# Warcast index: regional economic activity in Ukraine during an invasion.

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# This project

**Estimating current economic activity (GDP) in Ukraine by region.**

There are challenges in using/interpreting high frequency GDP as it seems to be very volatile.

Useful in a crisis:
- strong signals cut through the normal noise
- decisions need to be made faster in a crisis

# Regional vs National.

National effects are aggregated from heterogeneous regional economies.

National policy affects some regions more than others $\rightarrow$ aggregate effects depend on regional effects.

If a crisis is regional and an economy is unequal, regional breakdown is important.

A war is inherently a regional crisis where the most affected regions are not random.

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# Regional heterogeneity.

- Kyiv City is around 24% of the whole economy.

- Kyiv City and Kyiv oblast are around 30%.

- Focusing on GDP will emphasize Kyiv but other policy objectives (employment, equality, growth) may suggest different focus.

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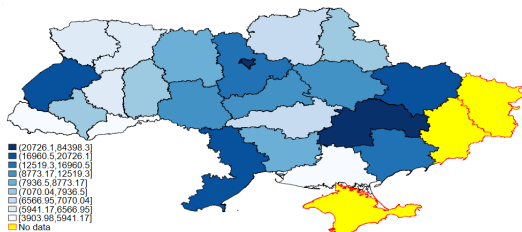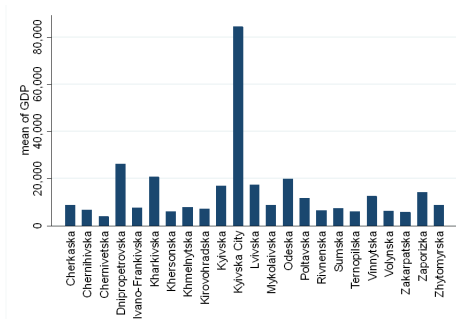
# Our approach.

Ukraine historic data challenges:
- Only low frequency of observations (annual)
- Only short time series (8-9 time periods)
- Conventional current data (payments, transactions, employment etc.) is unavailable

Solutions:
- Model annual GDP (for shorter periods assume that the period's level persists for a year and report the annual GDP)
- Use panel methods (current literature relies on time series)
- Use big data (Nightlights, Twitter and Google Trends)

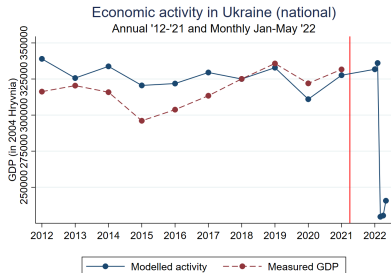No new indicators - using we know works and combine it in a new way.

# Results overview.

**Nigltlihgts+Google+Twitter**



**Nigltlihgts only**
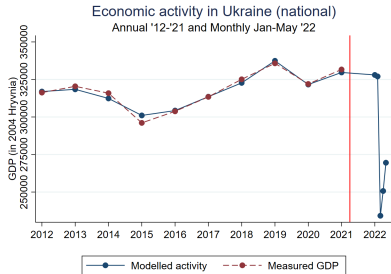


- If 2022 is the same as March 2022, economy shrinks by 40%, in April by 31% and May 22%.

- Directly affected regions loose more than others.

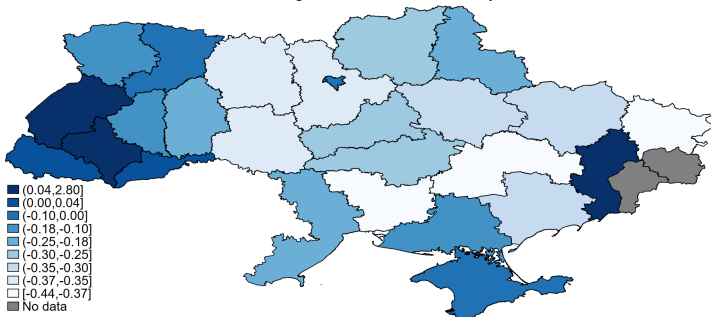- Nighlights alone give March 2022 at 43%, in April by 41% and May 36%.

- The index fits the historic data better AND is more optimistic.

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# Results overview.

Real GDP changes between 2021 and May 2022



| | |
|---|---|
| ■ | (0.04,2.80] |
| ■ | (0.00,0.04] |
| ■ | (-0.10,0.00] |
| ■ | (-0.18,-0.10] |
| □ | (-0.25,-0.18] |
| □ | (-0.30,-0.25] |
| □ | (-0.35,-0.30] |
| □ | (-0.37,-0.35] |
| □ | [-0.44,-0.37] |
| ■ | No data |

- Western regions seem to be doing well.

- Regions affected by violence see their economies shrink.

- Occupied regions appear to have increased levels of activity.

# Results overview.



1. Sudden and dramatic decrease in activity everywhere

2. Activity rebounds quickly in safe areas

3. Western economic activity rises to well above pre-war levels

4. Activity in occupied regions recovers slowly

5. Liberating a region accelerates its economic recovery.
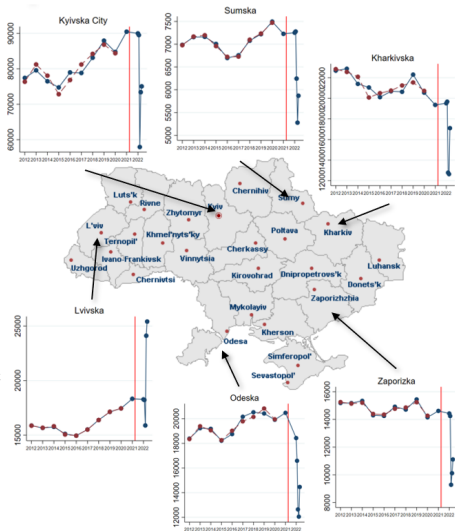
# Nowcasting GDP.

The choice is:

1. Measure - popular in developed countries with strong institutions but expensive and slow. Also, often not possible during a war.

2. Model - out of sample prediction based on structure of a model:

   2.1 Structural theory prediction for a scenario (IMF, WB etc.)
   2.2 Time series prediction based on past data
   2.3 **Prediction using correlated data**

All indicators of GDP are biased.
Using Big Data - back-of-envelope economic performance, fast, effective and well-documented.

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# Finding data.

The GDP nowcasting literature focuses on institutional high-frequency, high-quality datasets of early economic indicators.

- Electronic payments data, sector-level indices, expert surveys

- Flexible models borrowing structure from GDP's definition

- Large scope for evaluation and continuous updating

**Mostly not an option for us.**

Instead, we focus on a set of feasible GDP correlates emphasized by recent research:

- Twitter (Indaco 2020)

- Google Trends (Woloszko 2021)

- Nightlights (Henderson et al. 2011)

# The model.

**A simple linear regression (for each region $R$).**

$$\ln GDP_{it} = \alpha + R_i \times \left( \sum (\beta_i PCA_{it}) + \gamma_t \ln Tw_{it} + \theta_i \ln NLI_{it} \right) + \epsilon_{it} \tag{1}$$

- $\sum (PCA)$ - three principal components of Google trends
- $NLI$ - nightlights intensity
- $Tw$ - count of Tweets with pictures

In-sample: annual
Out-of-sample: monthly

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# Conclusions.

- GDP trackers offer intuitive results: sharp drop and quick partial recovery - typical shock response.

- Nightlights don't give a great fit of history and are likely biased downwards.

- Adding Google trends and Twitter improves historic fit and likely reduces the bias.

- Modeling choices affect the quantitative but not qualitative results. Drop in March: 25-45%, drop in May: 15-25%.

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# Thank you.

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