Mapping the Ukrainian Refugee Crisis Using Internet Measurements

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Applied Networking Research Workshop (ANRW)
2023

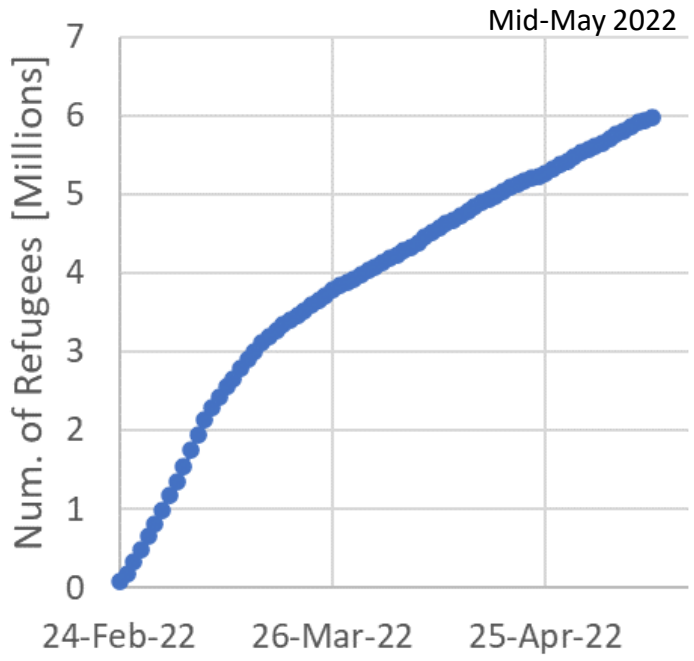
The Ukrainian Refugee Crisis, 2022-2023

https://www.politico.eu/article/ukraine-refugees-european-union-war-russia-temporary-protection-debate/

Ukrainian Refugees

[UNHCR]: daily statistics about Ukrainian refugees crossing the border to neighboring countries.

[UNHCR] – The UN Refugee Agency



> 9 million crossed the border [July, UNHCR]
> 25% of the population internally displaced

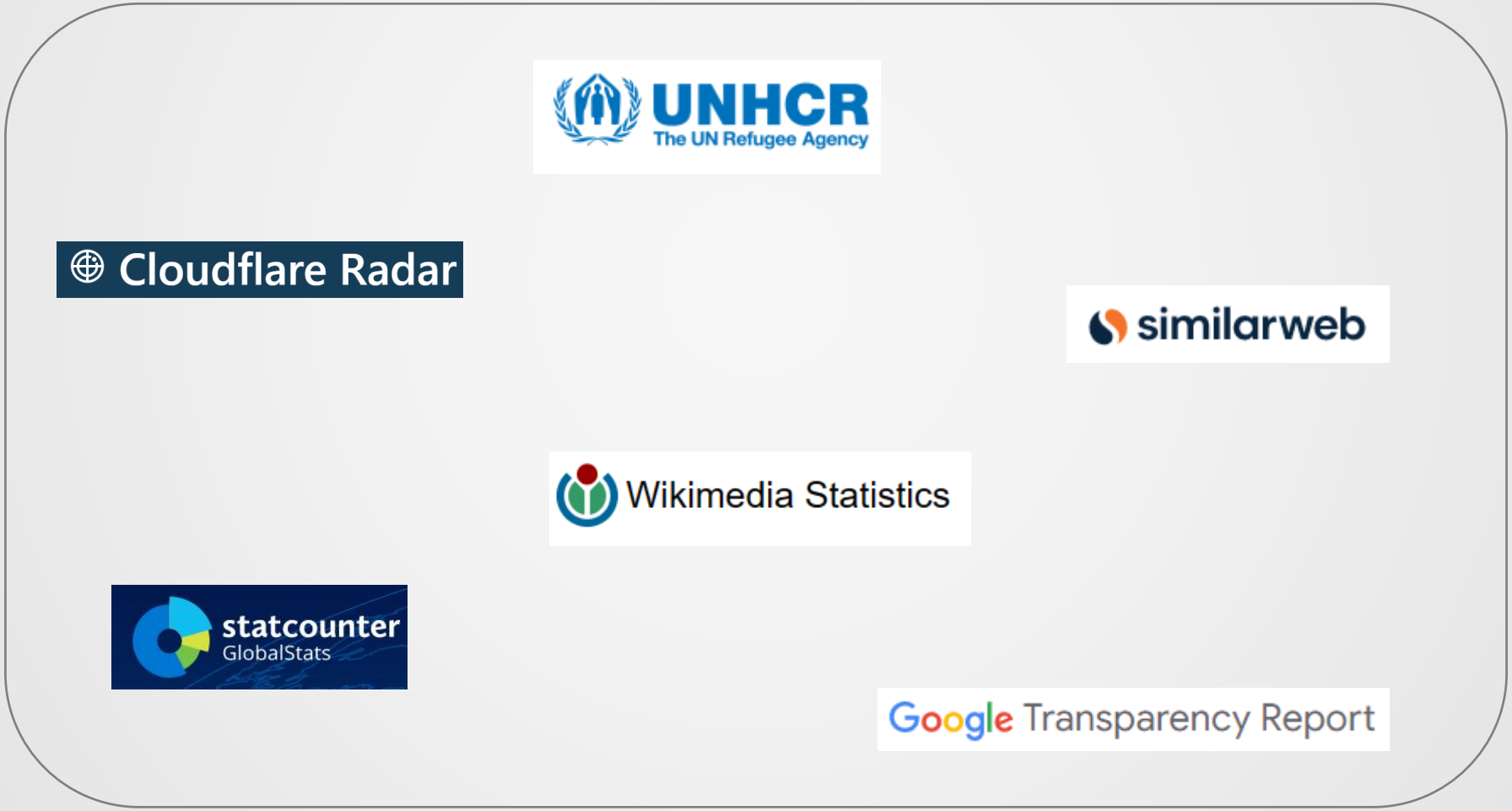
Mapping The Refugee Crisis

While there is accurate data about refugees that cross the border, there is no accurate data about where refugees end up staying. Traveling with the EU is not monitored.

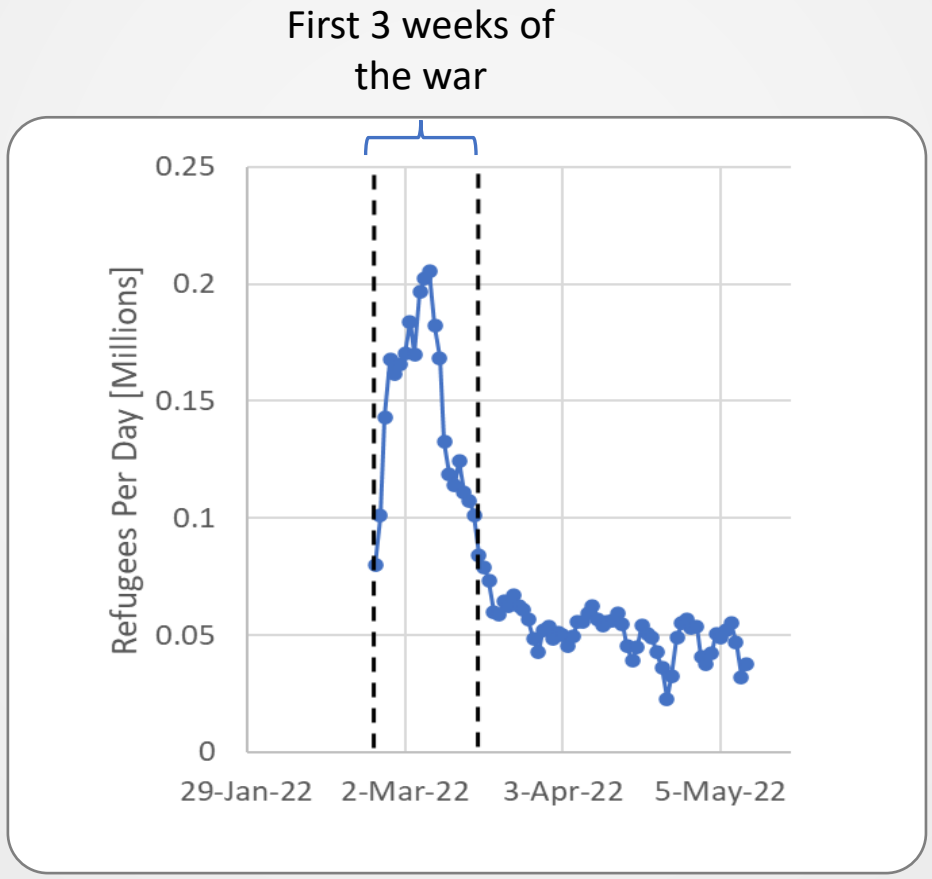
A first step towards helping and supporting refugees is knowing where they are.

Data Sources

This research is based on publicly available data from various sources:

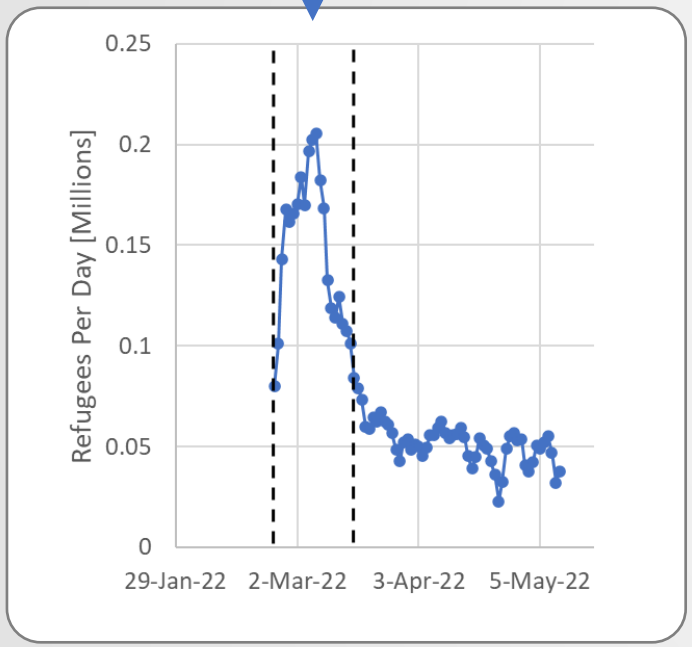


The Refugee Rate [UNHCR]

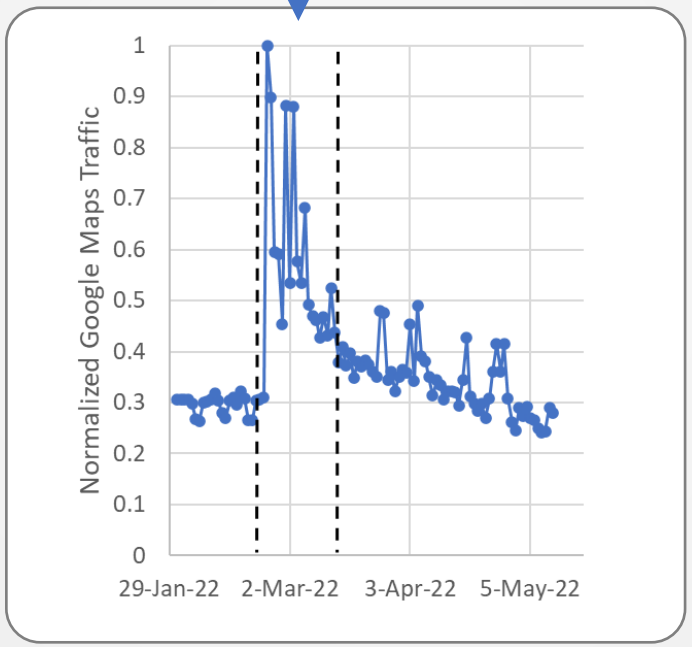


Correlating the Refugee Rate to Internet Measurements

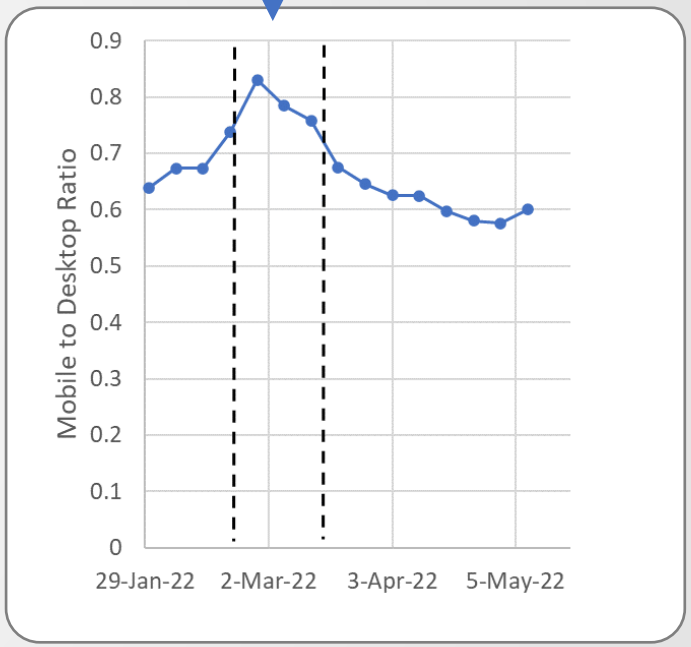
Refugee rate is highly correlated to navigation apps and to mobile device usage



Refugee Rate



Google Maps Traffic Rate

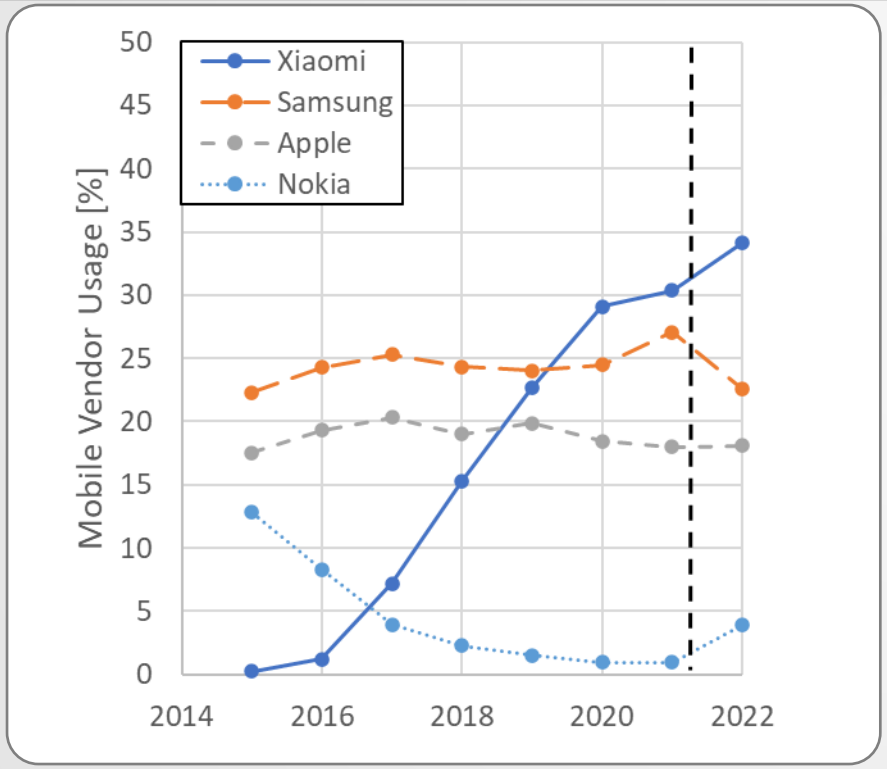


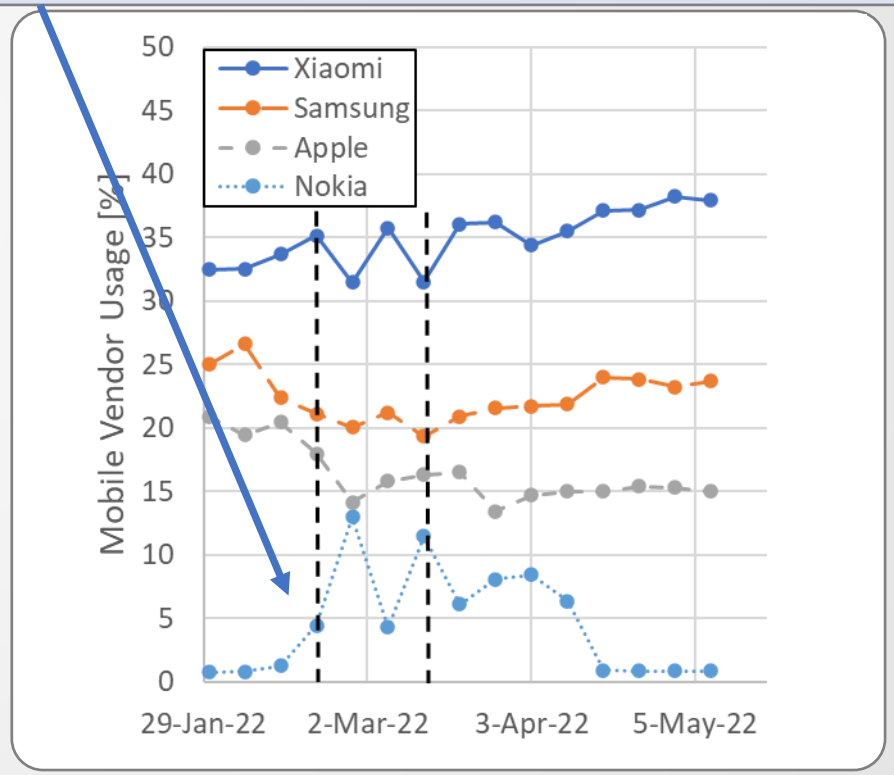
Traffic rate:
Mobile-to-desktop ratio

https://www.breakinglatest.news/news/summit-in-the-prefecture-on-ukrainian-refugees-the-mayor-of-conegliano-we-also-use-former-barracks/

Mobile Device Vendor Usage in Ukraine

Nokia devices were less than 1% before the war, and 13% of the devices two weeks into the war. Old devices were revived due to the refugee crisis and internal displacement.



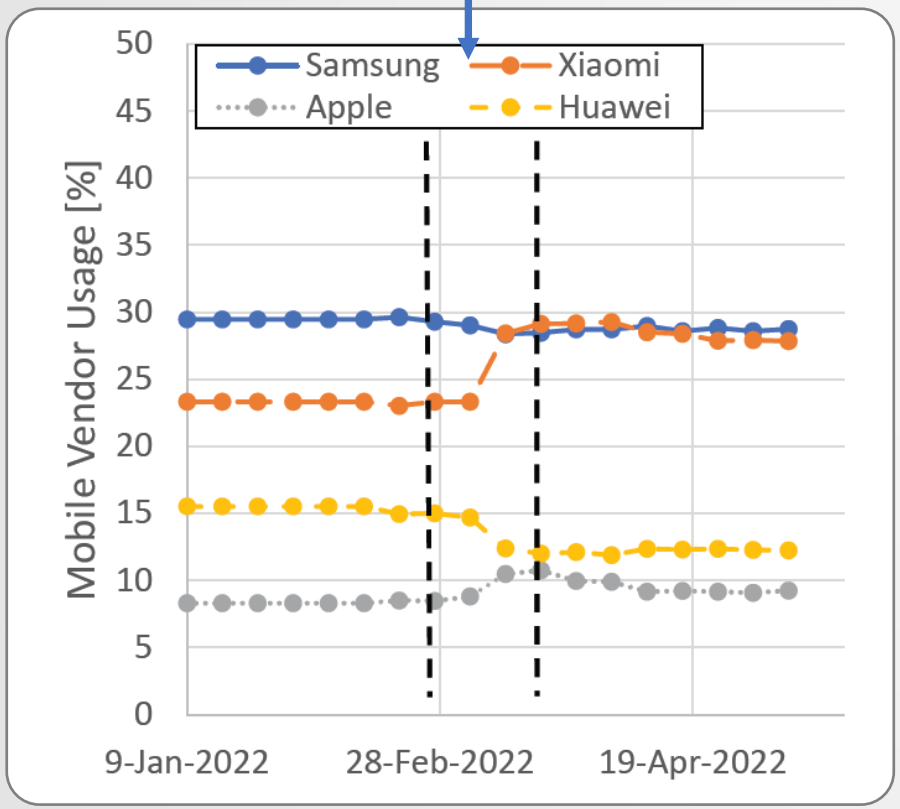


Data source: [Statcounter]

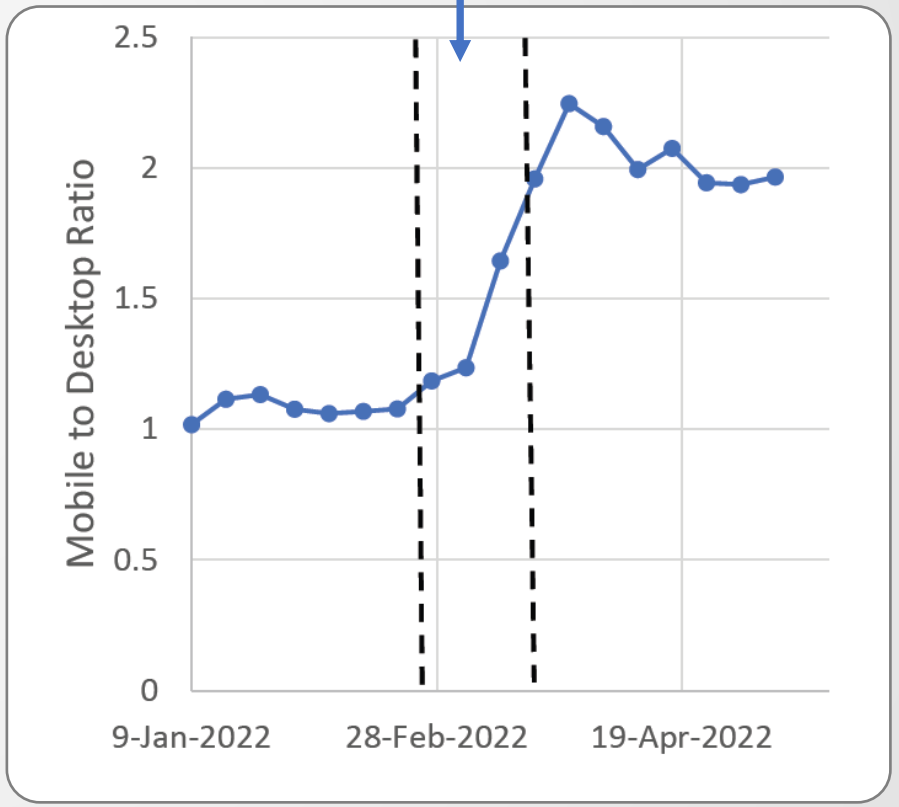
Poland: Mobile Device Usage

Xiaomi: a steep increase in **Poland**

Xiaomi is the top vendor in Ukraine (prev. slide)



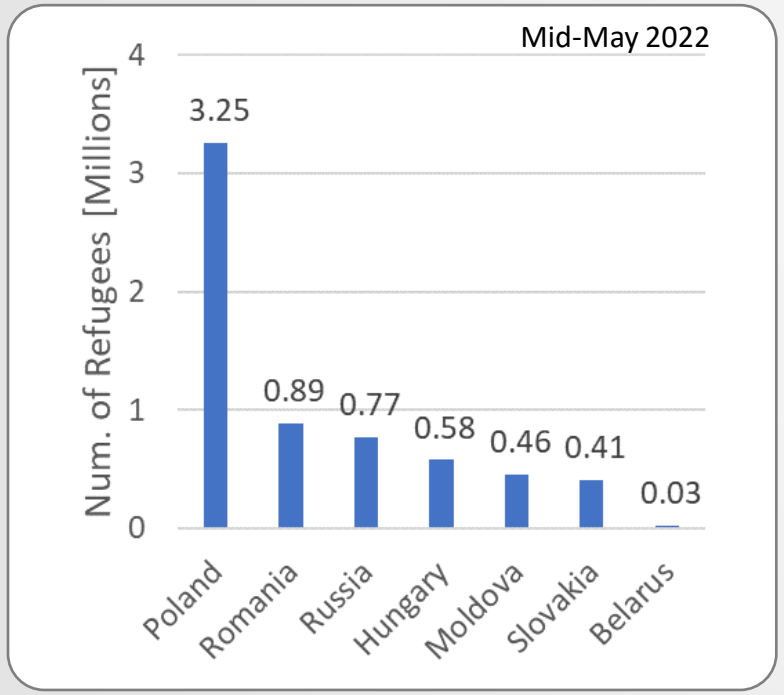
A steep increase in mobile device usage in **Poland**



Data source: [Statcounter]

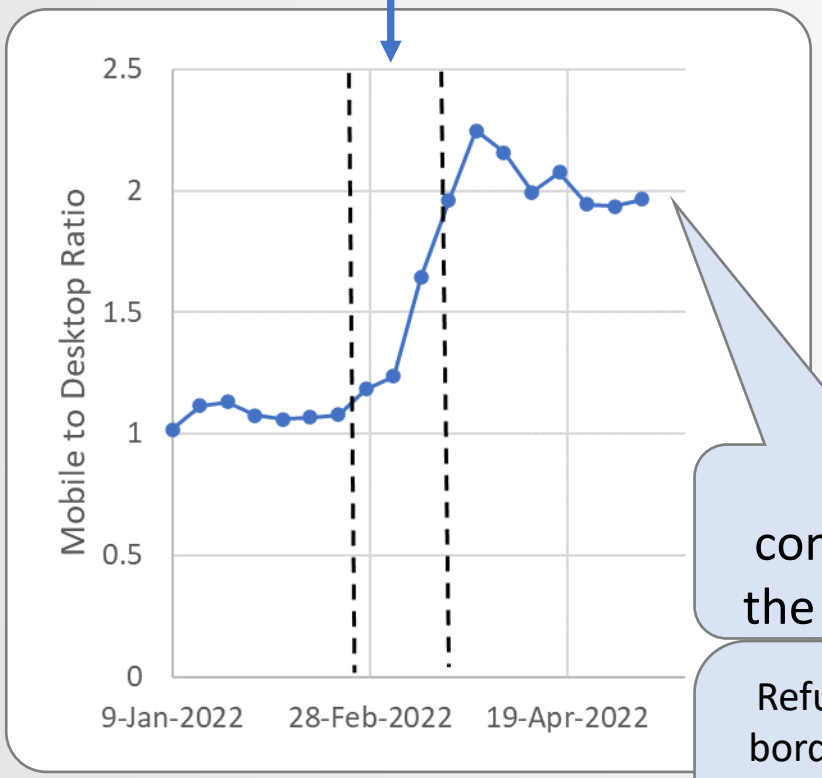
Refugees in Poland

Poland: more refugees crossed the border to Poland than to any other neighboring country.



Traces of the Ukrainian Refugee Crisis in Poland

Poland: steep increase in mobile device usage and in Internet traffic during the first 3 weeks of the war.

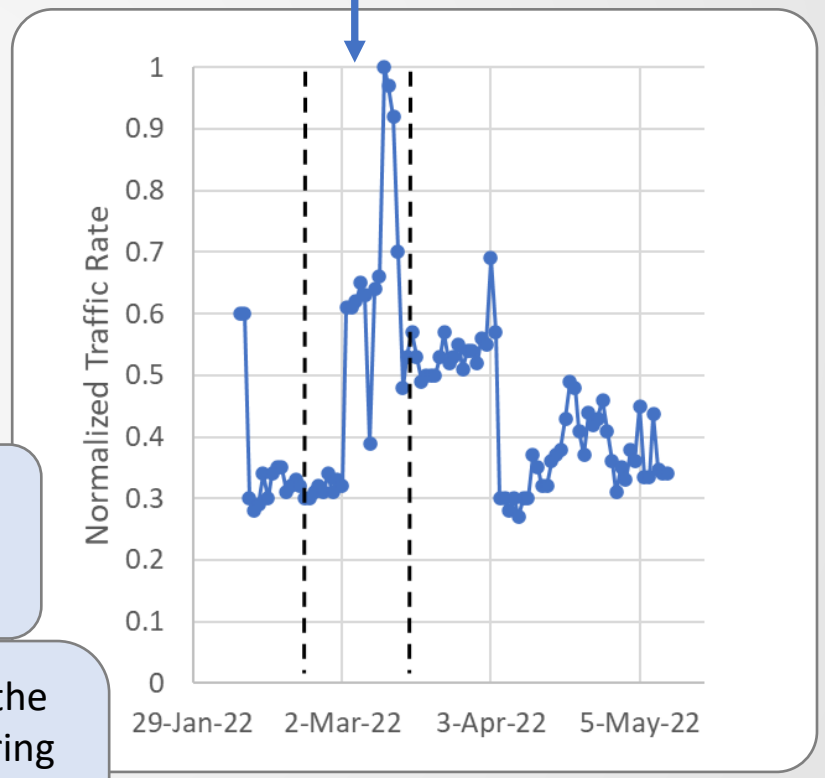


Traffic rate:
Mobile-to-desktop Ratio

Data source: [Statcounter]

Roughly constant after the first month

Refugees crossed the border to neighboring countries (e.g., Poland), and many continued to other countries.

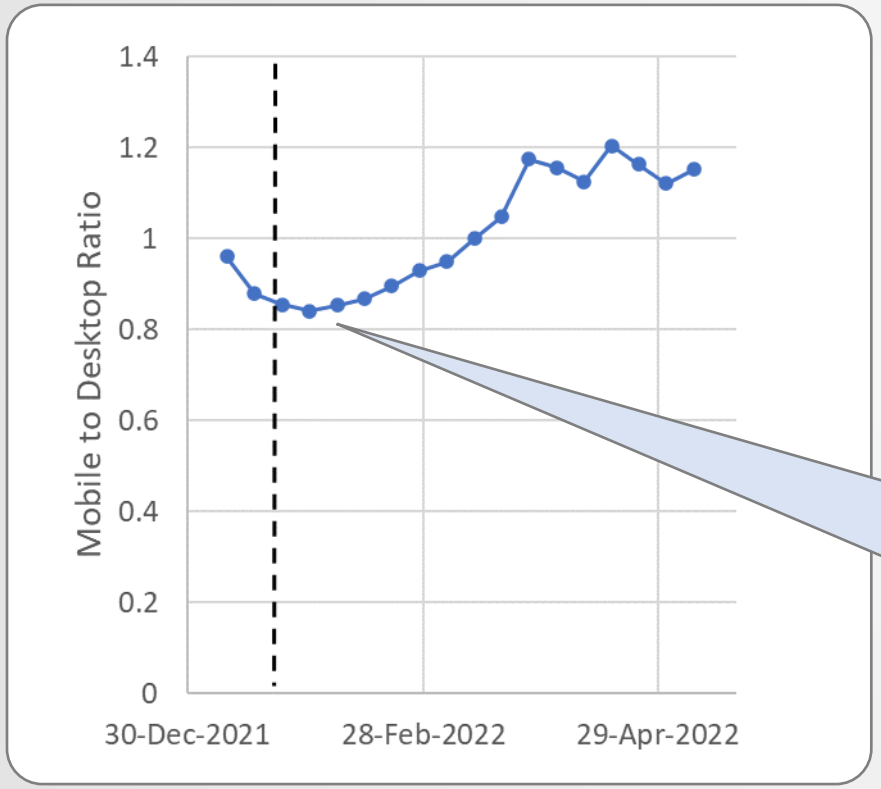


Traffic Rate

Data source: [Cloudflare]

What About Other Countries?

These traces were not significant enough in other countries we analyzed.
For example…



Europe
Mobile-to-desktop Ratio
Data source: [Statcounter]

EUROPE

Countries are relaxing restrictions after omicron spikes

Coronavirus cases have hit global records. Some countries have tightened measures, while others are pushing to relax rules because of the omicron variant's perceived milder infections and high national vaccination rates.

[DW, 17 January 2022]

COVID travel restrictions started to be removed in mid-January

↓

A steep increase in mobile device usage due to traveling

More dominant than any effects of the refugee crisis

Mapping the Refugee Crisis

UNHCR Data

A complementary approach that does not compromise privacy issues

Data collected from the government of each country

Data collected from humanitarian organizations such as the red cross

Use <u>publicly available</u> Internet measurements - the approach presented in the current work

Current work

?

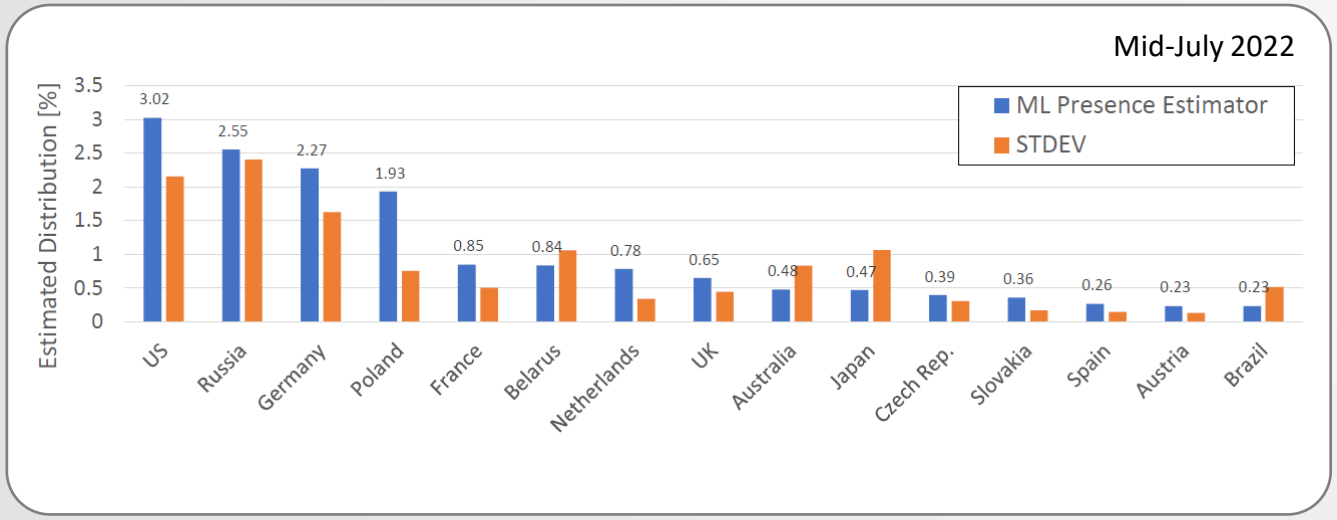
Border crossings

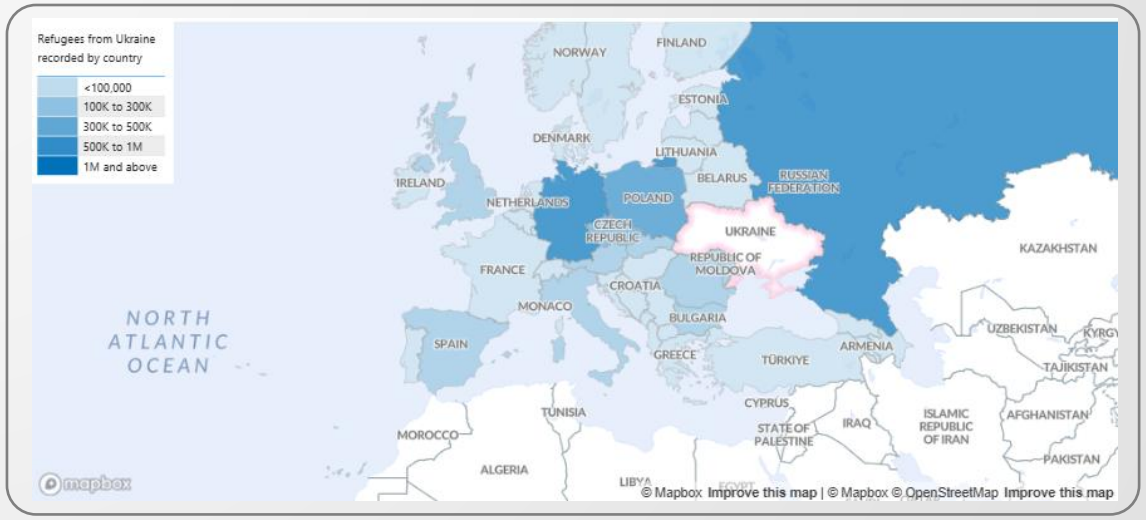
Non-public measurement data, e.g., from mobile operators, content providers, etc.

Not clear if this is done today, and may have privacy issues

Mapping the Refugee Crisis

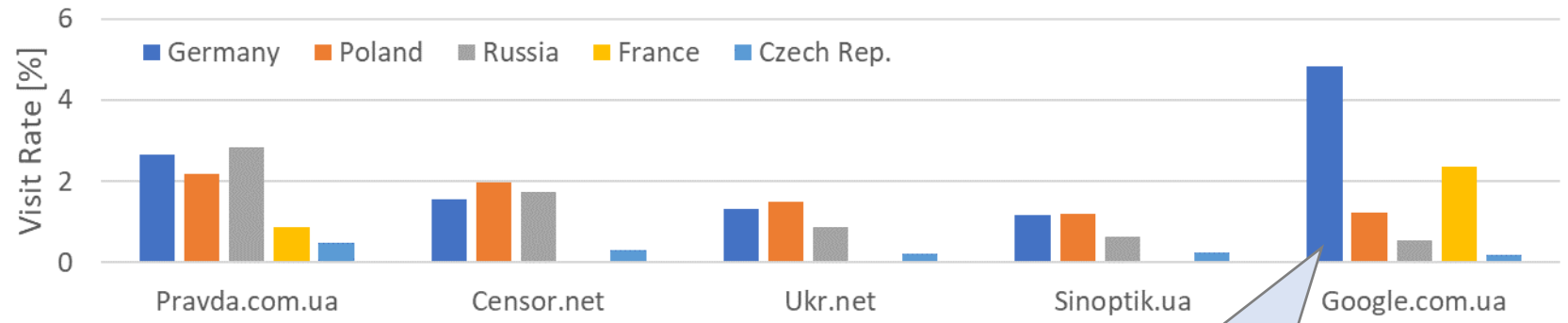
- We posted preliminary results of the estimates in May 2022 on ArXiv.
- To the best of our knowledge, at that time our work was the only source of data about refugee estimates in countries other than Ukraine's neighboring countries.
- A few weeks afterwards the [UNHCR] started publishing daily estimates of the number of refugees in each country in Europe.
- To the best of our knowledge, our work remains the only source of data about refugee estimates in countries outside of Europe.





Using Website Analytics

We combined three sources of data in our estimation method:
- Top accessed Ukrainian sites [Similarweb].
- Website visit location [Cloudflare, Wikimedia].
- Historical website visit location [Wikimedia].



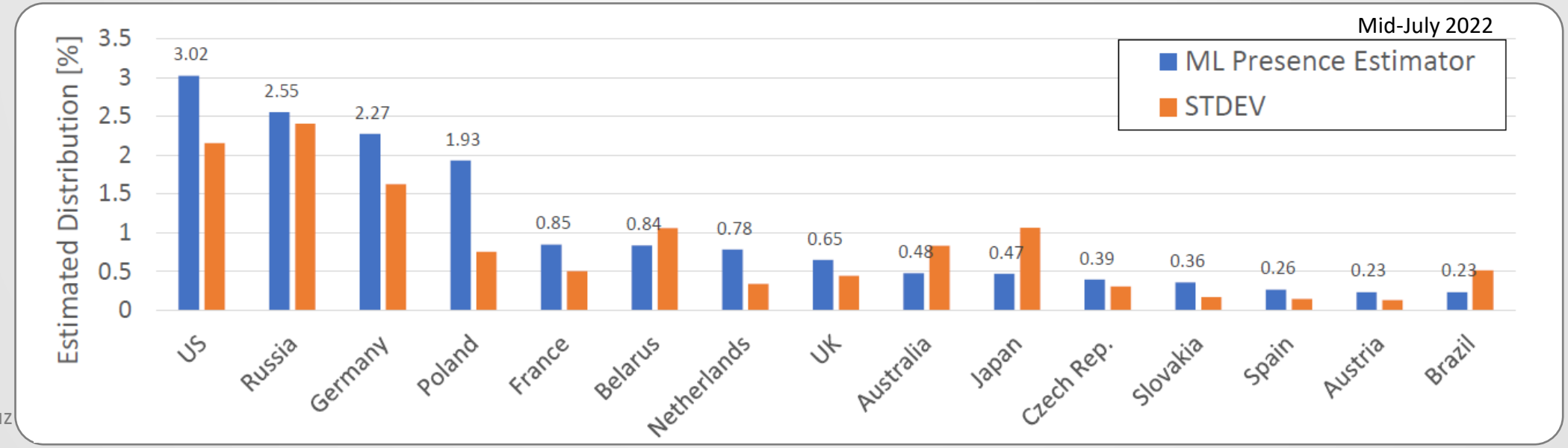
5% of the visits to google.com.ua came from Germany

Estimating the Ukrainian Presence in each Country

Data:

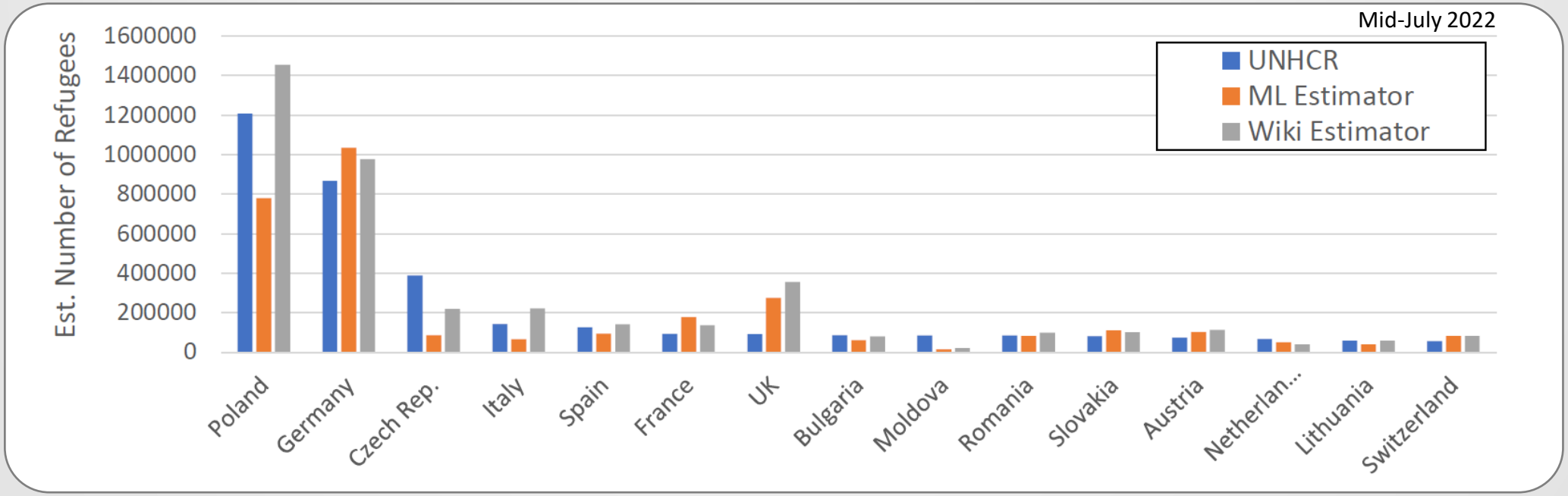
- Top 15 accessed Ukrainian sites [Similarweb].
  Eliminated international sites such as facebook.com and yandex.ru.
- For each site: extracted the visit percentage from each country [Cloudflare, Wikimedia].

Maximum likelihood (ML) estimation of the percentage of Ukrainians in each country.
Each website had a weight that is proportional to the number of visits per month.



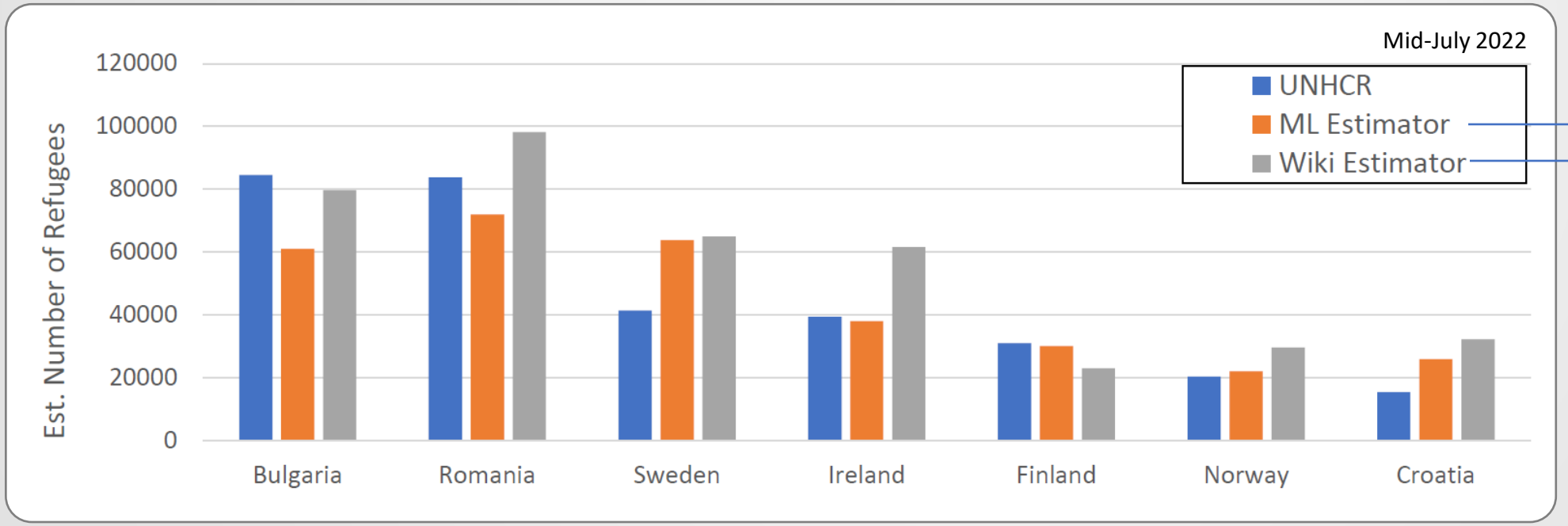
Estimating the Ukrainian **Refugees** in each Country

- The Ukrainian diaspora (people living abroad) was about 6 million people before the war.
  The estimated numbers reflect the sum (existing people and refugees).
- Using historical data [Wikimedia] about website visits to **uk.wikipedia.org** on a per-month basis.
- Two estimators for the number of refugees in each country:
  - **ML Estimator**: based on [Cloudflare] visit rate data and [Wikimedia] historical visit rate data.
  - **Wiki Estimator**: based on [Wikimedia] visit rate data.



Ground Truth Comparison

- [UNHCR] data is not accurate in most of the EU countries, since mobility within the Schengen (EU) countries is not monitored.
- Ground truth data: data about countries that are either not included in the Schengen area, or not accessible from Ukraine by ground transportation.

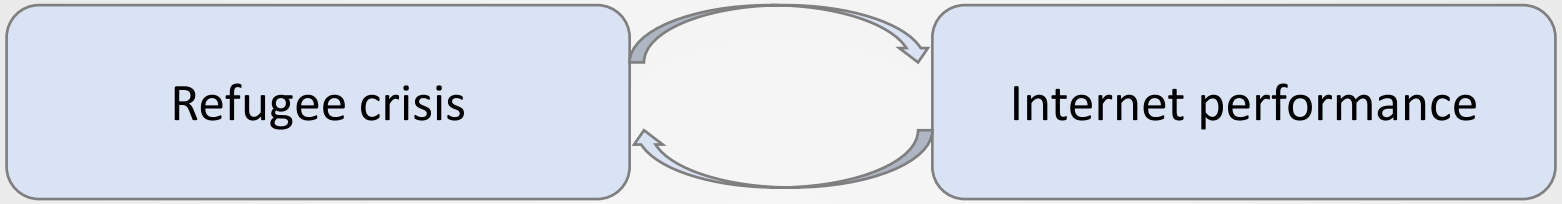


Mean percentage error

ML Estimator → 11.8%

Wiki Estimator → 25.6%

Conclusion



- We presented a method of mapping the Ukrainian refugee presence throughout the world using website analytics.
- The methods presented in this work can potentially be used as a complementary means for assessing the distribution and the flow of refugees throughout the world.

Thanks

Our hearts are with the families of the casualties and with the refugees.
We hope that the conflict will be resolved soon.

References

[1] T. Mizrahi, J. Yallouz, "Mapping the Ukrainian Refugee Crisis Using Internet Measurements", ANRW, 2023.

[2] T. Mizrahi, J. Yallouz, "Using Internet Measurements to Map the 2022 Ukrainian Refugee Crisis", Arxiv:2205.08903, 2022.

[3] T. Mizrahi, J. Yallouz, "Internet Performance in the 2022 Conflict in Ukraine: An Asymmetric Analysis", Arxiv:2205.08912, 2022.