Reconstructing Ukrainian Cities

Maximizing Benefits and Minimizing Costs

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Restoring what is lost

After destruction, there is a natural desire to recreate what was lost. But is that the right answer?

We do not talk about architectural styles (as in post-war Warsaw), but about region-level rebuilding.

Andrii's presentation will present a simple model which helps to think about the tradeoffs in east vs. west.

The Economists' Voice

Volume 2, Issue 1 2005 *Article 1*

Should the Government Rebuild New Orleans, Or Just Give Residents Checks?

Photo by "Vick Vaporub," article by me.

Reconstruction investment decisions

After World War II, rebuilding in Ukraine prioritized industry and infrastructure over housing. Is that timing right?

We're not going to answer this (sorry discussants), but we'd love to see a paper that does.

Costs of reconstruction

What choices can reduce the costs of reconstruction?

Procurement is about 15% of global GDP and deeply understudied. Institutional design, and procurement rules matter. Mass production (drones and bus costs).

Martina's presentation will handle this and I may be back at the end.

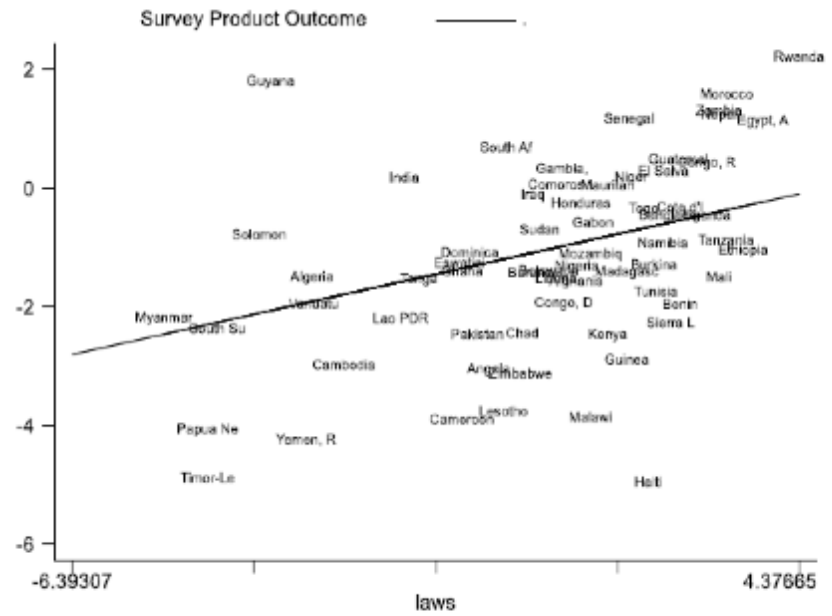


FIGURE 12: LAWS AND PRODUCTS IN LOW HUMAN CAPITAL COUNTRIES

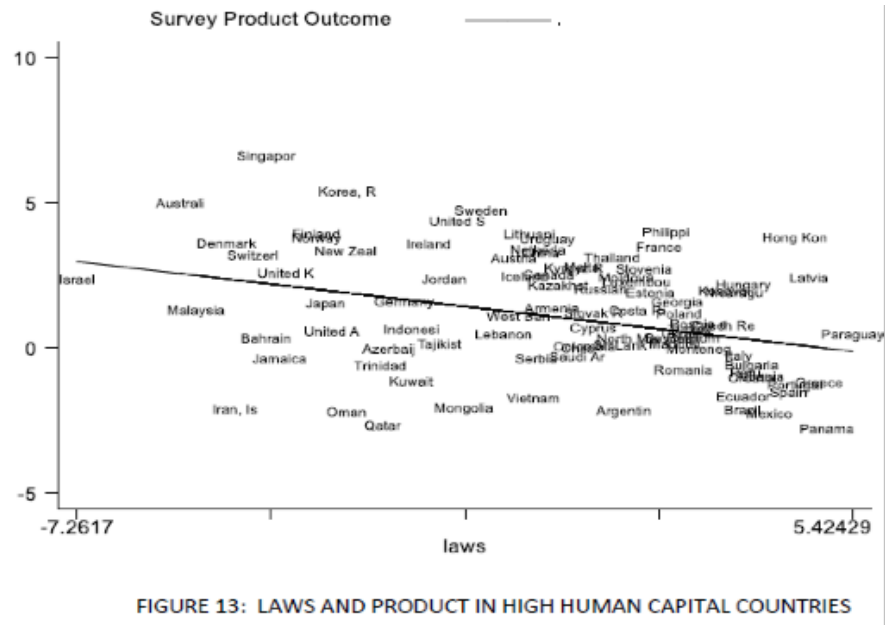


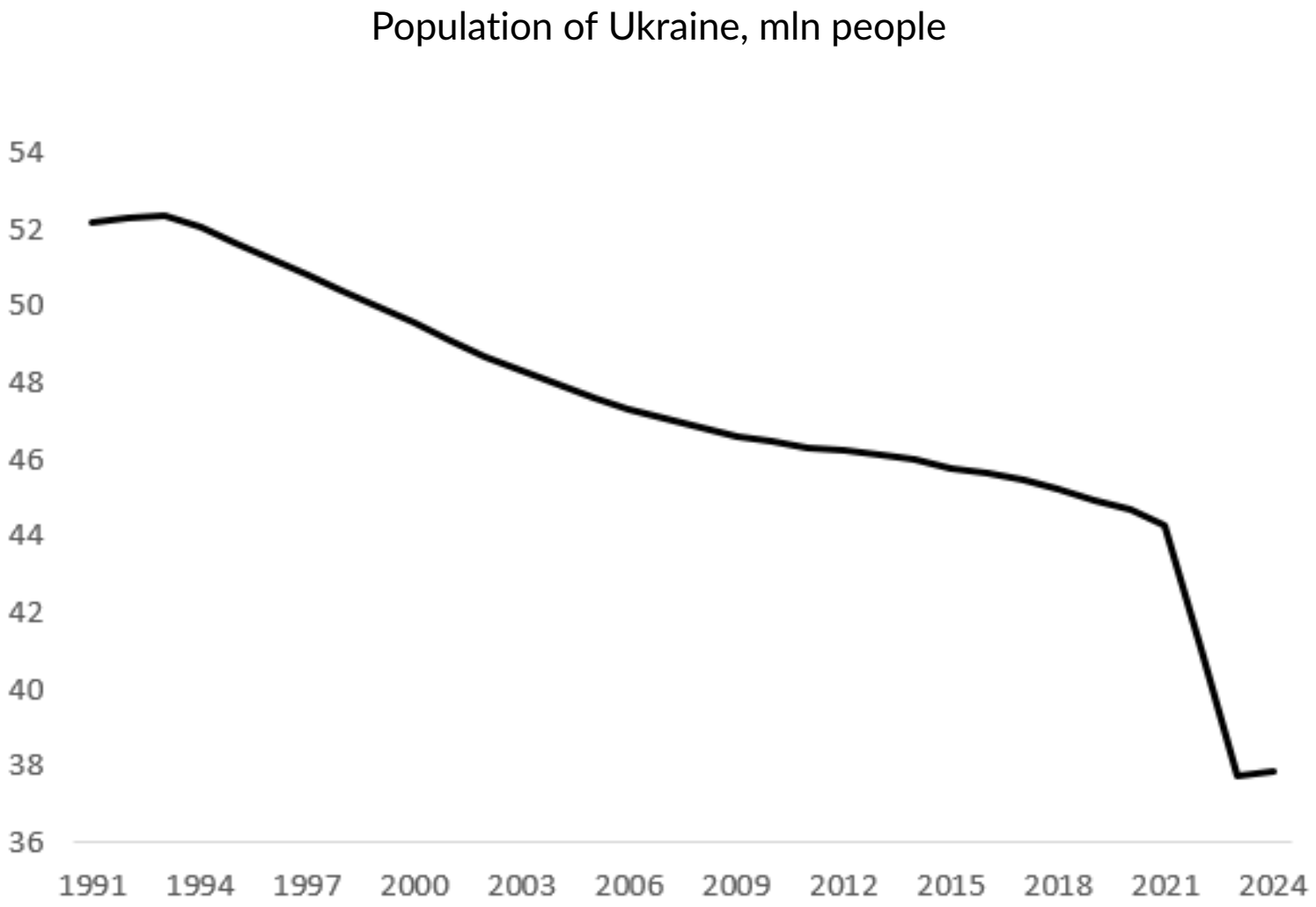
FIGURE 13: LAWS AND PRODUCT IN HIGH HUMAN CAPITAL COUNTRIES

Ukraine's Cities before the 2022 Full-Scale Invasion

Five facts about Ukraine and its cities:

1. population decline
2. spatial shift to the West
3. increasing concentration around Kyiv
4. an old and misallocated housing stock
5. inadequate urban infrastructure

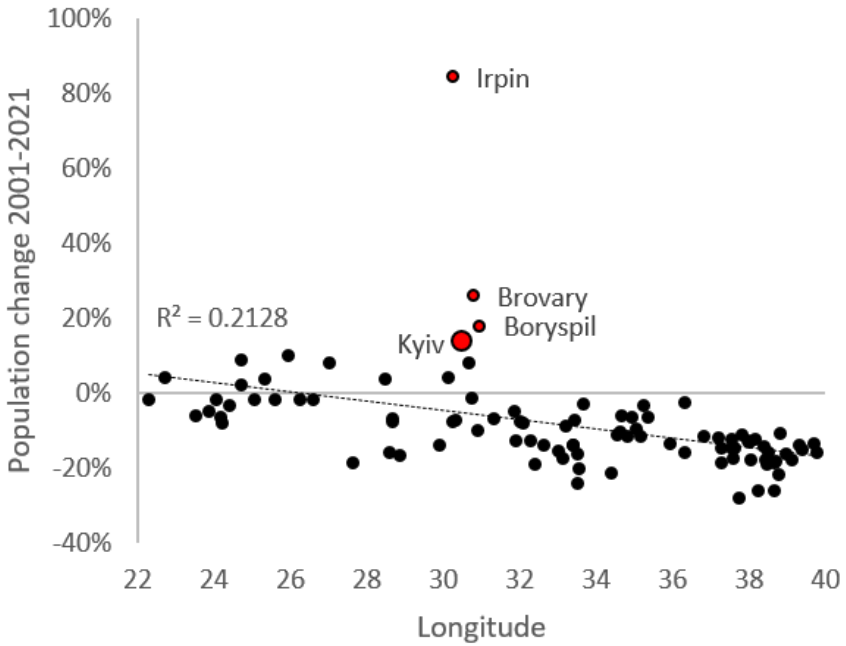
Population decline and aging



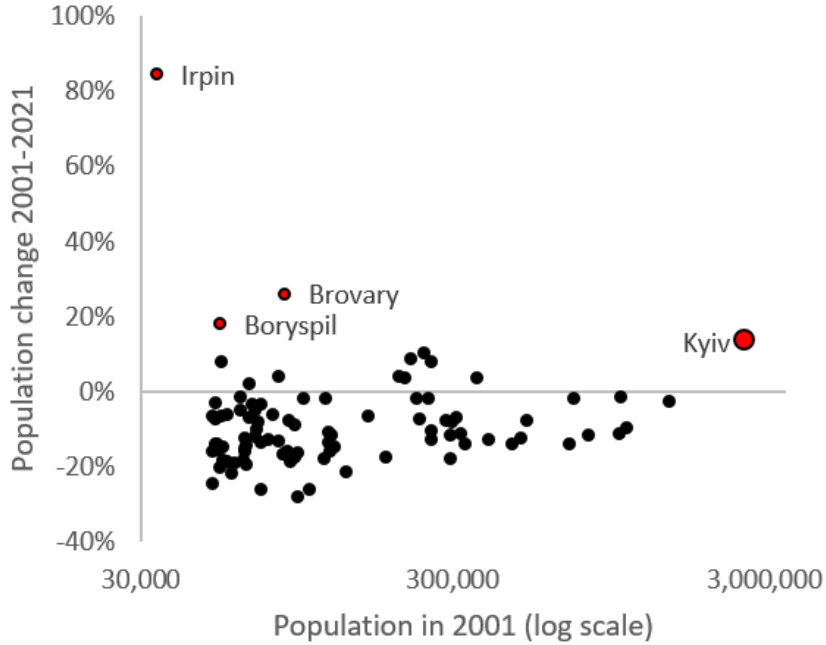
The East-West Shift.

Population change in Ukraine's cities, 2001–2021

Panel A

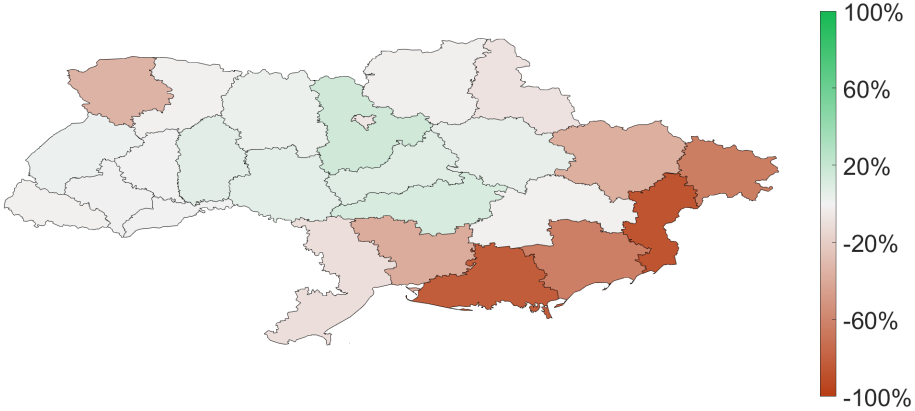


Panel B

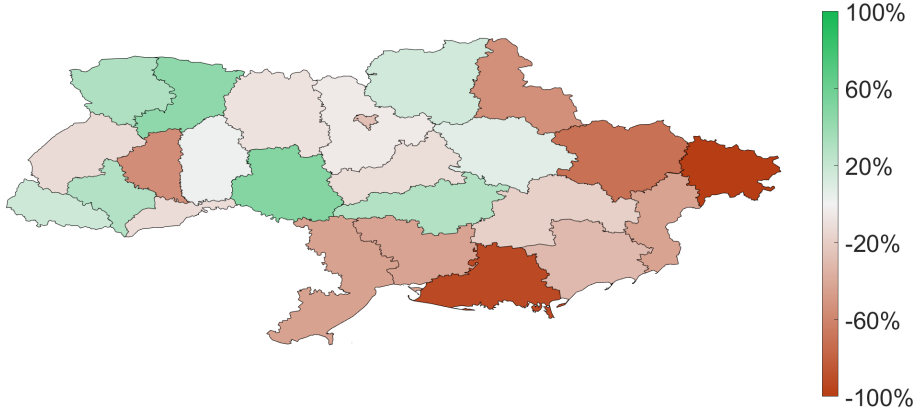


Changes from 2021 to 2024

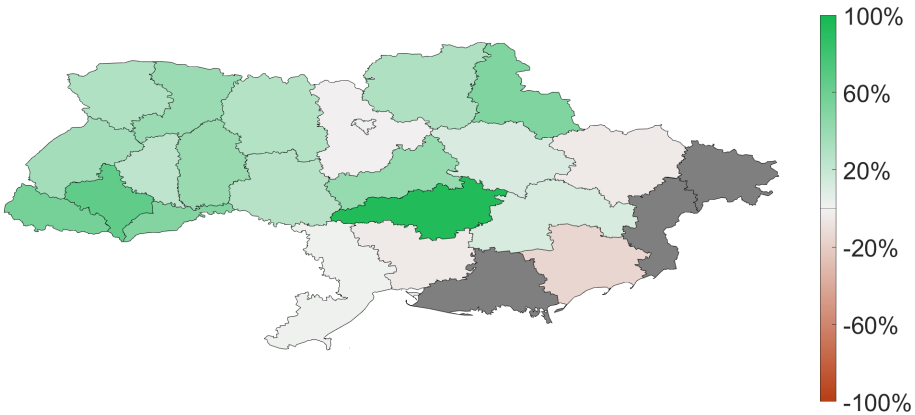
Panel A: population



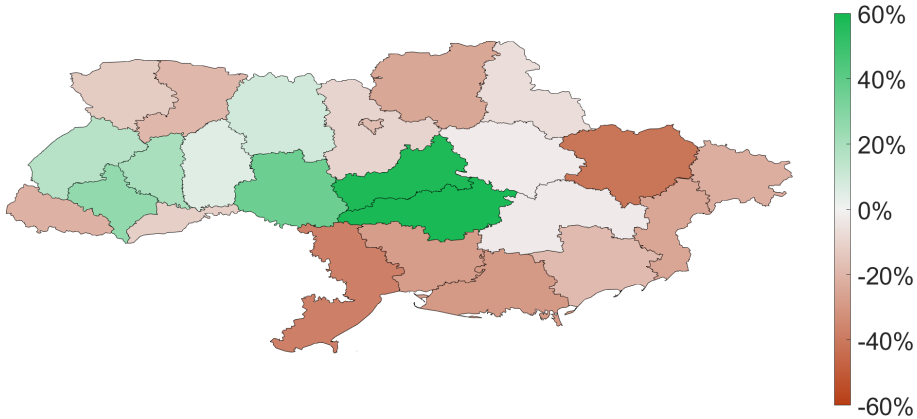
Panel B: residential construction



Panel C: house prices

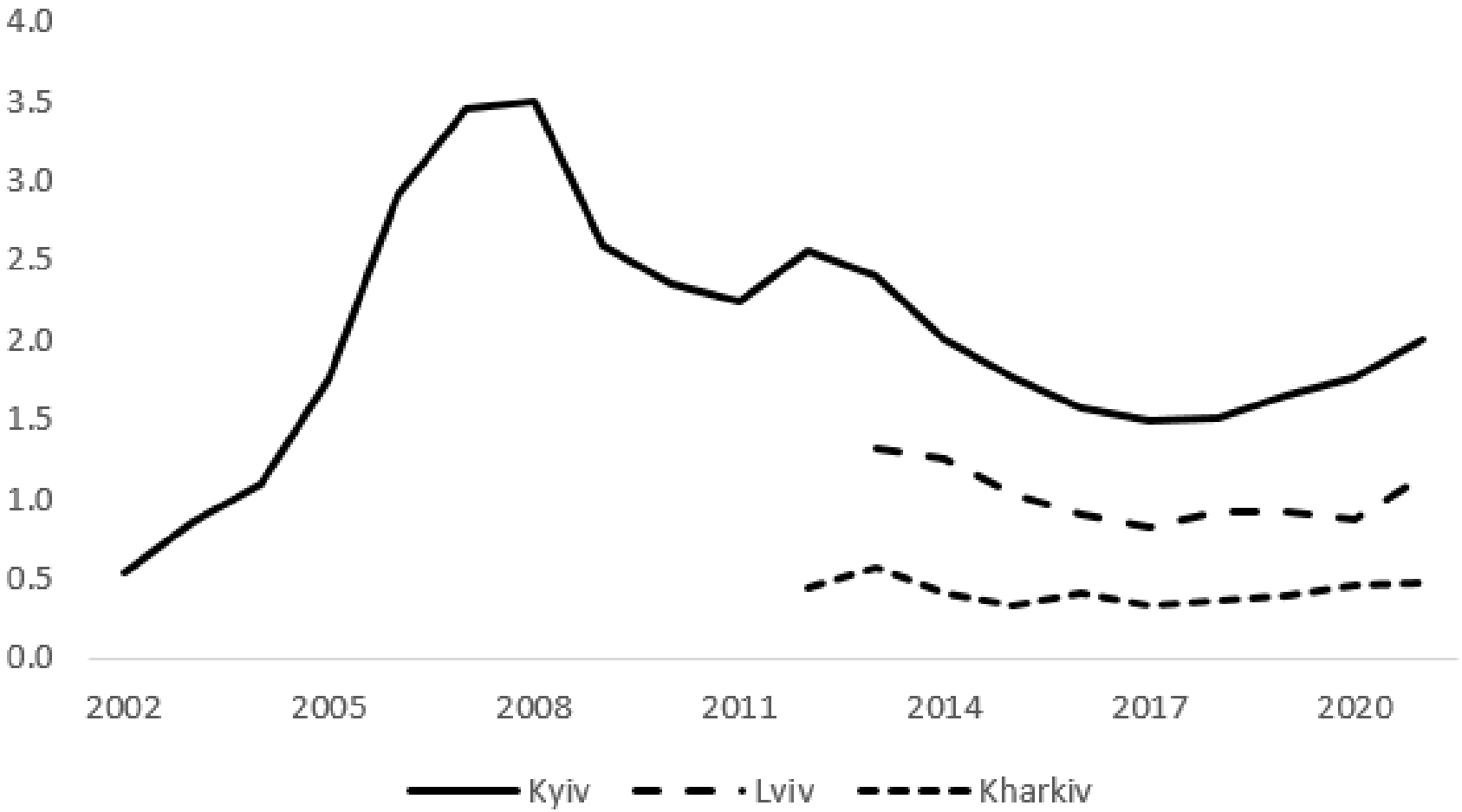


Panel D: house rents



Housing

Average house prices, thousand US dollars per sq. meter



Urban mobility

Ranking of Ukrainian cities by speed, congestion, and uncongested speed

Speed				Congestion				Uncongested Speed			
Rank	Global Rank	City	Index	Rank	Global Rank	City	Index	Rank	Global Rank	City	Index
1	321	Donetsk	.09	1	36	Kyiv (Kiev)	.11	1	376	Zaporizhzhya	.07
2	344	Zaporizhzhya	.08	2	41	Lviv	.11	2	413	Donetsk	.06
3	358	Luhansk	.08	3	86	Odesa	.08	3	428	Luhansk	.05
4	380	Kryvyi Rih	.07	4	99	Simferopol	.07	4	442	Mariupol	.05
5	381	Mariupol	.07	5	200	Sevastopol	.05	5	505	Kyiv (Kiev)	.02
6	536	Mykolaiv	0	6	294	Kharkiv	.03	6	519	Vinnitsa	.02
7	549	Vinnitsa	0	7	361	Vinnitsa	.02	7	520	Kryvyi Rih	.02
8	558	Dnipro	0	8	434	Dnipro	.01	8	524	Kharkiv	.02
9	583	Kharkiv	-.01	9	493	Mykolaiv	0	9	531	Simferopol	.01
10	686	Sevastopol	-.05	10	620	Zaporizhzhya	-.01	10	550	Dnipro	.01
11	703	Simferopol	-.06	11	723	Mariupol	-.02	11	558	Mykolaiv	.01
12	780	Kyiv (Kiev)	-.09	12	783	Luhansk	-.03	12	589	Sevastopol	-.01
13	809	Odesa	-.1	13	880	Donetsk	-.04	13	640	Odesa	-.03
14	911	Lviv	-.15	14	963	Kryvyi Rih	-.05	14	692	Lviv	-.05

Source: Akbar et al. (2023).

Locations

- Static spatial equilibrium model
- 25 regions (oblasts) in Ukraine + outside location
  - exclude Crimea and parts of Donbas occupied before 2022
- Locations characterized by:
  - amenities X_i
  - wages w_i
  - housing costs p_i
- Infrastructure:
  - producer infrastructure I_i^p affects productivity: $A_i = \bar{A}_i N_i^{\lambda} I_i^p$
  - consumer infrastructure I_i^c affects amenities: $X_i = \bar{X}_i N_i^{\rho} I_i^c$

Households

- Individual problem:
  - $\max u_i(c, h) = c^{1-\gamma} h^{\gamma} X_i \quad \text{s.t.} \quad w_i = p_i h + c$
  - indirect utility: $v_i(w_i, p_i) = (1-\gamma)^{1-\gamma} \gamma^{\gamma} w_i p_i^{-\gamma} X_i$
- Location choice:
  1. Choose to live in Ukraine vs abroad: Frechet shock with shape σ, res. value $\bar{V}$
  2. Choose oblast within Ukraine: Frechet shock with shape ϵ
- Equilibrium population:
  - Oblast i: $N_i = \frac{v_i(w_i,p_i)^{\epsilon}}{\sum_i v_i(w_i,p_i)^{\epsilon}} \times N_U$
  - Ukraine: $N_U = \frac{V_U^{\sigma}}{V_U^{\sigma} + \bar{V}^{\sigma}} \times N$

Firms

- Traded-good firms:
  - Cobb-Douglas technology in capital and labor
  - equilibrium wage: $w_i = \alpha A_i^{\frac{1}{\alpha}} \left(\frac{1-\alpha}{r}\right)^{\frac{1-\alpha}{\alpha}}$
- Housing supply:
  - DRTS technology in capital
  - $p_i = \chi_i H_i^{1/\zeta}$

Calibration

- Calibrate the model to 2021, just before the full-scale invasion
- Aggregate parameters:

Parameter	Description	Value	Target or source
λ	productive externality	0.05	Ahlfeldt and Pietrostefani (2019)
ρ	amenity externality	0	Ahlfeldt and Pietrostefani (2019)
α	labor share in production	0.56	Penn World Tables
r	interest rate	0.036	World Bank
γ	housing preference term	0.24	Davis and Ortalo-Magné (2011)
ζ	housing supply elasticity	1.75	Saiz (2010)
σ	Frechet elasticity, country choice	3.08	change in Ukraine's population 2021–2024
ϵ	Frechet elasticity, city choice	3.46	elasticity of oblast population to damages

- Regional parameters obtained by model inversion

Evaluate the effects of the war

- The war is modeled as destruction of consumer- and producer-related infrastructure: $I^c_{i,2024} = (1 - \eta_i) I^c_{i,2021}$ and $I^p_{i,2024} = (1 - \eta_i) I^p_{i,2021}$
- The war lowers amenities and firm productivity $\Longrightarrow$ makes locations less attractive to live and work

Evaluate the effects of the war

- Destruction rate η_i from satellite imagery collected by Scher and Van Den Hoek (2025):

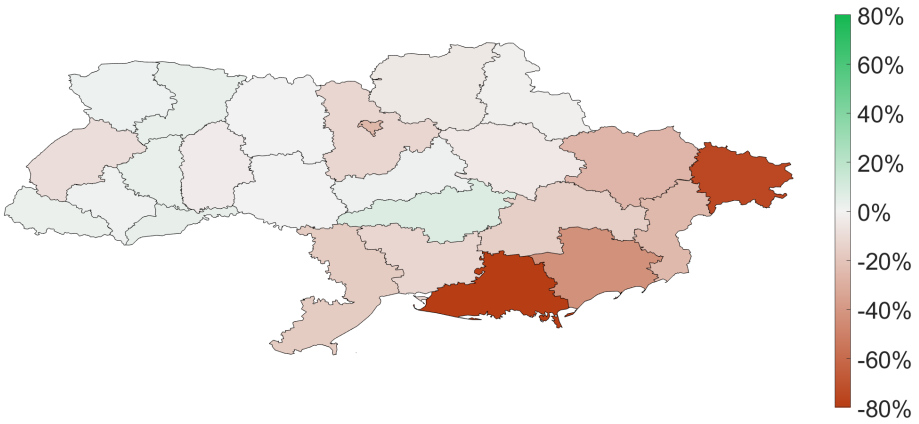
Percentage of damaged or destroyed structures by December 2024

Aggregate effects of the war

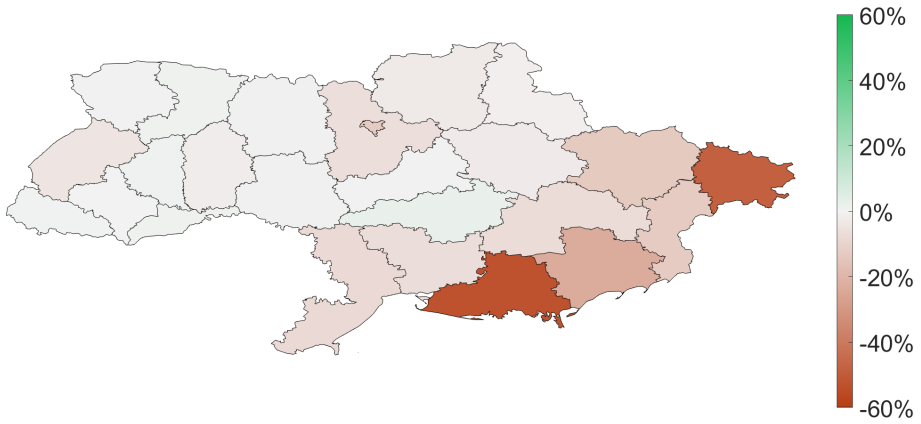
Aggregate results, percentage change			
Population	Output	Output p.w.	Welfare
-14.4	-18.0	-4.1	-6.6

Regional effects of the war

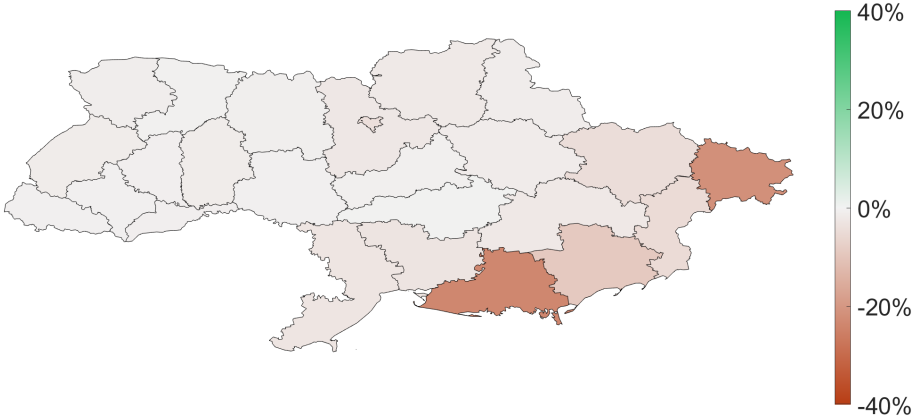
Panel A: Population



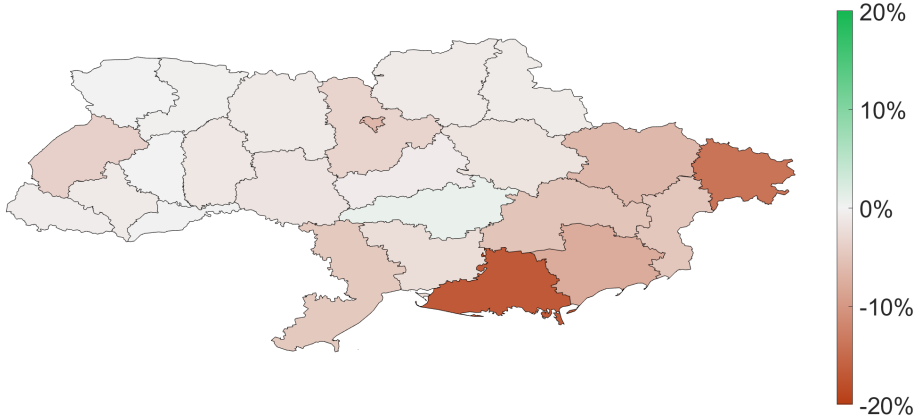
Panel B: House prices



Panel C: Productivity

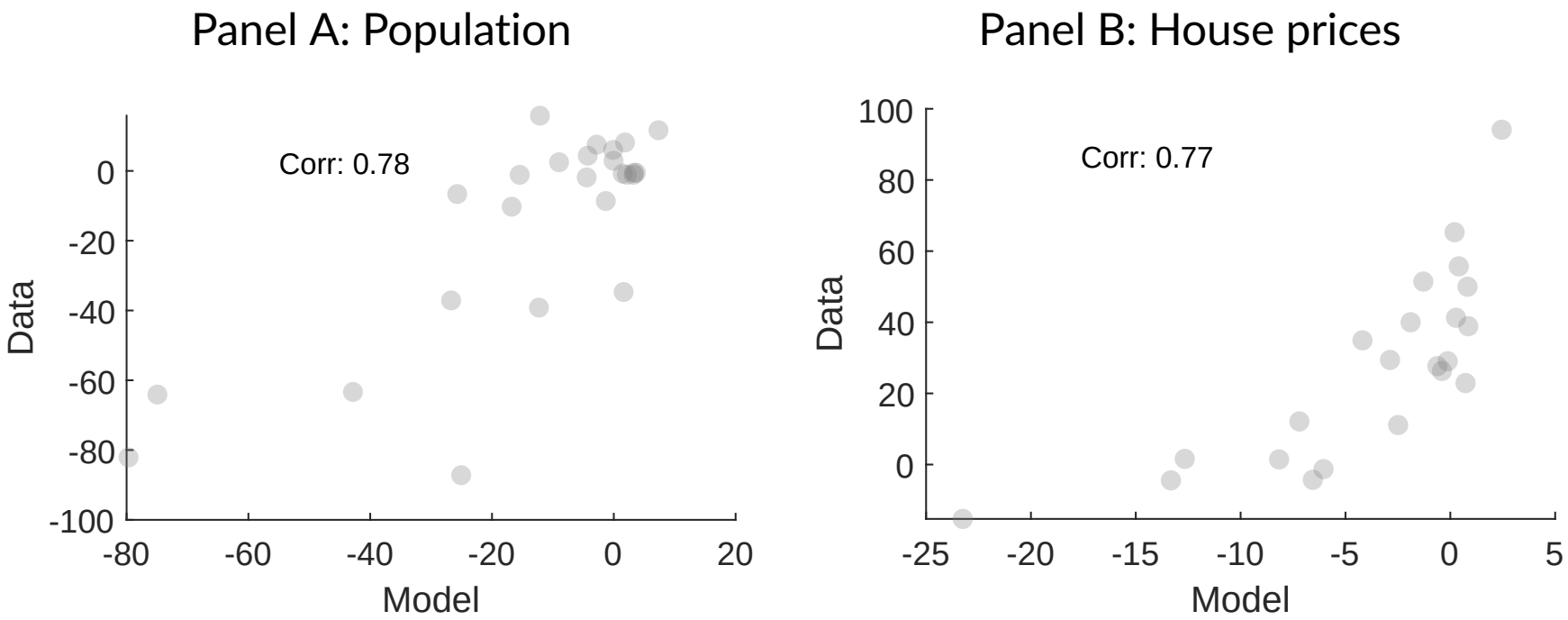


Panel D: Amenities



Validation

Percentage changes in population and house prices, model vs data



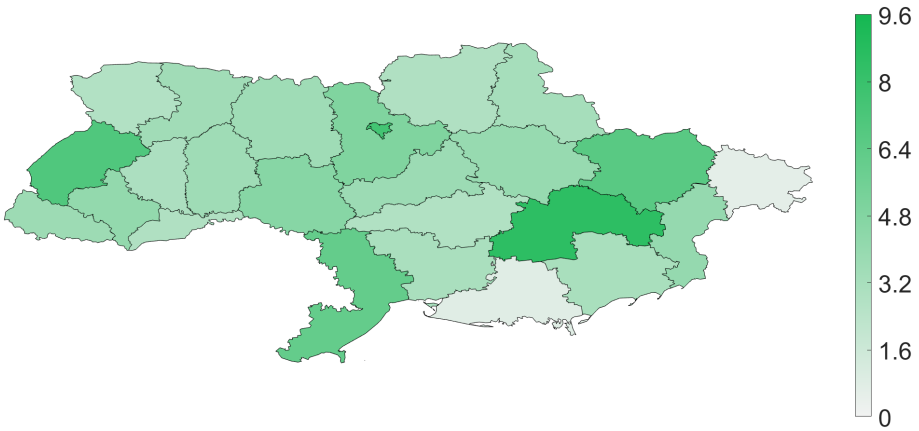
Optimal reconstruction policy

- Consider a planner that has access to reconstruction funds and can rebuild consumer and producer infrastructure, $I^c_{i,2024}$ and $I^p_{i,2024}$
- First-order perturbation approach: increase infrastructure in every oblast by a small amount and compare marginal gains

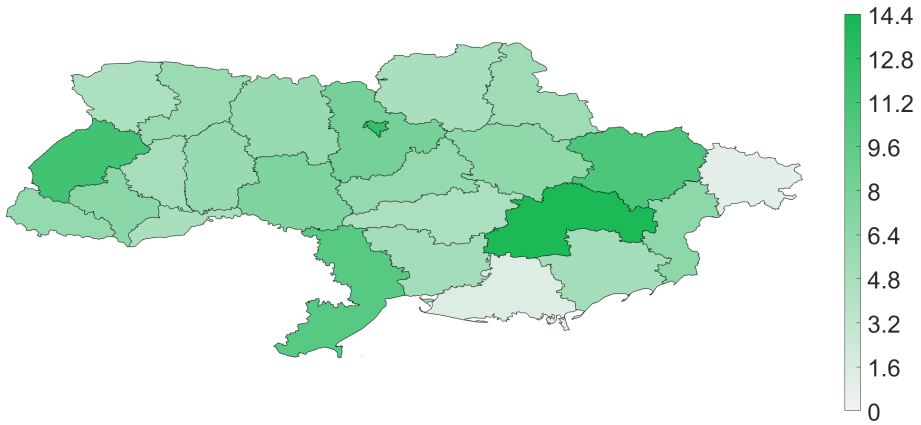
Optimal reconstruction policy

Marginal effect on **nationwide** welfare

Panel A: Consumer infrastructure



Panel B: Producer infrastructure



Optimal reconstruction policy

Marginal effect on **oblast** welfare

Panel C: Consumer infrastructure

Panel D: Producer infrastructure

Key takeaways from the model

- Optimal reconstruction policy prioritizes spending in oblasts with high productivity and amenities, as well as places where people moved
- Agglomeration effects matter: lower optimal investment in Kyiv w/o agglomeration
- Equity-efficiency tradeoff: investing in East/South lowers regional disparities and may attract people back
- There are symbolic and strategical reasons to invest more in East/South that we don't consider
- What should be rebuilt first? We find larger marginal benefits of investing in producer vs consumer infrastructure

The reconstruction cost curve

Elasticity of supply in the construction sector determines the effect of reconstruction on prices.

We think about the cost of an individual project as being captured by $(1 + \text{Markup}) \times C_{ij}(\text{Wages}, \text{Material costs}, \text{Equipment costs})$ where C_{ij} reflects the project's cost for firm i and project type j.

Markups can be reduced by improving competitive procurement or more standardized products.

Additional cost shifters: use of more efficient firms, better supporting infrastructure.

Three broad strategies: openness, standardization and investing-in-investing (Collier, 2011).

Price level of gross fixed capital formation before the war (World =100)

Data on prices construction sector goods rare, but can look at aggregates from International Comparison Project.

	Ukraine		Upp Mid Inc	
Item	2017	2021	2017	2021
Gross Fixed Capital Formation	49.2	47.4	90.2	90.6
Machinery and Equipment	79.7	83.4	114.2	115.1
Construction	36.0	35.0	84.4	85.1

Overall price level is between 30% to 60% lower.

The impact of the war on the construction sector

Construction costs have almost doubled between 2022 and 2025 (International Finance Corporation, 2025): shortage of worker, damages, reorganization of supply chains, electricity.

Effects on construction output between 2021 and 2022:

- 37 percent drop in new housing construction
- 42 percent drop in the volume of civil construction
- 26 percent drop in transport infrastructure construction

Ending conflict key for reducing the cost of building (Collier et al., 2016).

Industrial Organization

Mostly small firms: 80% have 10 people or less, 3.2% are medium-sized, and only 7 firms had more than 250 people (Sibbel and Mihes, 2025).

Top international contractors, 2003-2024, data from Bernard et al. (2025)

Year	# of firms	Av rank	Top rank	# of coun	Countries
2005	12	71	1	8	Belgium, China, France, Germany, North Macedonia, Norway, Turkey, United States
2010	19	83	1	9	Austria, China, Denmark, France, Germany, Italy, Spain, Turkey, United States
2015	17	53	3	8	Austria, China, Denmark, France, Italy, Spain, Turkey, United States
2020	16	62	3	7	Austria, China, France, Italy, Spain, Turkey, United States
2024	10	139	19	3	China, Italy, Turkey

Materials

Construction is a large user of intermediate inputs (Çakmaklı et al., 2021).

Distortions in upstream sectors providing inputs to structures have long-term effects on output (Kirchberger and Beirne, 2021).

Particularly important for largely non-traded inputs, such as cement, sand or gravel.

Ukraine has a strong domestic production capacity (about 80% of materials).

Key upstream constraint: electricity, mentioned by 80% of construction material producers and industry associations. (USAID, 2023).

Substantial damage to capacity in several sectors.

Cement plants in Ukraine

Drop in capacity by 35 percent due to plants being damaged (*Baltsem*), mothballed (*Kramatorsk*), or in occupied territories (*Amvrosiivka*).

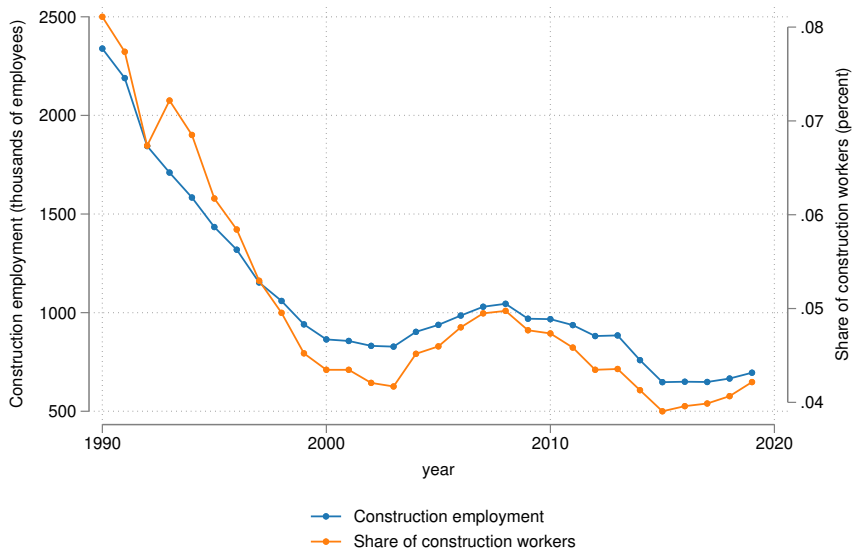
Three key players currently in cement market.

Labor

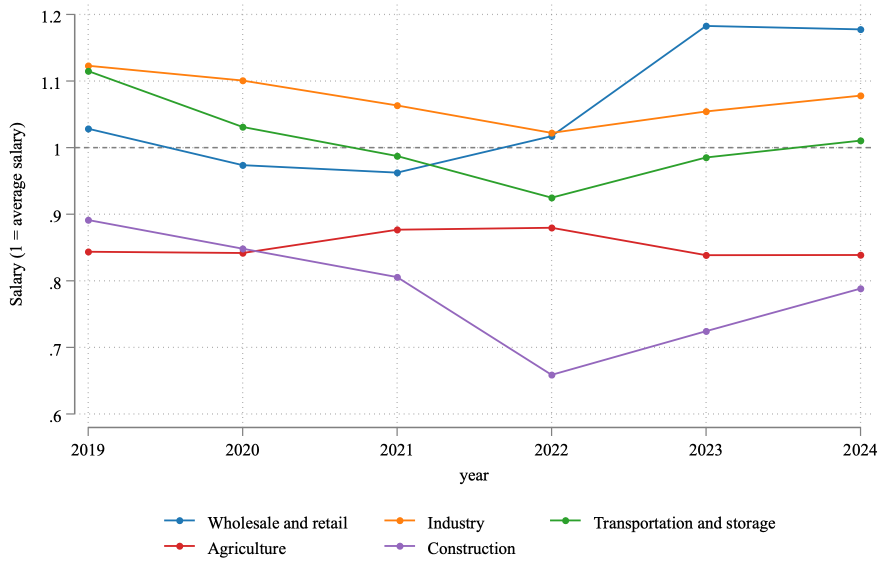
Declining employment and declining wages.

Employment and Wages

Employment



Wages



3 Strategies

1. Opening: increase the number of firms and workers available to rebuild

2. Standardization: specific products e.g., electric panels; regulation: building codes, zoning types; modular and pre-fab buildings

3. Investing-in-investing: physical inputs and infrastructure, vocational training, institutional reforms

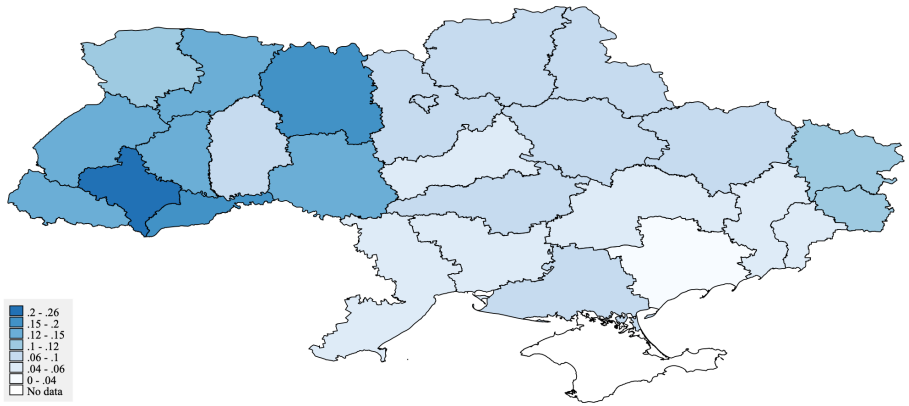
Geography of Procurement Efficiency

Procurement is central to the reconstruction cost curve, impacts from markups to material costs.

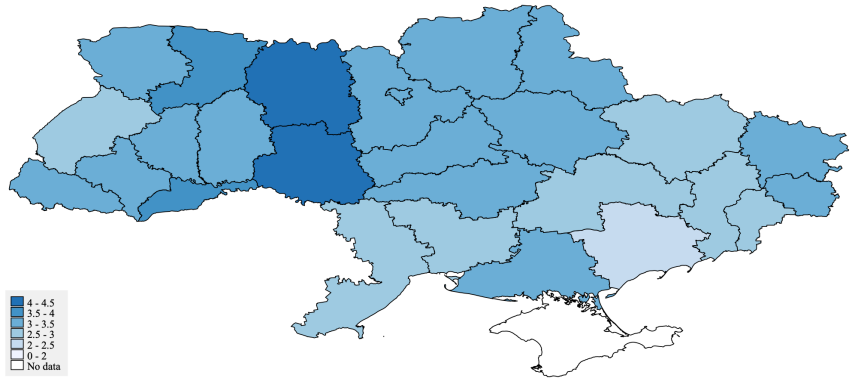
E-procurement implemented in Ukraine in 2016 following demand for greater transparency and accountability.

Reconstruction-related procurement auctions in 2019.

Cost Savings



Number of bidders



One way to think about the geography of costs and identify bottlenecks.

Institutions for Rebuilding

Tripartite institutional structure as one possibility:

1. Planning authority: responsible for developing 5-10 year reconstruction plan

2. Financial authority: responsible overseeing the flow of funds, designing systems for procurement, operations and audit

3. Implementers: groups overseeing projects themselves, could be at regional or local levels

Tension between over regulation (stymie innovation) and under regulation (allow corruption) is ubiquitous.

Conclusion

Rebuilding Ukraine will be one of the great construction tasks of the 21st century.

The economic approach to rebuilding can be divided into maximizing benefits (where to rebuild) from and minimizing costs.

Our model highlights equity-efficiency tradeoff in rebuilding east (equity) vs. west (efficiency). There are also national security implications of regional choices that we are not qualified to answer.

Three strategies for lowering costs: openness, standardization and investing-in-investing. Ukraine will get better at rebuilding over time, and learning-by-doing should be part of the overall plan.

Needs for future research: optimal timing of different types of infrastructure with a dynamic framework, formalizing issues of technology transfer and reconstruction, analysis of the connection between mass production and costs.

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