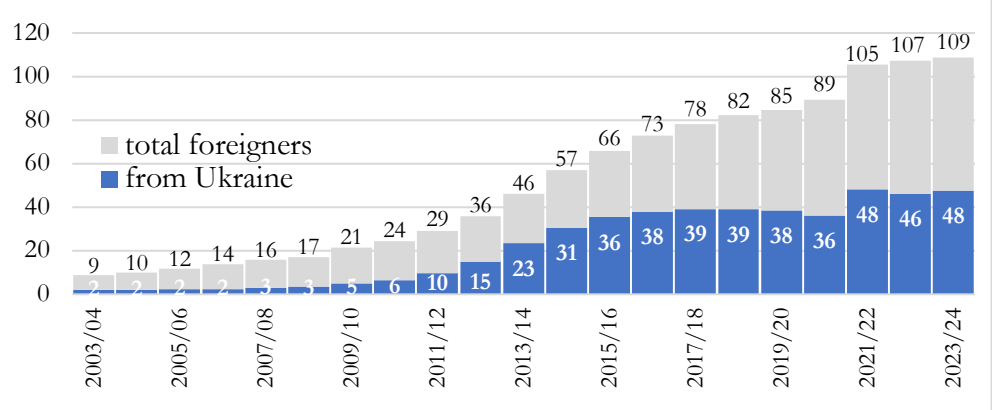


Figure 1. Number of Ukrainian and total foreign students in Polish universities in a given academic year, thousand people

Source: Statistics Poland

The motivation of the thesis can be summarized in two points. First, to reduce the knowledge gap about Ukrainian-born students who choose to study abroad—information that is necessary for policy responses in Ukraine to address demographic decline and the outflow of human capital. Second, to reduce potential tensions around Ukrainian immigrants and refugees in Poland by

providing evidence on whether these inflows bring net benefits or impose net costs on the local economy.

Objective

The objective of the thesis is to examine whether an increase in the number of Ukrainian-born students at Polish universities affects the average salary of native graduates one year after graduation.

Hypotheses

The main working hypothesis is that a larger number of Ukrainian-born students at Polish universities generates negative spillovers—lower average salaries for native graduates. The mechanism that drives this is a university-capacity channel. Hosting more foreign students increases administrative and teaching pressure, which in turn slows and weakens the learning process.

However, there is also an alternative hypothesis based on a competition effect: a higher share of Ukrainian students may push peers to work harder during their studies and gain some knowledge from students from the neighboring country with their unique studying experience. A resource effect is also possible: universities enrolling substantial numbers of Ukrainians may receive additional support from government or municipalities which improves outcomes for the whole cohort.

The rest of the thesis proceeds as follows: literature review, data and descriptive analysis, methodology, estimation results, and conclusions.

Chapter 2

LITERATURE REVIEW

Spillovers

The spillover effect, or externality, is one of the earliest economic ideas, likely emerging alongside ancient economic thought, albeit named and explained differently across countries, cultures, and contexts. At the turn of the 19th and 20th centuries, economists continued to elaborate on spillover effects, shaping the modern framework of this concept. As stated in Henry Sidgwick's The Principles of Political Economy (1883), "it may easily happen that the benefits of a well-placed lighthouse must be largely enjoyed by ships on which no toll could be conveniently imposed," which boils down to passing ships benefiting from information about nearby land: avoiding rocks and shoals, staying on course. Very similar discussions appear in the work of other economists of that era (Smart 1895, Pigou 1920).

With the development of statistics and computational power in the second half of the twentieth century, it became possible to study spillover effects quantitatively in real cases, to see how they function and are distributed across people and society, and to measure the magnitude and direction of various externalities in practice.

Since this work studies spillover effects from Ukrainian students, it is necessary to clarify what exactly is examined under this concise but vague term, justify why it is meaningful, and show whether similar studies have been conducted before.

Peers effect

Peers shape each other's behavior, and economists have repeatedly examined whether a person's academic or research performance is influenced by those with whom they attend lectures, do practicums, or share a dormitory room. Zimmerman (1999) finds that median-grade students at Williams College (Massachusetts, USA) tend to worsen their scores if they share a room with a low-performing peer, while top students are least affected. Sacerdote (2001) emphasizes the possibility of social gains at Dartmouth College (New Hampshire, USA) through roommate reassignment, since top students can help other top students or lower-performing students raise their GPA. Winston and Zimmerman (2004) broaden peer-effects analysis to six colleges and universities covering more than 10,000 students and suggest that students in the middle 70 percent of the test-score distribution may perform somewhat worse if they share a room with a student in the bottom 15 percent—similar to Zimmerman (1999) but with a slightly larger negative effect. Griffith and Rask (2014), using data from two anonymized medium-sized institutions with 1996–2008 and 2006–2009 cohorts, find a positive effect of roommate performance growth on peer performance, with the strongest effects for male, minority, and aided students, those with certain subsidies/support as vulnerable categories. Feld and Zolitz (2017) provide different and somewhat unexpected evidence in higher education: high- and middle-ability students benefit from better peers, while low-ability students are harmed by high-ability peers.

These papers are only a small subset of a large body of similar work. Moreover, they address the basic case focused on academic performance without introducing foreign students.

Foreign peer effects

Another, more specific but often broader, line of research examines spillovers from international classmates. Tonello (2015) finds a weak negative impact of the non-native share in Italian junior high schools on native peers' test scores. Schneeweis (2015) shows that native students in Austria between 1980 and 2001 were not affected by the migrant-student share. Branden et al. (2019) find that native Swedish and immigrant students' grades are relatively unaffected by the proportion of immigrant schoolmates. Anelli et al. (2020) show that foreign classmates can displace domestic US students across STEM majors and occupations without reducing the displaced students' expected earnings.

In general—whether explicitly stated or not—foreign-student inflows are a normal feature of an integrated world, involving gradual, planned, deliberate decisions by both applicants and receiving schools, universities, companies, and communities, as a consequence of free movement of people who choose where to study or work.

A related literature studies refugee inflows, which differ from voluntary migration in scale, speed, and the absorptive capacity of host institutions. In these settings, schools, universities, and public administrations often face sudden increases in demand, while refugees may encounter substantial constraints on their ability to study or work at full capacity due to displacement-related disruption, legal barriers, trauma, language differences, uncertainty.

In the final part of the literature review, I will examine papers covering major crises with waves of human displacement. I will then conclude by defining the specific case, period, and object of this study and proceed to the next sections of the thesis.

Refugee spillovers: mass exodus, wars and natural disasters

The first example is a positive political event with harsh economic consequences for the former metropole: Algeria's 1962 independence from France, after which some 900,000 Algerians of European origin returned within a year. Hunt (1992) estimates that within four to five years, the average annual salaries of non-repatriates were lower by at most 1.3% due to the arrivals, and unemployment rose by at most 0.3 percentage points. Next is the 1980 Mariel boatlift, when mostly relatively unskilled Cuban immigrants increased Miami's labor force by 7%. Card (1990) finds no effect on the wages or unemployment rates of less-skilled workers. However, Borjas (2015) brings a new perspective, suggesting that the relative wage of the least educated Miamians fell by 10–30%.

Glitz (2012) studies the effect of the post–Berlin Wall return migration of ethnic Germans from Eastern Europe and the former Soviet Union on Germany's labor market, indicating a displacement effect of about three unemployed workers for every ten immigrants who found a job, but no effect on relative wages. Gould et al. (2009) analyze immigrant children in classrooms using the early-1990s mass migration from the former Soviet Union to Israel and find that the fraction of immigrants in 5th grade had a substantial adverse effect on native students' matriculation-exam pass rates, potentially through crowding out already strained school resources.

During the height of the Burundi Civil War (1993) and the Rwandan genocide (1994), a massive wave of refugees moved to neighboring Tanzania. Alix-Garcia and Saah (2009) find positive wealth effects of refugee camps on nearby rural households and negative wealth effects in urban areas. Baez (2011) documents adverse impacts on children's well-being, including reductions in years of schooling and literacy. Maystadt and Verwimp (2014) find on average a positive impact with substantial heterogeneity across the host population. Maystadt and

Duranton (2018), using a 1991–2010 household panel, find persistent positive impacts of refugees on local welfare.

Kreibaum (2016) analyzes the impact of long-term refugee presence and additional inflows in Uganda following the Second Congo War, finding benefits for nearby Ugandan populations in consumption and public-service provision, alongside negative perceptions of their own economic situation.

Following the Arab Spring in early 2011 and its violent consequences, new inflows moved into neighboring countries and Europe. Labanca (2020) finds that while migration in Italy did not affect native wages or overall employment, it had significant and offsetting short-term employment effects across industries—increasing unemployment in construction and educational services and decreasing it in wholesale trade, hotels, and restaurants—with both effects dissipating over time. The Syrian civil conflict further exacerbated the regional refugee situation. Carpio and Wagner (2015) conclude that low-educated individuals and women in Türkiye experienced net displacement from the labor market and declining earnings opportunities. Tumen (2016) finds small but statistically significant losses in informal employment among natives in Türkiye and increased demand for higher-quality neighborhoods as natives sought to shield themselves from refugee inflows into low-cost rentals. Fallah et al. (2019) analyze the Syrian influx into Jordan and—standing out from earlier studies—find that "Jordanians living in areas with a high concentration of refugees have had no worse labor market outcomes than Jordanians with less exposure to the refugee influx." Tumen (2021) provides evidence of Syrian refugees' marginally positive spillovers on Turkish adolescents' PISA test results. Mayer (2024) examines the 2015/2016 refugee crisis in Germany and documents a positive effect of the refugee share in schools on natives' likelihood of selecting higher academic tracks.

The death of Venezuelan president Hugo Chávez in 2013 marked ongoing political and economic turbulence. Since 2016, immigration of Venezuelans to Colombia has surged. Caruso et al. (2019) argue that a one percentage point increase in immigration from Venezuela reduced informal-sector wages by ten percentage points in urban areas. Peñaloza-Pacheco (2022) also shows declines in hourly wages in Colombia and negative effects on the employment rate of low-skilled workers. At the same time, Benítez-Rueda (2023) finds that a one percentage point increase in the migration share at the industry level increased labor productivity by 7.6%, driven by the replacement of less-educated natives with higher-skilled migrants. Shamsuddin et al. (2022) examine the Venezuelan influx into Roraima, Brazil, and find increases in formal-sector employment among Brazilians. Sant'Anna and Shrestha (2023) also study Brazil and find about 2% wage gains in Roraima.

Beyond conflict-driven displacement, it is also worth noting studies on spillovers from natural-disaster-induced displacement. McIntosh (2008) suggests that the arrival of 2005 Hurricane Katrina evacuees to the Houston metro area caused little harm to native labor-market outcomes. Figlio and Özek (2018) examine the influx of poor, non–English-speaking Haitian migrants into Florida public schools after the 2010 Haiti earthquake and find zero or modestly positive effects on locals' outcomes. Özek (2020) analyzes the large influx of migrant students into Florida public schools after 2017 Hurricane Maria and finds strains on instructional capacity and peer disruptions.

Overall, there are many more analyses of refugee or migrant spillovers on peers or labor markets: the US (Ottaviano and Peri 2007, 2011; Peri and Sparber 2011; Llull 2014), the UK (Dustmann et al. 2013; Costas-Fernández et al. 2023), Denmark (Foged and Peri 2015; Hassan et al. 2022), and others.

Ukraine's context

One of the priority destinations for Ukrainian refugees in 2022 was Poland, where almost 1.4 million Ukrainians held temporary protection at the peak[1]. Approximately a quarter were aged 18–34, the group most likely to enroll in higher education programs.

Understanding the distribution of Ukrainians who entered Polish higher education institutions, their effects on whole-class study results, their influence on graduates' early careers, and whether the influx of Ukrainian students affected Polish labor markets is of particular interest for both economists and policymakers. Economists can incorporate the results into models of migration and human capital development and their effects on the macroeconomic stability of Ukraine's neighbors, while policymakers can advocate greater support for Ukrainian students in host countries—emphasizing potential positive spillovers—and analyze the patterns and individual characteristics of Ukrainians abroad to address demographic decline and design the most effective domestic policy responses.

Existing research already finds no effect of Ukrainian refugees on host wages or employment in some contexts. For Poland, early-invasion inflows show no effect on labor-market outcomes of the Polish population and other migrants in the short term (Gromadzki, Lewandowski 2022). During the same period, Ukrainian refugees had no economically meaningful impact on employment or inactivity rates in the Czech Republic (Postepska, Voloshyna 2025). For Poland, Mykhailyshyna and Zuchowski (2025) find small positive effect on the average wage and unemployment for the overall Ukrainian refugee wave. However, as Cui (2024) notes in a comprehensive meta-analysis of education externalities compiling more than a thousand estimates from 32 empirical studies, "relying on

[1] Eurostat. Beneficiaries of temporary protection – Link

the results of a single empirical study, regardless of its significance or robustness, is often insufficient to establish convincing evidence."

Varying effects across countries, periods, and circumstances indicate that each new case should be analyzed individually, with conclusions not biased by past events. This is especially true given different datasets, methods of handling them, and the possibility of viewing the same situations from different angles, which can yield unexpected results. I will test whether this holds in the empirical study based on the data collected for this thesis.

Chapter 3

DATA

Sources

Information on foreign-student enrollment by university is taken from RAD-on[2] («Raporty, Analizy, Dane»), Poland's central platform aggregating reports, analytical outputs, and administrative data on higher education and science. The database covers approximately 450 Polish higher-education institutions and reports aggregate counts of native and foreign students by gender, age, and study characteristics, including study type and format, institutional profile and governance, and related descriptors.

University-level data on graduates' earnings are taken from ELA[3] («Ekonomiczne Losy Absolwentów», Economic Fate of Graduates), Poland's national graduate-tracking system. The intersection of RAD-on and ELA coverage constrains the university-level panel to 2019–2023.

Powiat-level average monthly wage data for the studied period are taken from Statistics Poland[4], the state's official provider of economic and demographic statistics. Because each university can be assigned to a specific powiat, these data provide an additional contextual measure—the local average wage level in the administrative unit where the institution operates—thereby enriching both the dataset and the empirical specifications.

[2] RAD-on. Foreign Students – Link

[3] ELA. Expert Zone – Link

[4] Statistics Poland. Data by Domains – Link

Limitation to master's students only

The analysis is restricted to master's degrees only. Potential peer effects from Ukrainian-born students who entered bachelor's programs in 2022 cannot be measured with the available data: the time between entry and graduation is around four years, while ELA graduate outcomes are available only through 2023 (Figure 2).

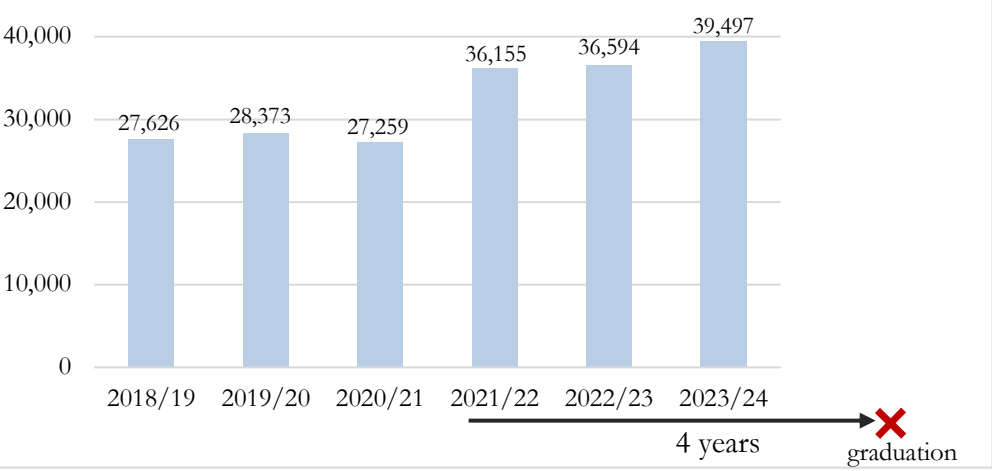


Figure 2. Number of Ukrainian-born 4-year bachelor's students in Polish universities in a given academic year

Source: RAD-on

Even for the relevant master's cohorts, wage coverage is not complete for Polish students who studied alongside Ukrainian-born peers over the full 2022–2024 period (Figure 3).

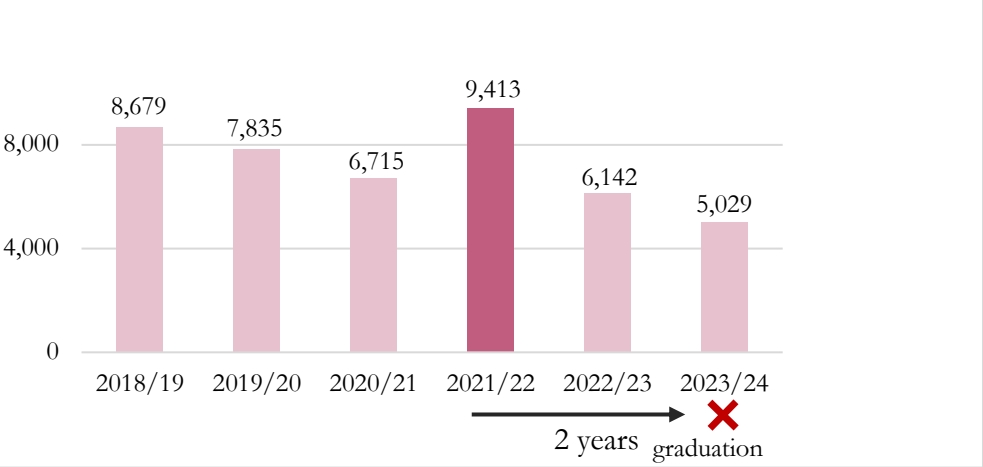


Figure 3. Number of Ukrainian-born 2-year master's students in Polish universities in a given academic year

Source: RAD-on

Still, because master's programs are approximately twice as short as bachelor's programs and students graduate much sooner, and because master's cohorts are often smaller and more tightly integrated (e.g., overlapping in courses across first- and second-year master's students, as at Kyiv School of Economics), it remains plausible that spillover's from the 2021/2 academic-year shock could be detected for master's students in the adjacent, one-year-older cohort, whereas a similar argument for bachelor's students would be even more difficult to sustain.

Descriptive analysis

The simplest way to illustrate why the 2021/22 academic year represented a major shock for Ukrainian master's students in Polish universities is to compare that year's dynamics with the trend over the period under consideration.

As shown in Figure 3, in the two academic years prior to the full-scale invasion, the number of Ukrainian-born students in Polish universities was declining—by

almost 10% in 2019/20 and by 14% in 2020/21. Comparing 2023/24 with 2020/21, the level remains about 25% lower, suggesting a broader downward trajectory that was interrupted only by the 2021/22 shock: an increase of nearly 2,700 students, or about 40%, relative to the pre-war academic year.

Notably, the increase was driven entirely by male students, while female enrollment continued the declining trend (Figure 4). In addition, a sizable share of the newly enrolled students from Ukraine were older than 30, representing more than a fourfold increase from pre-war levels (Figure 5).

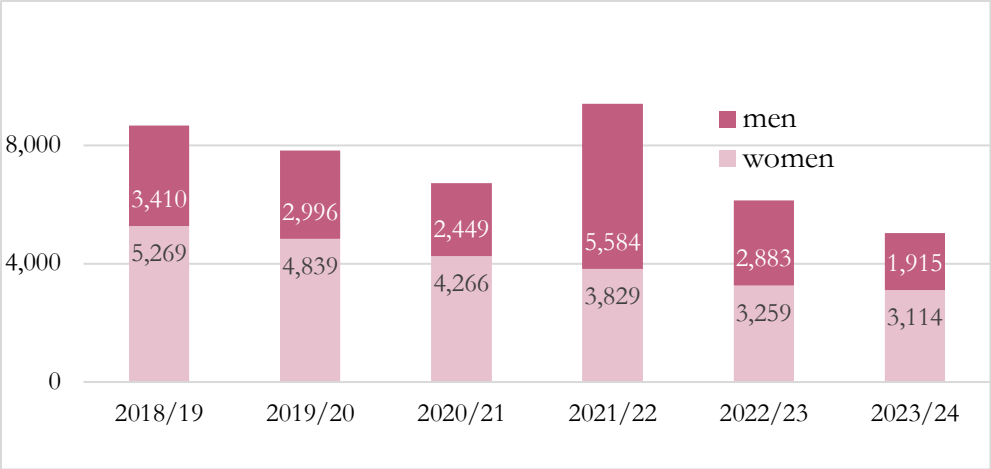


Figure 4. Number of Ukrainian-born 2-year master's students in Polish universities in a given academic year, gender decomposition

Source: RAD-on

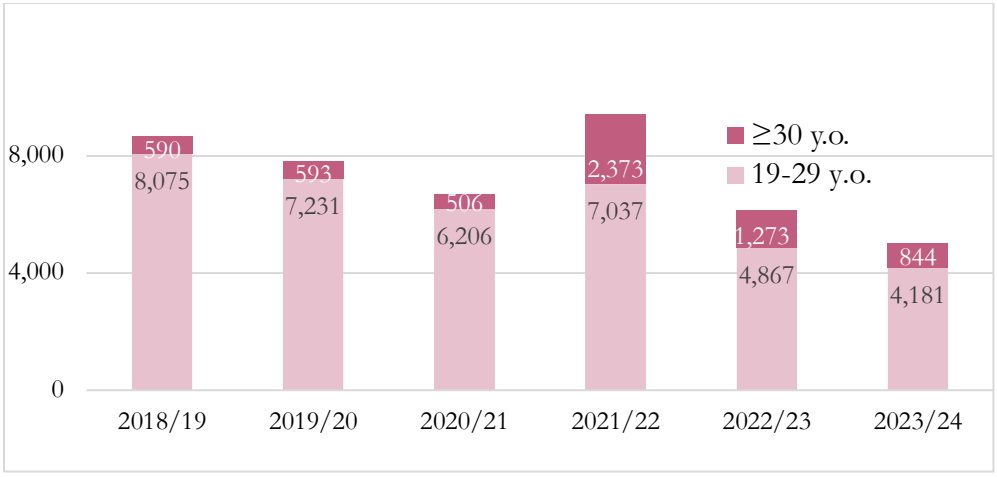


Figure 5. Number of Ukrainian-born 2-year master's students in Polish universities in a given academic year, age decomposition

Source: RAD-on

By study format, the expansion concentrated in standard full-time programs (Figure 6). About 63% of the increase occurred in academic-type institutions and 37% in practice-oriented institutions (Figure 7). Around 87% of the net increase—roughly 2,300 students—was absorbed by private universities, which may reflect limited access capacity and/or more demanding admission procedures in public universities (Figure 8).

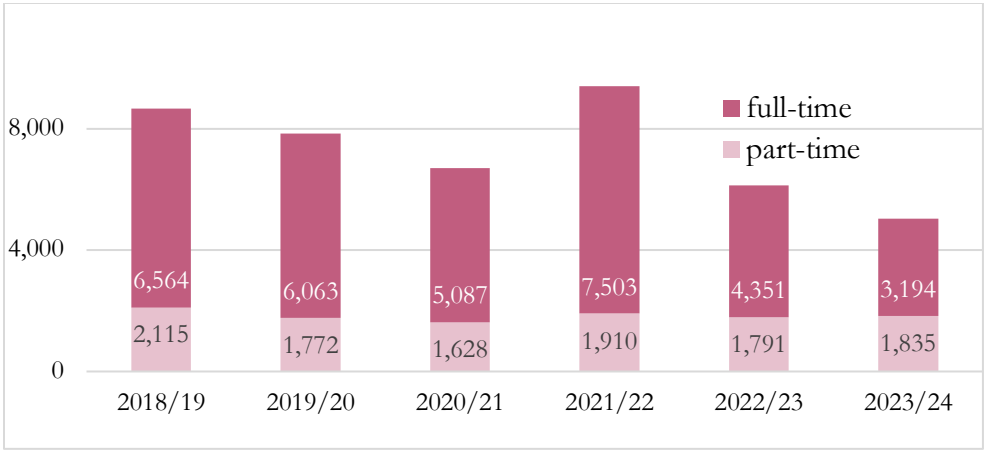


Figure 6. Number of Ukrainian-born 2-year master's students in Polish universities in a given academic year, study format decomposition

Source: RAD-on

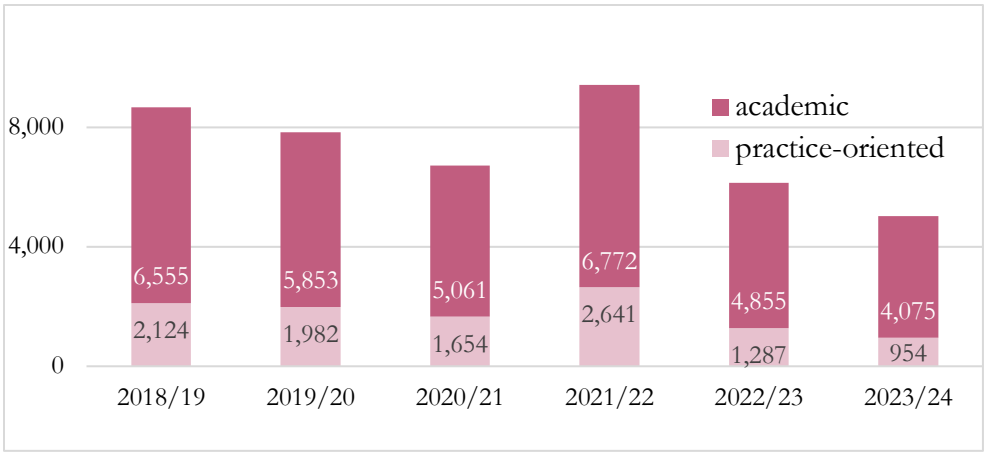


Figure 7. Number of Ukrainian-born 2-year master's students in Polish universities in a given academic year, study type decomposition

Source: RAD-on

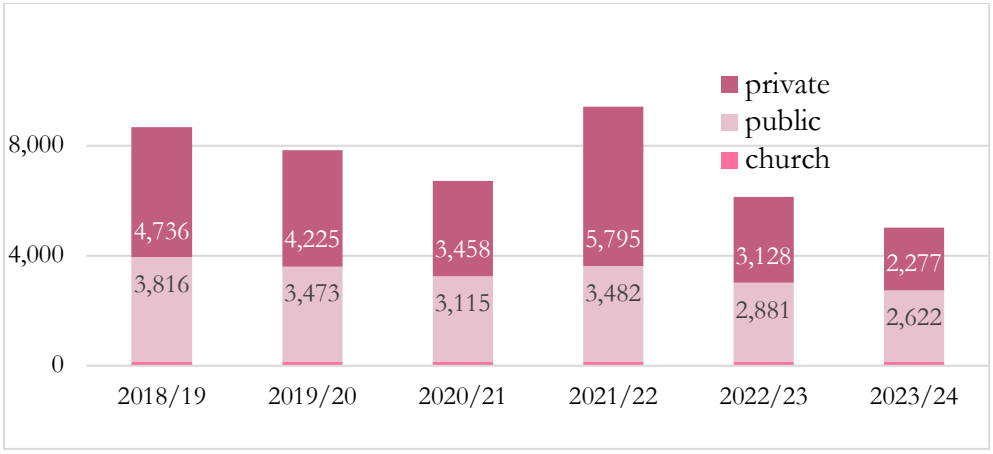


Figure 8. Number of Ukrainian-born 2-year master's students in Polish universities in a given academic year, governance decomposition

Source: RAD-on

The sharp increase in master's enrollment in the 2021/22 academic year followed by an almost symmetric decline suggests that a large share of the inflow cohort did not persist to completion. Many students likely withdrew or dropped out after one year of study.

Spatially, 78% of the 2021/22 increase relative to 2020/21—about 2,100 students—was concentrated in six cities with powiat status: Opole (627, +260%), Warszawa (564, +32%), Dąbrowa Górnicza (452, +334%), Słupsk (162, +208%), Łódź (160, +39%), and Rzeszów (134, +81%) (Figure 9).

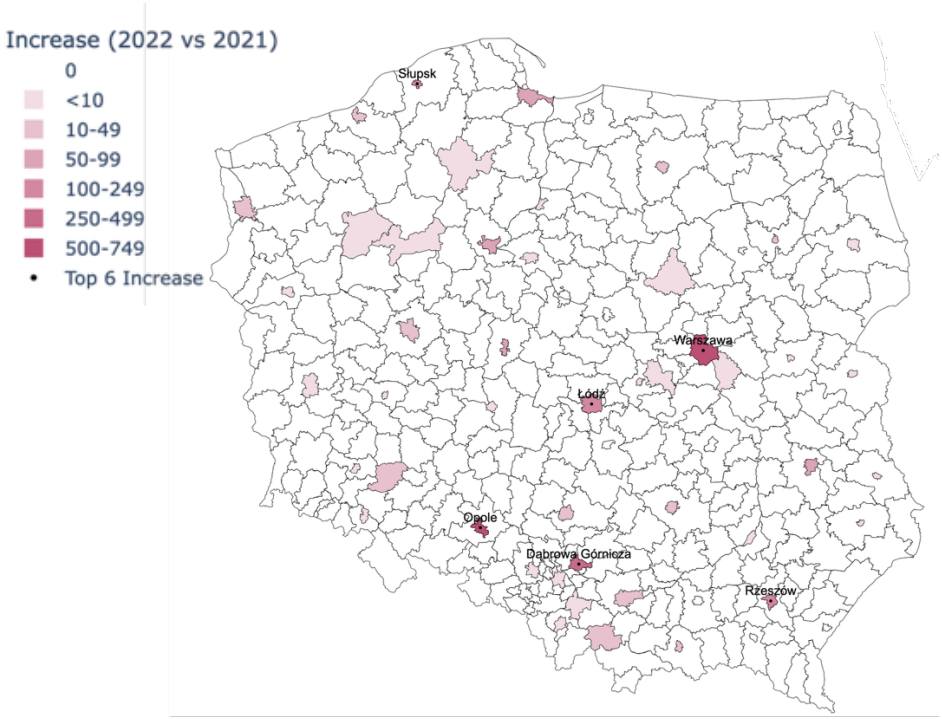


Figure 9. Poland map with powiats where number of Ukrainian-born master's students in 2021/22 academic year increased compared to previous academic year

Source: RAD-on

In five of previously mentioned six cities—all except Słupsk—the 2021 average monthly powiat wage exceeded the national average (Figure 10).

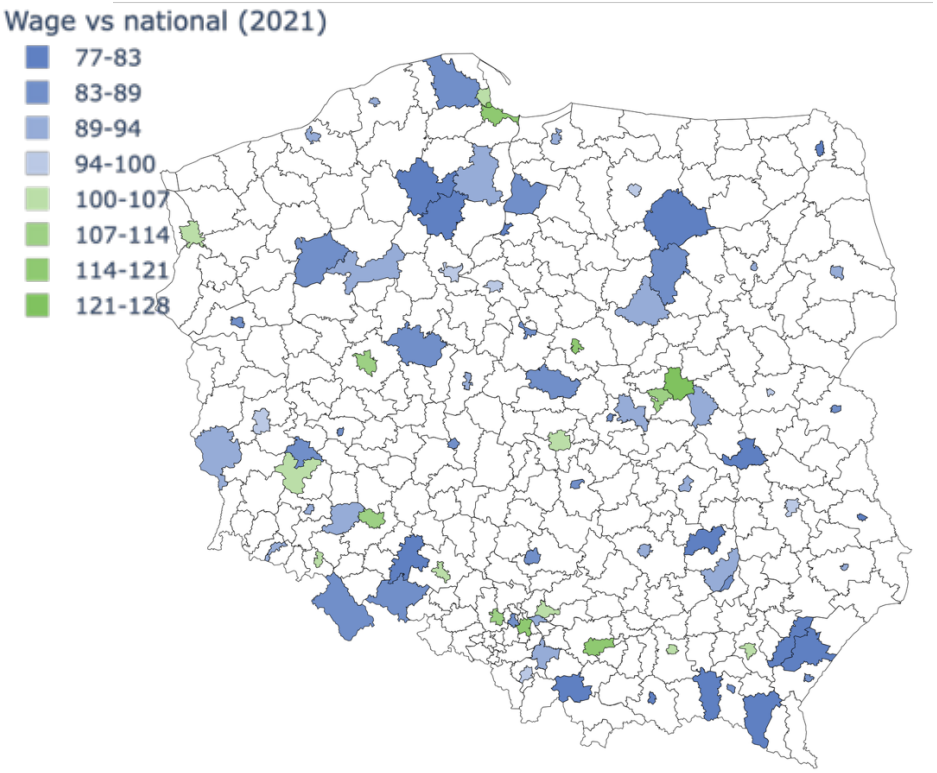


Figure 10. Monthly average wages compared to national average for powiats with Ukrainian-born master students in 2021

Sources: RAD-on, Statistics Poland

This may proxy local economic attractiveness for migrants and refugees. By program profile, the largest increase in 2021/22 academic year—around 1,300 students—was in business, economics, and management, while most of the remaining increase was recorded in multidisciplinary institutions.

Regarding wages, both the average monthly graduate wage and the powiat-level average wage follow a similar upward trajectory across all five analyzed years, while the first-year-after-graduation average wage remains consistently below the national average (Figure 11). At the same time, the situation differs across universities, with noticeable dispersion in graduate wage levels by institution (Figure 12).

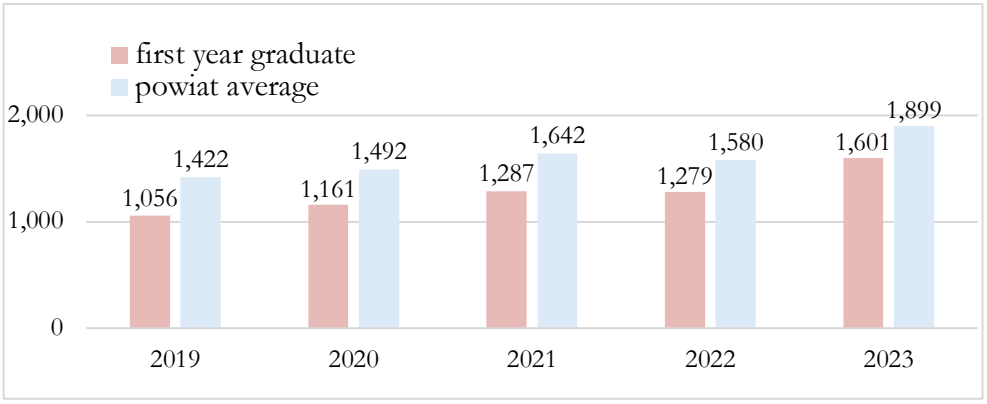


Figure 11. Average monthly graduate and powiat-level wages in USD

Sources: ELA, Statistics Poland

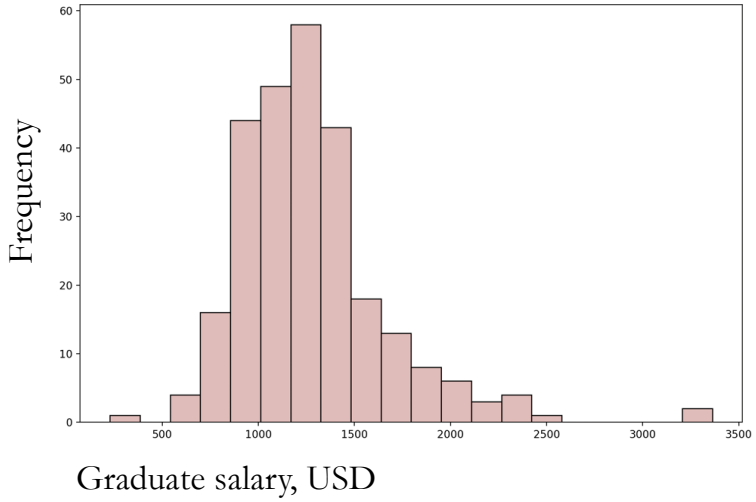


Figure 12. University-level average graduates salary distribution in 2022

Source: ELA

Figure 11 also shows that 2022 was the first year in some time when both first-year graduate wages and powiat-level average wages declined year-on-year in USD terms. However, the magnitude is quite small and does not imply a real decline in nominal wages.

Chapter 4

METHODOLOGY

Given the study's framework, data availability, and unit of analysis relative to the reviewed literature, previously tested methodologies cannot be applied directly. There are examples of work analyzing graduates' earnings across higher-education institutions (Stanley et al. 2021; Micha-Shannon Smith 2025), but these typically rely on richer and more disaggregated data within universities.

To my knowledge, no prior work uses university-level average graduate salaries as the dependent variable in regression analysis. There is also a clear limitation of this approach: university averages mask possible substantial heterogeneity in individual earnings. In that sense, the uniqueness of the dataset is not necessarily an advantage, but it reflects the best feasible data coverage I was able to assemble and represents an attempt to identify spillovers under these constraints.

Accordingly, the empirical strategy relies on three specifications: a two-way fixed effects (TWFE) model, a "shock-based" TWFE model, and a two-stage least squares (2SLS) instrumental-variable (IV) approach, all described below.

Two-way fixed effects

The first model is defined as follows:

$$\begin{aligned}\ln\left(GradSalary_{i,t}\right) &= \beta_1 \ln\left(1 + UA_{i,t}\right) + \beta_2 \ln\left(1 + UA_{i,t-1}\right) + \\ &+\beta_3 \ln\left(1 + OtherForeign_{i,t}\right) + \beta_4 \ln\left(PowiatWage_{i,t}\right) + \\ &+\alpha_i + \gamma_t + \varepsilon_{i,t}\end{aligned} \tag{1}$$

Where:

- i indexes universities; t indexes years;

- $GradSalary_{i,t}$ is our dependent variable, average graduate salary during one year after graduation in year t from university i;
- $UA_{i,t}$ is the number of Ukrainian-born students studying in university i in year t;
- $OtherForeign_{i,t}$ is the number of non-Ukrainian foreign students studying in university i in year t;
- $PowiatWage_{i,t}$ is the powiat average wage-level from the powiat of the university i in year t;
- α_i and γ_t are university and year fixed effects;
- $\varepsilon_{i,t}$ is the error term.

This is the simplest of the three specifications used in the study—essentially a log–log regression with two fixed effects capturing time-invariant differences across universities and common time shocks (inflation, economy-wide trends, and other external factors). The model tests whether the number of Ukrainian-born students in a given year is a statistically significant predictor of university-level average graduate salary. By including the lagged (previous-year) number of Ukrainian students, the specification also allows spillover effects to materialize with a delay. To enrich explanatory power, I additionally control for the average wage level in the powiat where each university is located. Table 1 summarizes the intuition behind the included variables and the expected sign of their relationship with the dependent variable—graduate salary.

Table 1. TWFE model explanatory variables and expected signs

Variable	Description	Expected effect
UA	Number of Ukrainian-born master students	Negative in both periods
OtherForeign	Number of foreign-born master students, not from Ukraine	Ambiguous
PowiatWage	Wage level in powiat where university is located	Positive

"Shock-based" two-way fixed effects

The second model is defined as follows:

$$\begin{aligned}\ln\left(GradSalary_{i,t}\right) &= \beta_{22}(Exposure_i \cdot \mathbb{1}\{t = 22\}) + \\ &+\beta_{23}(Exposure_i \cdot \mathbb{1}\{t = 23\}) + \\ &+\theta_1 \ln\left(1 + OtherForeign_{i,t}\right) + \\ &+\theta_2 \ln\left(PowiatWage_{i,t}\right) + \alpha_i + \gamma_t + \varepsilon_{i,t}\end{aligned} \tag{2}$$

$$Exposure_i = ln\left(1 + UA_{i,2022}\right) - \frac{1}{3}\sum_{s=2019}^{2021} ln\left(1 + UA_{i,s}\right) \tag{3}$$

Where:

- $Exposure_i$ is a university-specific shock measure capturing how much the number of Ukrainian students at university i increased in 2022

(2021/22 academic year) relative to that university's own average level over the three pre-2022 years;

- all other variables are defined as in the baseline TWFE specification.

The main difference from the baseline TWFE model is the introduction of an "exposure" measure: for each university, the increase in Ukrainian-born students in 2022 relative to that university's own average over the previous three years. This matters because some universities historically enrolled many Ukrainians, so a high 2022 level may largely reflect a pre-existing pattern rather than a new inflow. Conversely, other universities may have low Ukrainian enrollment in absolute terms but still experience a large shock relative to their own baseline—precisely what the exposure variable captures. By interacting this exposure with 0–1 dummies for 2022 and 2023, I treat the increase as a shock, which motivates the model's name. The expected sign of the exposure effect mirrors the expected sign of the Ukrainian-student variable in the basic TWFE specification, i.e., negative.

2SLS (IV)

The third model is defined as follows:

First stage

$$\ln(1 + UA_{i,t}) = \pi Z_i + \delta_1 \ln(1 + OtherForeign_{i,t}) + \delta_2 \ln(PowiatWage_{i,t}) + \nu_{i,t} \quad (4)$$

With distance as an instrument

$$Z_i = -DistKM_i \tag{5}$$

Second stage

$$\begin{aligned} &\ln\left(GradSalary_{i,t}\right) = \beta \ln\left(1 + UA_{i,t}\right) + \\ &+\theta_1 \ln\left(1 + OtherForeign_{i,t}\right) + \\ &+ \theta_2 \ln\left(PowiatWage_{i,t}\right) + \varepsilon_{i,t} \end{aligned} \tag{6}$$

Where:

- $DistKM_i$ is the straight-line distance (km) from the nearest Poland-Ukraine border crossing to the centroid of the powiat in which university i is located;
- all other variables are defined as in the previous specifications.

This is the model where I instrument the number of Ukrainian-born students, trying to take a more complex approach and go one step further than in the previous two specifications. The basic TWFE model and the "shock-based" TWFE model are useful because they show whether universities that enrolled more Ukrainian students, or experienced a larger 2022 jump in such enrollment, also had different graduate salary outcomes. However, both models still rely on the actual observed number of Ukrainian-born students. This creates an important limitation: the observed inflow may reflect not only peer exposure itself, but also students' emergency location choices after 2022. In other words, universities may have

received more Ukrainian students simply because they were easier to reach in wartime conditions, not because of any university characteristic connected to later labor market outcomes. For that reason, I add a 2SLS specification as an additional robustness check that tries to isolate only the part of enrollment variation driven by geography.

Potentially, other instruments could have been used—for example, whether programs are taught in English or only in Polish—but I was not able to collect such data, and I believe it would be too complex to do manually for each university. Even within the same university, different programs may have different teaching languages, which makes a clean university-level aggregation practically impossible. I therefore use distance to the nearest Poland–Ukraine border crossing as an instrument. The intuition is simple: after 2022, many Ukrainian students likely preferred not to move too far from home, so universities located closer to the border may have been more attractive because they were easier and cheaper to reach and allowed more frequent contact with Ukraine.

This intuition is also broadly consistent with the descriptive evidence. As shown in Figure 13, five out of the six powiats with the largest increase in the number of Ukrainian-born master's students are located within roughly 300 km of the nearest border crossing.

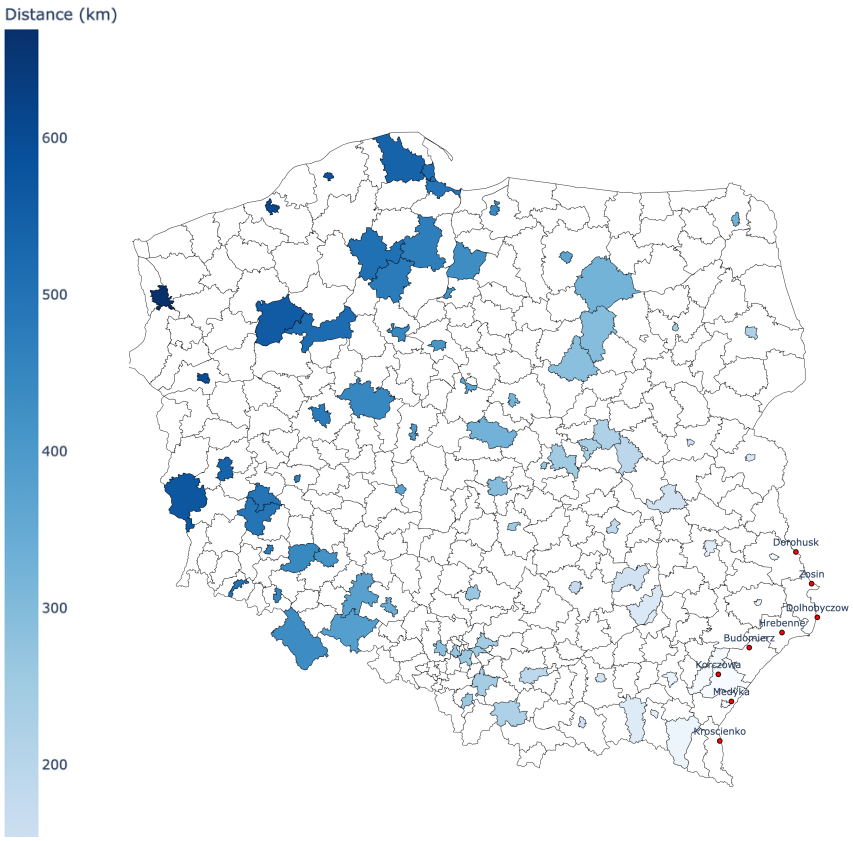


Figure 13. A straight-lines shortest distance between Poland-Ukraine border crossings and the powiats of universities where Ukrainians study for a master's degree

At the same time, by definition, an instrument should affect the dependent variable only through the endogenous regressor. In this case, the assumption is that distance to the border can affect graduate salaries only indirectly, through its impact on the inflow of Ukrainian-born students as the peer exposure studied here, and not through a direct connection with wages themselves. This assumption is based on economic logic, although, as with any IV strategy, it should still be treated with caution.

Chapter 5

ESTIMATION RESULTS

In this chapter, I present the estimation results. All three specifications suggest a small positive association between the 2021/22 academic-year inflow of Ukrainian-born students into Polish universities and graduates' salaries, alongside a negative one-year lagged effect. However, none of the estimated effects is statistically significant (Tables 2–5).

Table 2. TWFE model results

Variable	Estimate	Standard error
log(Ukrainians)	0.015	0.022
log(Ukrainians), lagged	-0.027	0.018
log(other foreign)	0.026**	0.012
log(powiat wage)	1.027**	0.436

Note: **p<0.05

Table 3. "Shock-based" TWFE model results

Variable	Estimate	Standard error
Exposure x 2022	0.014	0.022
Exposure x 2023	-0.009	0.022
log(other foreign)	0.024***	0.009
log(powiat wage)	0.564*	0.295

Note: *p<0.1, ***p<0.01

The baseline TWFE model indicates that a 10% increase in Ukrainian-born students is associated with about 0.15% higher graduate salaries in the same year

and about 0.27% lower salaries in the following year, with both coefficients statistically indistinguishable from zero. The model also shows that higher numbers of non-Ukrainian foreign students and higher local (powiat-level) wages are positively correlated with higher graduate salaries, and these relationships are statistically significant.

The "shock-based" TWFE specification suggests that universities with higher exposure to the 2021/22 inflow recorded about 1.4% higher salaries in 2022 and about 1.0% lower salaries in 2023, with both effects not statistically different from zero. The same positive and statistically significant correlations with non-Ukrainian foreign students and local wages remain.

Table 4. 2SLS (IV) model results for year 2022

Variable	Estimate	Standard error
log(Ukrainians)	0.086	0.089
log(other foreign)	-0.046	0.055
log(powiat wage)	0.071	0.138

Table 5. 2SLS (IV) model results for year 2023

Variable	Estimate	Standard error
log(Ukrainians)	0.073	0.130
log(other foreign)	-0.049	0.072
log(powiat wage)	-0.124	0.136

As shown in tables 4-5, the 2SLS (IV) model also produces statistically insignificant result: a 10% increase in Ukrainian-born students is associated with about 0.87% higher salaries in 2022 and about 0.89% higher salaries in 2023. I additionally re-estimated inference using weak-IV-robust procedures for weak-IV F-stat values of

6.93 and 3.32 for years 2022 and 2023, accordingly—the Anderson–Rubin test and the tF procedure (Lee et al. 2022)—and did not reject a zero effect.

Chapter 6

CONCLUSIONS

The research results suggest that none of the initial hypotheses is confirmed: Ukrainian-born master's students did not generate statistically detectable positive or negative spillovers on Polish graduates' first-year salaries. Across all three specifications, the estimated effect of the 2021/22 academic-year inflow is statistically indistinguishable from zero.

Given the overall size of the Polish student population, the number of Ukrainian-born master's students may be too small to generate a measurable effect at the level of university-average wages, and Poland's higher-education system may have absorbed the inflow without noticeable consequences for graduate outcomes.

A statistically insignificant result implies there is no evidence of a negative spillover effect of Ukrainian-born master's students on graduates' salaries, which is an important and informative finding in itself. Moreover, the descriptive analysis reveals several notable patterns of the 2021/22 inflow: it is concentrated among male students, often above 30 years old; most of the net increase is absorbed by private universities; and a sizable share of the cohort appears to withdraw or drop out rather than complete a master's degree. This suggests that, in the early phase of Russia's full-scale invasion of Ukraine and prior to it in the 2021/22 academic year, postgraduate enrollment abroad may have served for some refugees as a pathway toward integration rather than as a purely education-driver decision.

Overall, a null result remains a result and contributes to narrowing uncertainty around the economic implications of this specific student's inflow episode.

WORKS CITED

Alix-Garcia, Jennifer, and David Saah. 2008. "The Effect of Refugee Inflows on Host Communities: Evidence from Tanzania." Available at SSRN: https://ssrn.com/abstract=836147

Anelli, Massimo, Kevin Shih, and Kevin Williams. 2020. "Foreign Students in College and the Supply of STEM Graduates." *https://kevinyshih.weebly.com/uploads/5/5/8/7/5587146/foreign_classmates_and_stem_careers.pdf*

Baez, Javier. 2011. "Civil wars beyond their borders: The human capital and health consequences of hosting refugees." *Journal of Development Economics*, 96(2), 391-408. https://doi.org/10.1016/j.jdeveco.2010.08.011

Benitez-Rueda, Miguel. 2023. "The Productivity Effects of Forced Migration: Evidence from Venezuelan Migrants in Colombia." *Inter-American Development Bank*. http://dx.doi.org/10.18235/0005336

Borjas, George. 2017. "The wage impact of the Marielitos: A reappraisal." *ILR Review*, 70(5), 1077-1110. https://doi.org/10.1177/0019793917692945

Branden, Maria, Gunn Elisabeth Birkelund, and Ryszard Szulkin. 2019. "Ethnic Composition of Schools and Students' Educational Outcomes: Evidence from Sweden." *International Migration Review*, 53(2), 486-517. https://doi.org/10.1177/0197918318769314

Card, David. 1990. "The impact of the Mariel boatlift on the Miami labor market." *Industrial and Labor Relations Review*, 43(2), 245-257. http://arks.princeton.edu/ark:/88435/dsp016h440s46f

Caruso, German, Christian Gomez Canon, and Valerie Mueller. 2019. "Spillover effects of the Venezuelan crisis: Migration impacts in Colombia." *Oxford Economic Papers*, 73(2), 771-795. https://doi.org/10.1093/oep/gpz072

Costas-Fernandez, Julian, Greta Morando, and Angus Holford. 2023. "The effect of foreign students in higher education on native students' outcomes." *European Economic Review*, 160. https://doi.org/10.1016/j.euroecorev.2023.104595

Cui, Ying. 2024. "Education Spillover Effects." *Queen Mary University of London Theses*. https://qmro.qmul.ac.uk/xmlui/handle/123456789/97029

Del Carpio, Ximena, and Mathis Wagner. 2015. "The Impact of Syrian Refugees on the Turkish Labor Market." *Policy Research Working Paper Series*, 7402. https://documents1.worldbank.org/curated/en/505471468194980180/pdf/WPS7402.pdf

Dustmann, Christian, Tommaso Frattini, and Ian P. Preston. 2013. "The effect of Immigration along the Distribution of Wages." *The Review of Economic Studies*, 80(1), 145-173. https://doi.org/10.1093/restud/rds019

Fallah, Belal, Cariline Krafft, and Jackline Wahba. 2019. "The Impact of Refugees on Employment and Wages in Jordan." *Journal of Development Economics*, 139, 203-216. https://doi.org/10.1016/j.jdeveco.2019.03.009

Feld, Jan, and Ulf Zolitz. 2017. "Understanding Peer Effects: On the Nature, Estimation, and Channels of Peer Effects." *Journal of Labor Economics*, 35(2), 387-428. https://www.jstor.org/stable/26553260

Figlio, David, and Umut Özek. 2019. "Unwelcome Guests? The Effects of Refugees on the Educational Outcomes of Incumbent Students." *Journal of Labor Economics*, 37(4), 1061-1096. https://doi.org/10.1086/703116

Foged, Mette, and Giovanni Peri. 2016. "Immigrants' Effect on Native Workers: New Analysis on Longitudinal Data." *American Economic Journal: Applied Economics*, 8(2), 1-34. https://www.aeaweb.org/articles?id=10.1257/app.20150114

Glitz, Albrecht. 2012. "The Labor Market Impact of Immigration: A Quasi-Experiment Exploiting Immigrant Location Rules in Germany." *Journal of Labor Economics*, 30(1), 175-213. https://doi.org/10.1086/662143

Gould, Eric D., Victor Lavy, and M. Daniele Paserman. 2009. "Does immigration affect the long-term educational outcomes of natives? Quasi-experimental evidence" *The Economic Journal*, 119(540), 1243-1269. https://www.jstor.org/stable/40271390

Griffith, Amanda L., and Kevin N. Rask. 2014. "Peer effects in higher education: A look at heterogeneous impacts." *Economics of Education Review*, 39, 65-77. https://doi.org/10.1016/j.econedurev.2014.01.003

Gromadzki, Jan, and Piotr Lewandowski. 2022. "Refugees from Ukraine on the Polish labour market." https://ibs.org.pl/wp-content/uploads/2023/02/2023_US.Tip_Refugees-from-Ukraine-on-the-Polish-labour-market_EN_Gromadzki_Lewandowski.pdf

Hassan, Said, Camilla Hvidtfeldt, Lars Hojsgaard Andersen, and Rebecca Overgaard Udsen. 2022. "Do refugee children impair the academic performance of native children in the school? Informative null results from Danish Register Data." *European Sociological Review*, 39(3), 352-365. https://doi.org/10.1093/esr/jcac059

Hunt, Jennifer. 1992. "The impact of the 1962 Repatriates from Algeria on the French labor market." *ILR Review*, 45(3), 556-572. https://doi.org/10.2307/2524278

Kreibaum, Merle. 2016. "Their Suffering, Our Burden? How Congolese Refugees Affect The Ugandan Population." *World Development*, 78, 262-287. https://doi.org/10.1016/j.worlddev.2015.10.019

Labanca, Claudio. 2020. "The effects of a temporary migration shock: Evidence from the Arab Spring migration through Italy." *Labour Economics*, 67. https://doi.org/10.1016/j.labeco.2020.101903

Llull, Joan. 2014. "The Effect of Immigration on Wages: Exploiting Exogenous Variation at the National Level." *Journal of Human Resources*, 53(3), 608-662. https://doi.org/10.3368/jhr.53.3.0315-7032R2

Lee, David S., Justin McCrary, Marcelo J. Moreira, and Jack Porter. 2022. "Valid t-Ratio Inference for IV." *American Economic Review*, 112(10), 3260-3290. https://www.aeaweb.org/articles?id=10.1257/aer.20211063

Mayer, Lea. 2024. "Foreign Classmates and Secondary Education Track Choice – Evidence from Germany during the «Refugee Crisis»." Available at SSRN: https://ssrn.com/abstract=4853807

Maystadt, Jean-Francois, and Gilles Duranton. 2019. "The Development Push of Refugees: Evidence from Tanzania." *Journal of Economic Geography*, 19(2), 299-334. https://doi.org/10.1093/jeg/lby020

Maystadt, Jean-Francois, and Philip Verwimp. 2014. "Winners and Losers among a Refugee-Hosting Population." *Economic Development and Cultural Change*, 62(4), 769-809. https://doi.org/10.1086/676458

McIntosh, Molly Fifer. 2008. "Measuring the Labor Market Impacts of Hurricane Katrina Migration: Evidence from Houston, Texas." *American Economic Review*, 98(2), 54-57. https://www.aeaweb.org/articles?id=10.1257/aer.98.2.54

Mykhailyshyna, Dariia, and David Zuchowski. 2025. "Migration shocks and voting: Evidence from Ukrainian migration to Poland." Available at SSRN: https://ssrn.com/abstract=5223038

Ottaviano, Gianmarco I.P., and Giovanni Peri. 2007. "The Effects of immigration on U.S. Wages and Rents: A General Equilibrium Approach." *Migration Impact Assessment*, 3, 107-146. https://doi.org/10.4337/9780857934581.00010

Ottaviano, Gianmarco I.P., and Giovanni Peri. 2011. "Rethinking the effect of immigration on wages." *European Economic Association*, 10(1), 152-197. https://ideas.repec.org/a/bla/jeurec/v10y2012i1p152-197.html

Özek, Umut. 2020. "Examining the Educational Spillover Effects of Severe Natural Disasters: The Case of Hurricane Maria." *EdWorkingPaper*: 20-217.

Retrieved from Annenberg Institute at Brown University: https://www.edworkingpapers.com/ai20-217

Penaloza-Pacheco, Leonarda. 2022. "Living with the neighbors: the effect of Venezuelan forced migration on the labor market in Colombia." *Journal for Labour Market Research*, 56(1), 1-32 https://doi.org/10.1186/s12651-022-00318-3

Peri, Giovanni, and Chad Sparber. 2011. "Highly Educated Immigrants and Native Occupational Choice." *Industrial Relations*, 50(3), 385-411. https://doi.org/10.1111/j.1468-232X.2011.00643.x

Postepska, Agnieszka, and Anastasiia Voloshyna. 2025. "The effect of Ukrainian refugees on the local labour markets: the case of Czechia." *Journal of Population Economics*, 38(30) https://link.springer.com/article/10.1007/s00148-025-01080-9

Sacerdote, Bruce. 2001. "Peer effects with random assignment: Results for Dartmouth roommates." *The Quarterly Journal of Economics*, 116(2), 681-704. https://www.jstor.org/stable/2696476

Sant'Anna, Hugo, and Samyam Shrestha. 2023. "Labor Market Effects of the Venezuelan refugee Crisis in Brazil." Available at SSRN: https://ssrn.com/abstract=4349083

Schneeweis, Nicole. 2015. "Immigrant concentration in schools: Consequences for native and migrant students." *Labour Economics*, 35, 63-76. https://econpapers.repec.org/article/eeelabeco/v_3a35_3ay_3a2015_3ai_3ac_3ap_3a63-76.htm

Shamsuddin, Mrittika, Pablo Ariel Acosta, and Rovane Battaglin Schwengber. 2022. "The Labor Market Impacts of Venezuelan Refugees and Migrants in Brazil." *IZA Discussion Papers*, 15384. https://docs.iza.org/dp15384.pdf

Sidgwick, Henry. 1883. "The Principles of Political Economy." https://www.researchgate.net/publication/364782789_The_Principles_of_Political_Economy

Smith, Micha-Shannon. 2025. "How graduate salaries vary by degree subject." *Prospects Luminate*. URL: https://luminate.prospects.ac.uk/how-graduate-salaries-vary-by-degree-subject

Stanley, Brian, Victor Pigott, and Valerie Harvey. 2021. "An analysis of Graduate Earnings across Higher Education Institutions." *Higher Education Authority*. https://hea.ie/assets/uploads/2021/09/Higher-Education-Institutions-Earnings-Report-September-2021.pdf

Tonello, Marco. 2015. "Peer effects of non-native students on natives' educational outcomes: mechanisms and evidence." https://link.springer.com/article/10.1007/s00181-015-0995-y

Tumen, Semih. 2016. "The Economic Impact of Syrian Refugees on Host Countries: Quasi-Experimental Evidence from Turkey." *American Economic Review*, 106(5), 456-460. https://www.aeaweb.org/articles?id=10.1257/aer.p20161065

Tumen, Semih. 2021. "The Effect of Refugees on Native Adolescents' Test Scores: Quasi-Experimental Evidence from PISA" *IZA Institute of Labor Economics.* https://docs.iza.org/dp14039.pdf

Winston, Gordon C., and David J. Zimmerman. 2004. "Peer Effects in Higher Education." *National Bureau of Economic Research.* http://www.nber.org/chapters/c10105

Zimmerman, David J. 1999. "Peer effects in academic outcomes: Evidence from a natural experiment." *The Review of Economics and Statistics*, 85(1), 9-23. https://ideas.repec.org/a/tpr/restat/v85y2003i1p9-23.html