Estimating the True Cost of War:
Conflict in Eastern Ukraine 2014-2019

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What is the impact of conflict on welfare?

- Conflicts have heavy toll on people
- Difficult to account for non-monetary aspects
  - Deaths, sexual violence, erosion of social trust, institutional degradation
- GDP and other economic measures are inaccurate
- We need creative methods to measure the impact
  - Can we use data on outmigration from conflict areas?

Idea: Calculate welfare from migration outflows

- A well-established concept in international trade literature
  - Labor: Artuc, Chaudhuri and McLaren (2010)
  - Trade: Arkolakis, Costinot and Rodriguez-Clare (2012)

- Very general with only few assumptions (not a black box!)
  - Static or dynamic, agnostic about expectation formation, risk-averse or risk-neutral, different time preferences, etc.
  - Assumptions/restrictions: (i) moving costs did *not* decline or regional outputs did *not* increase because of the conflict (ii) homogenous agents

- A framework that generalizes the back-bone of popular discrete choice models
  - Static: Eaton and Kortum (2002), Redding (2016)
  - Dynamic: Caliendo, Dvorkin and Parro (2019), and many others

Background

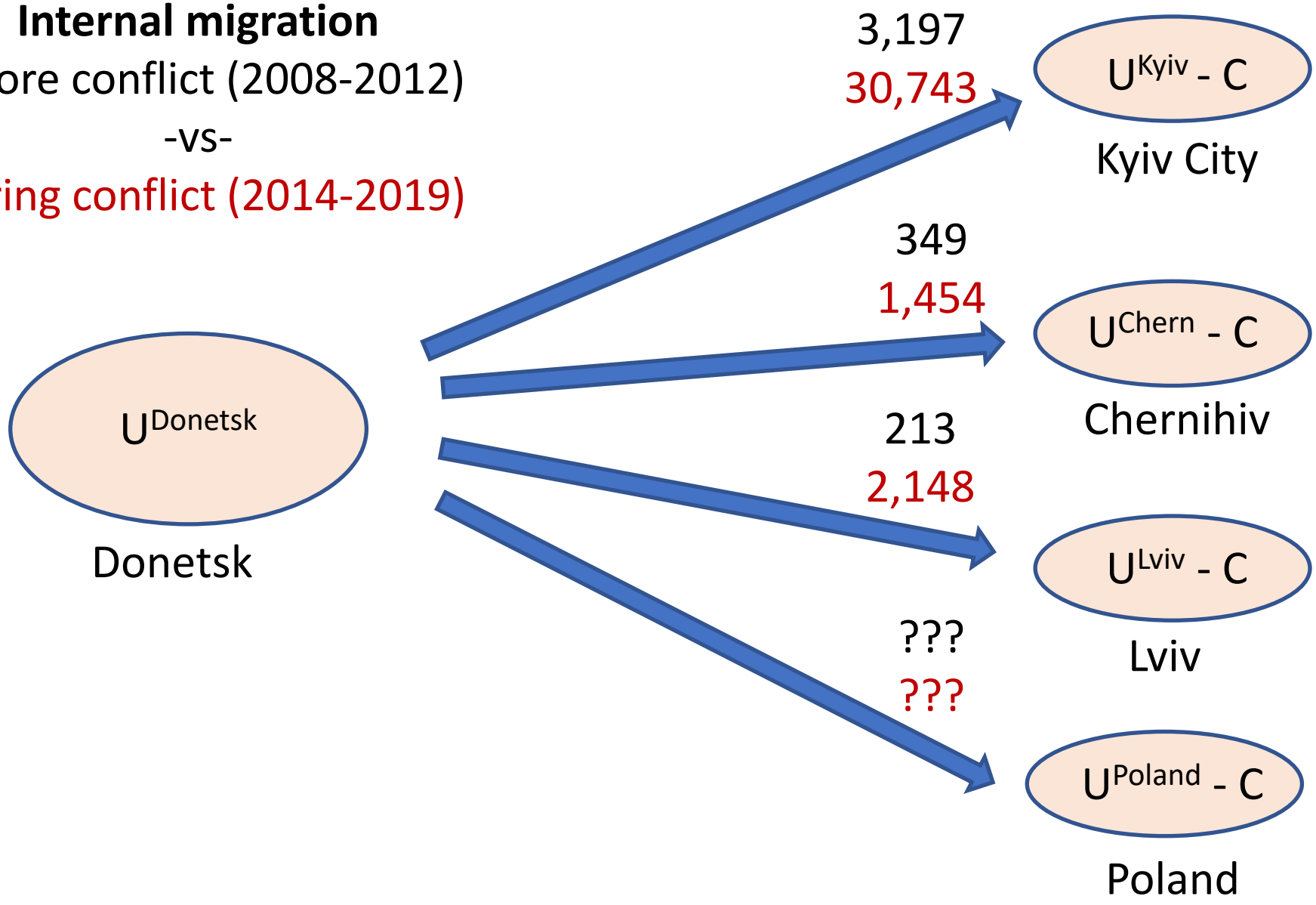
- Donbas: *Donetskyi vuhilnyi basein (Donetsk & Luhansk)*
- Center of Ukraine's declining mining industry
- Donetsk was founded by Welsh businessman John Hughes in 1869
  - Steel industry and coal mines
  - Originally named after him (initially Yuzovo)
- Economic decline after the fall of Soviet Union
- Pre-2014, Donetsk was the most populous oblast in Ukraine and 2nd in GRP per capita (and Luhansk was above average in both)
- Conflict started in 2014 and separatists took control of eastern parts

Internal migration

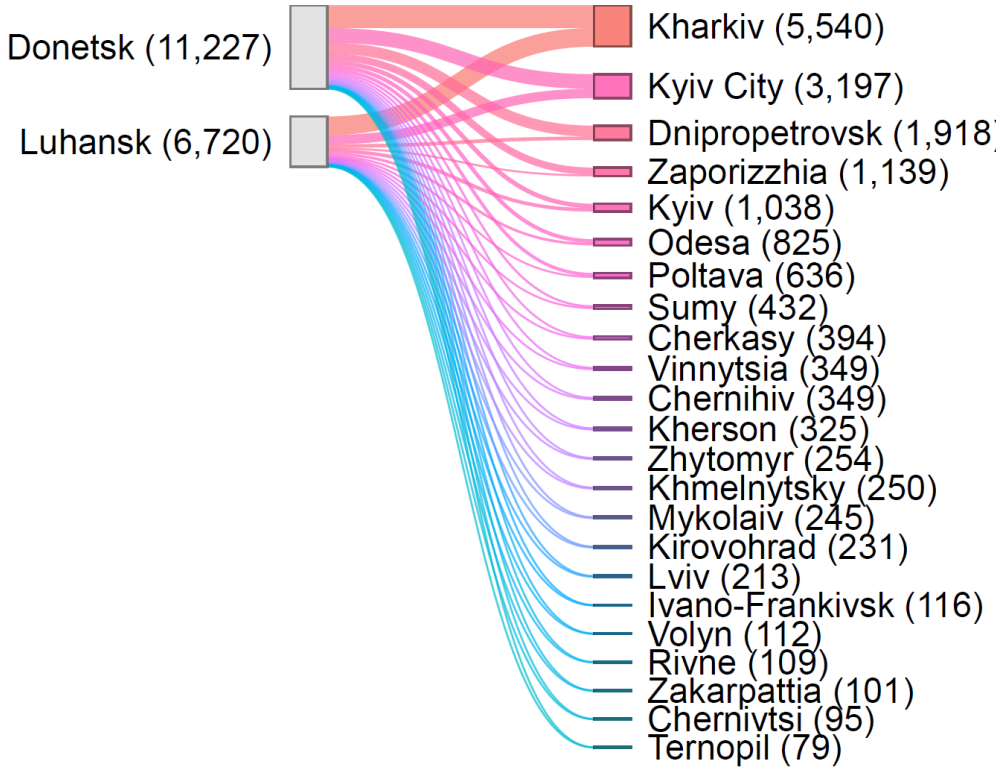
Before conflict (2008-2012)

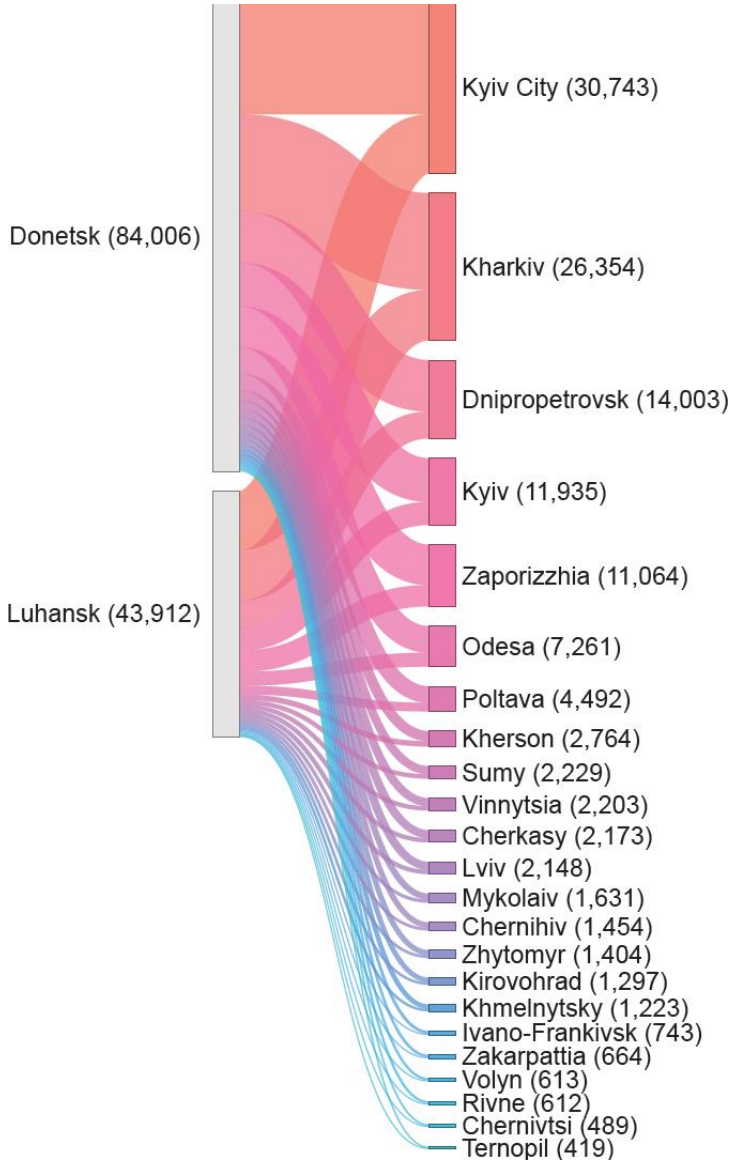
-vs-

During conflict (2014-2019)



Emigration from Donbas 2008-2012 vs 2014-2019





Average 7 times increase in outflows

- Outflows from Donbas suddenly increase between 5 times to 10 times to all oblasts after the conflict

- What can explain this sudden increase in flows?
  - Decrease in expected welfare in Donbas
  - Welfare decrease can be through to non-monetary channels

- Any other alternative explanations?
  - Welfare increase in all other oblasts about the same amount
  - Decline in moving costs from Donbas to other regions

A simple, tractable and general model

- Agents decide based on location-specific value *U*, moving cost *C*, and iid shock *z*:

$$l^* = \arg\max_l \left(U_t^l - C_t^{kl} + z_t^{i,l} \right)$$

utility

moving cost

iid shock (Gumbel)

- Welfare defined as:

$$W_t^k \equiv E_z \max_l \left(U_t^l - C_t^{kl} + z_t^{i,l} \right)$$

Model

- Assume that *utility does not increase in other regions* and *moving costs do not decrease* due to the conflict - or more generally:

$$\sum_{l \in \Phi} \phi_l \Delta \left[U_t^l - C_t^{kl} \right] \leq 0$$

- Then, welfare change upper bound:

$$\Delta W_t^k \leq \frac{1}{\theta} \sum_{l \in \Phi} \phi_l \left(-\Delta \log m_t^{kl} \right)$$

scale parameter (elasticity)

weights

flows

Model

- Let's characterize the utility function as a Bellman equation

$$U_t^k = \upsilon\left(w_t^k\right) + \eta^k + \beta E_t E_z \max_l \left(U_{t+1}^l - C_{t+1}^{kl} + z_{t+1}^{i,l}\right)$$

wage

amenity parameter

discount factor

next period utility

moving cost

iid shock

where

$$\upsilon\left(w_t^k\right) = \frac{\left(w_t^k\right)^{1-\sigma} - 1}{1-\sigma}$$

Implementation

- Define forward looking behavior
  - Discount factor [**β = 0.97**, **0.90** or **0**]
- Define functional form of the utility function
  - Risk neutral or risk averse [**σ = 1** or **0**]
- Estimate dispersion parameter (migration semi-elasticity) [**θ = 0.6**]
- Migration data from Donetsk and Luhansk to other oblasts [**m**]
  - Exclude border oblasts or oblasts with large airports
  - Exclude large oblasts
- Other robustness tests and variations

Results

- What is the change in income that gives the same decline in utility as the conflict?

- Similar numbers for Donetsk and Luhansk
- Equivalent impact depends on the structure of utility function
- ***Ukraine-wide impact unaccounted: Numbers are lower bounds***

- Amortized as a ten-year loss
  - Risk-averse [σ= 1] → Donetsk loss: **31%** to **40%**
  - Risk-neutral [σ= 0] → Donetsk loss: **28%** to **38%**

- Calculated as a life-time loss
  - Risk-averse [σ= 1] → Donetsk loss: **9%** to **8%**
  - Risk-neutral [σ= 0] → Donetsk loss: **7%** to **25%**

Conclusion

- Welfare impact of conflict can be estimated from migration outflows

- Requirements:
  - Proper estimation of the elasticity governing parameter
  - Migration outflow data *before* and *after* the shock

- Caveat: Cannot be applied to all conflict situations

- The conflict in Eastern Ukraine pre-2022 invasion significantly reduced welfare of Donbas residents:
  - Lower-bound estimates suggest welfare reduction equivalent to about 7% to 25% life-time income loss

Thank you

VOX EU column:

https://cepr.org/voxeu/columns/estimating-true-cost-war-conflict-eastern-ukraine-2014-2019

IZA working paper:

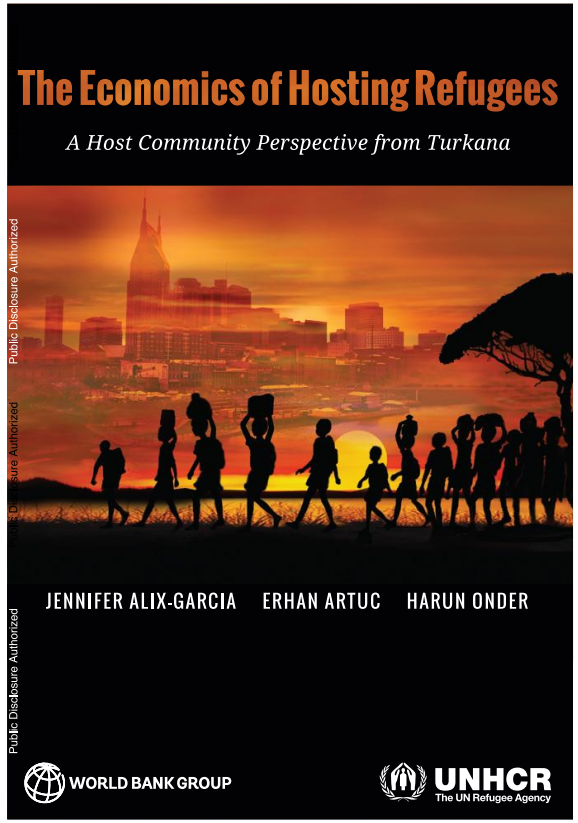
https://www.iza.org/publications/dp/15900/the-true-cost-of-war

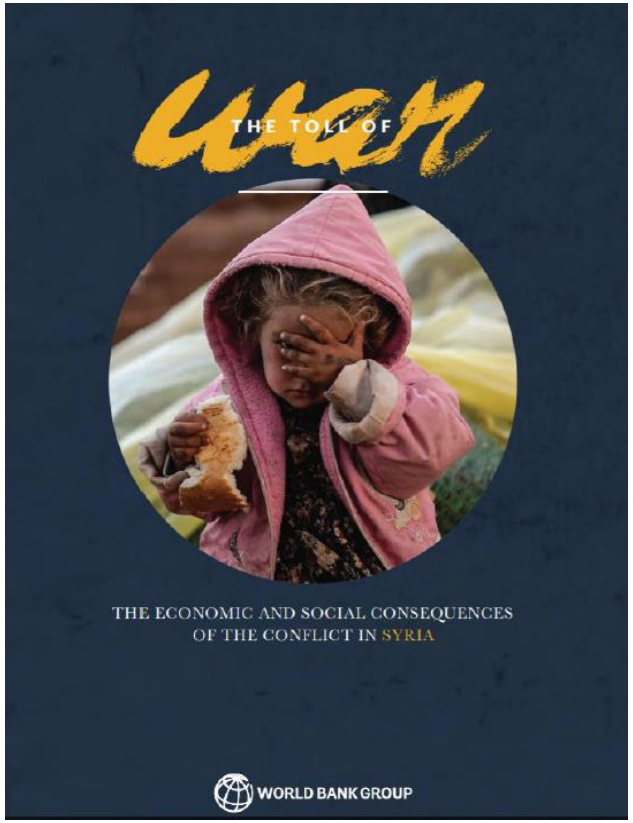
WB working paper:

http://documents.worldbank.org/curated/en/099846210202232755

Measure impact of conflict in data-constrained environments

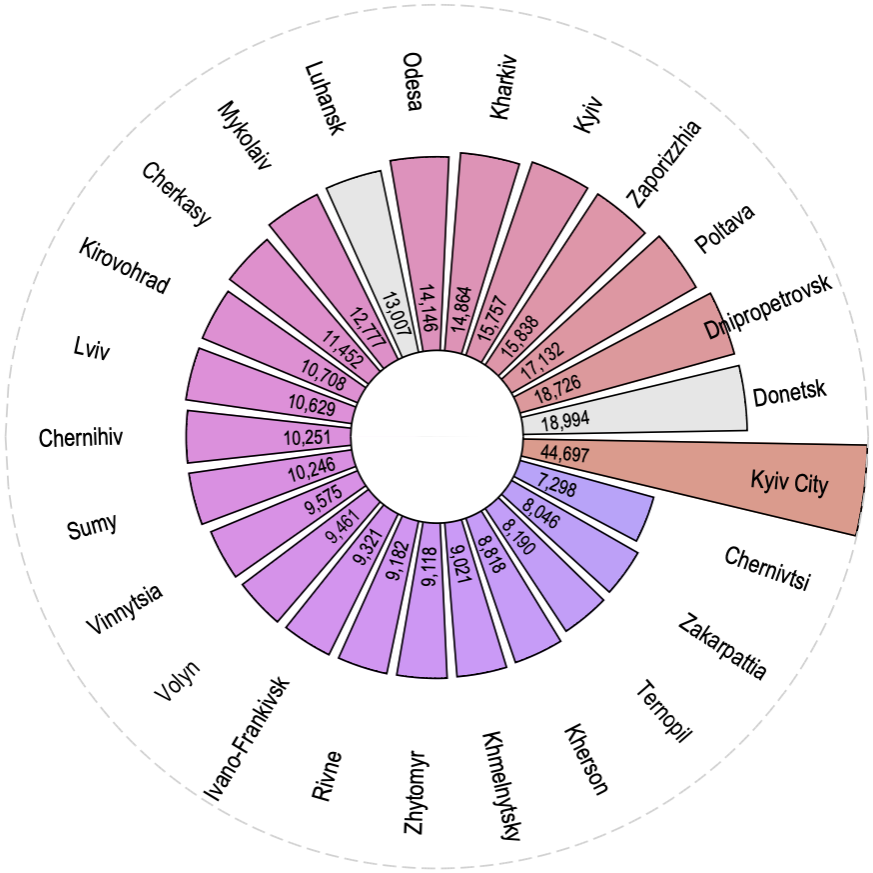
Building on experience and data from previous policy work in 2019



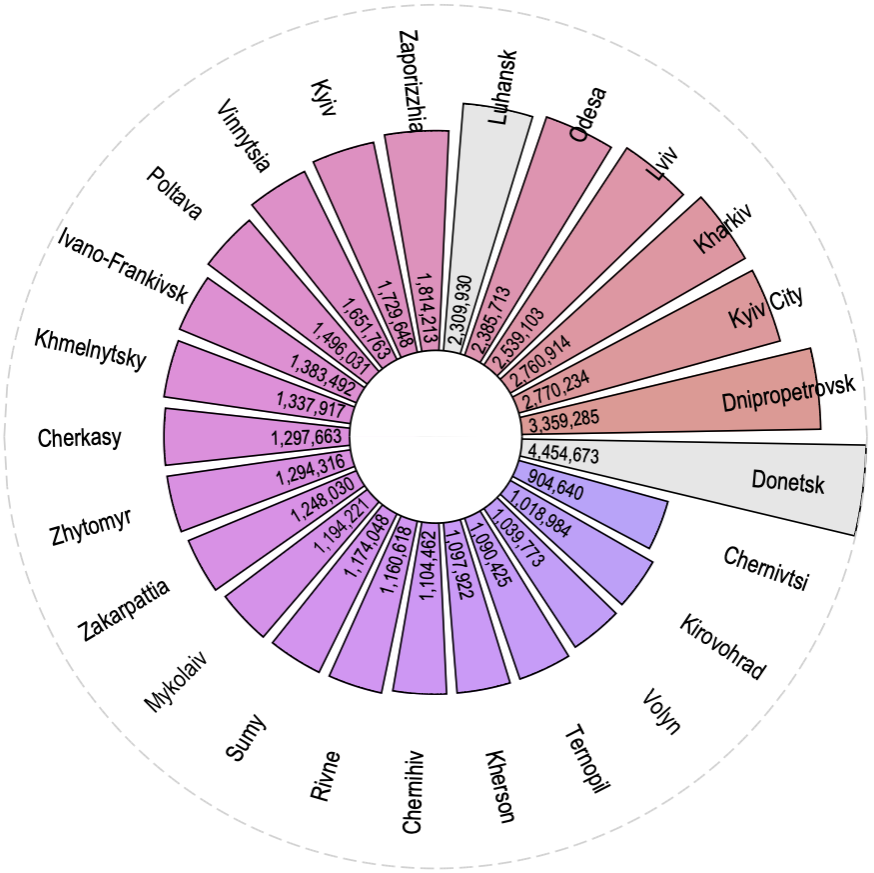


Extra Slides

(a) Real GRP per capita

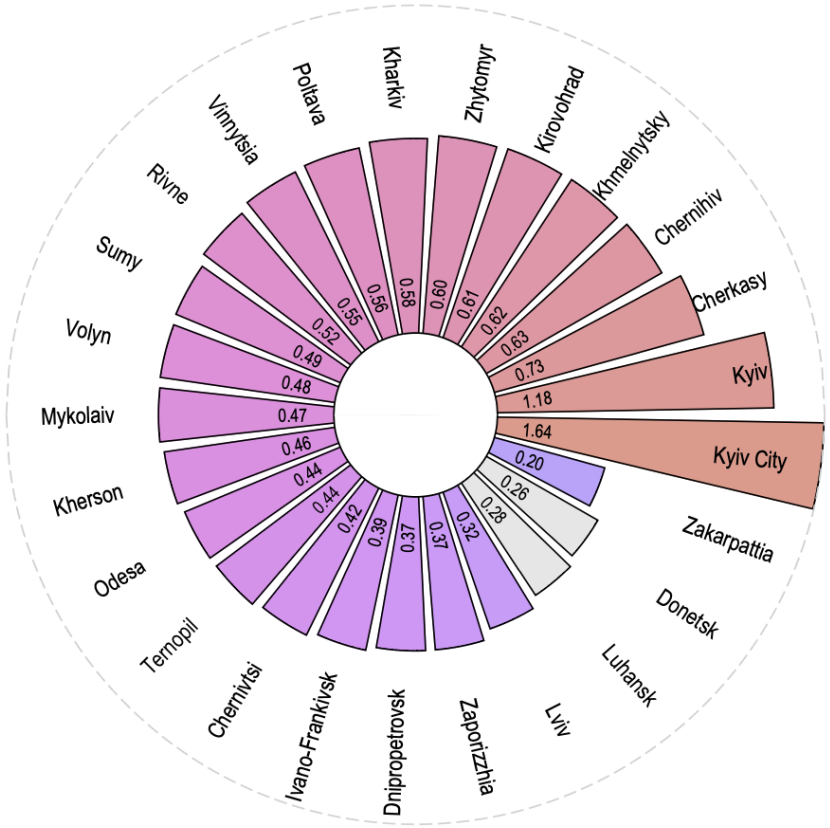


(b) Population

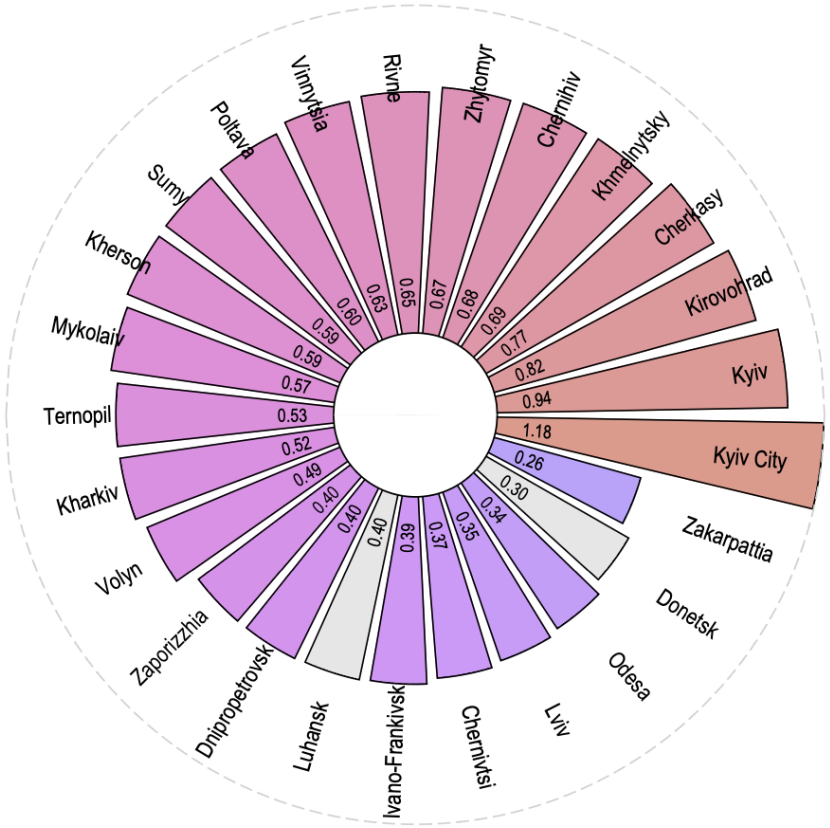


Extra Slides

(c) Migration inflows
(of destination population)



(d) Migration outflows
(of source population)



Extra Slides - Model

- We try to write the simplest possible general discrete choice migration model, while keeping it reasonably general and tractable
  - Agents are homogenous
  - Dynamic or static variations possible
  - Consider Frechet or Gumbel iid shocks
  - Allow risk neutral or risk averse agents

- Agents choose a region in each period given the future expected income, moving costs and iid shocks

Extra Slides - Model

Expected welfare calculated as:

$$W_t^k = \frac{1}{\theta} \log \left[\sum_l \exp \left(U_t^l - C^{kl} \right)^\theta \right],$$

Migration:

$$m_t^{kl} = \left(\frac{\exp \left(U_t^l - C_t^{kl} \right)}{\exp \left(W_t^k \right)} \right)^\theta,$$

Welfare change:

$$\Delta W_t^k = \sum_{l \in \Phi} \phi_l \left(\Delta U_t^l - \Delta C_t^{kl} \right) + \frac{1}{\theta} \sum_{l \in \Phi} \phi_l \left(-\Delta \log m_t^{kl} \right),$$

Extra Slides

Table 1: Estimates for migration elasticity parameter (θ)

	$\beta = 0.97$	$\beta = 0.90$	$\beta = 0$
$\sigma = 0$	0.682	0.667	0.479
	(0.053)	(0.063)	(0.197)
$\sigma = 1$	0.612	0.601	0.458
	(0.027)	(0.035)	(0.162)

Extra Slides

Table 2: The estimated welfare impact of the conflict by region

	$\sigma = 0$		$\sigma = 1$	
	Donetsk	Luhansk	Donetsk	Luhansk
$\beta = 0.97$	-2.91	-2.60	-3.24	-2.90
	(0.15)	(0.29)	(0.16)	(0.32)
$\beta = 0.90$	-2.97	-2.66	-3.30	-2.95
	(0.15)	(0.29)	(0.16)	(0.33)
$\beta = 0$	-4.14	-3.70	-4.33	-3.88
	(0.21)	(0.41)	(0.22)	(0.43)

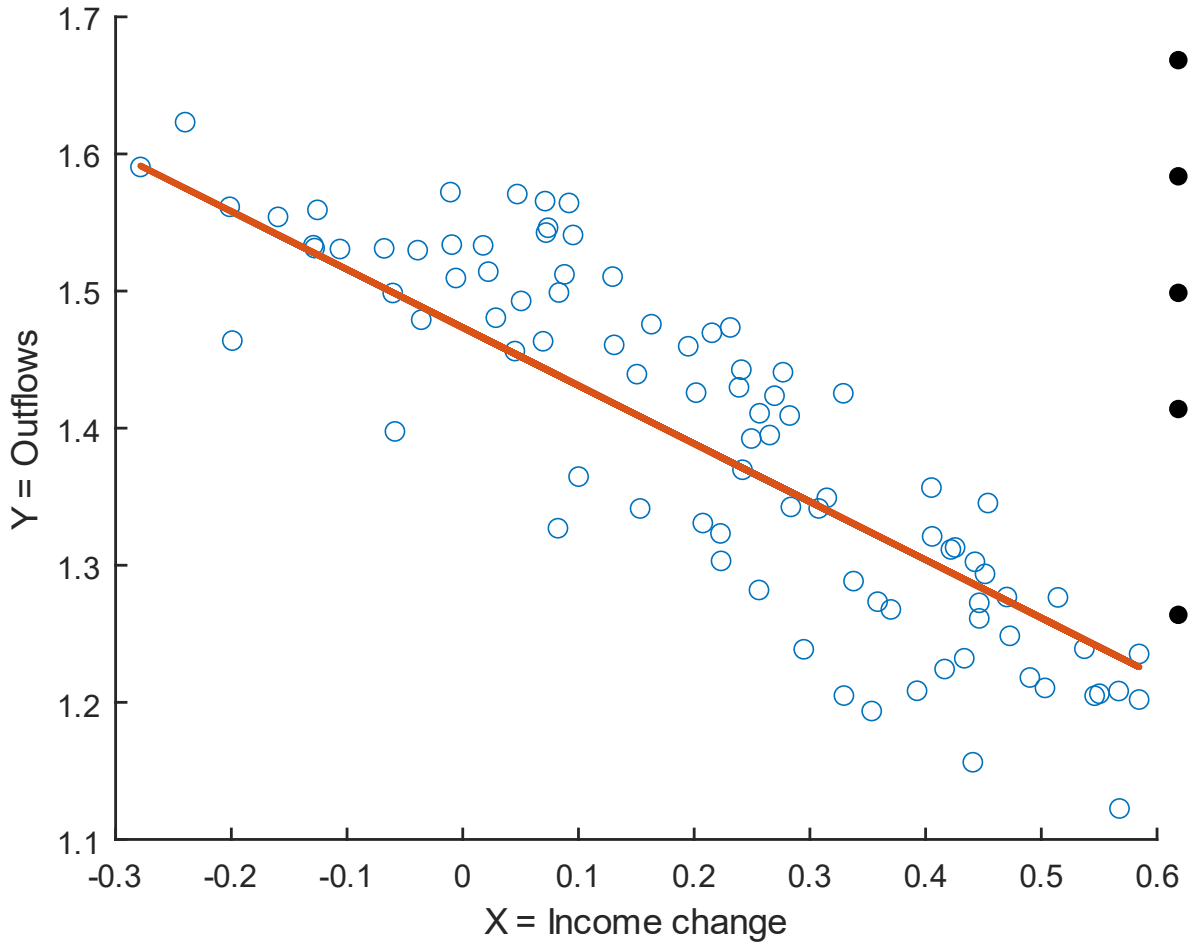
Extra Slides

Table 3: Income equivalent of the welfare loss, percent

		$T=1$		$T=10$		$T=\infty$	
		Donetsk	Luhansk	Donetsk	Luhansk	Donetsk	Luhansk
$\sigma=0$	$\beta=0.97$	-242.61	-245.41	-27.72	-28.04	-7.28	-7.36
		(11.93)	(27.07)	(1.36)	(3.09)	(0.36)	(0.81)
	$\beta=0.90$	-247.92	-250.79	-38.06	-38.50	-24.79	-25.08
		(12.20)	(27.66)	(1.87)	(4.25)	(1.22)	(2.77)
	$\beta=0$	-345.22	-349.21	-	-	-	-
		(16.98)	(38.52)	-	-	-	-
$\sigma=1$	$\beta=0.97$	-96.08	-94.48	-30.93	-28.18	-9.26	-8.32
		(0.62)	(1.69)	(1.25)	(2.60)	(0.43)	(0.88)
	$\beta=0.90$	-96.31	-94.77	-39.74	-36.43	-28.10	-25.55
		(0.59)	(1.63)	(1.49)	(3.14)	(1.16)	(2.40)
	$\beta=0$	-98.69	-97.93	-	-	-	-
		(0.28)	(0.86)	-	-	-	-

Extra Slides - Intuition: migration elasticity

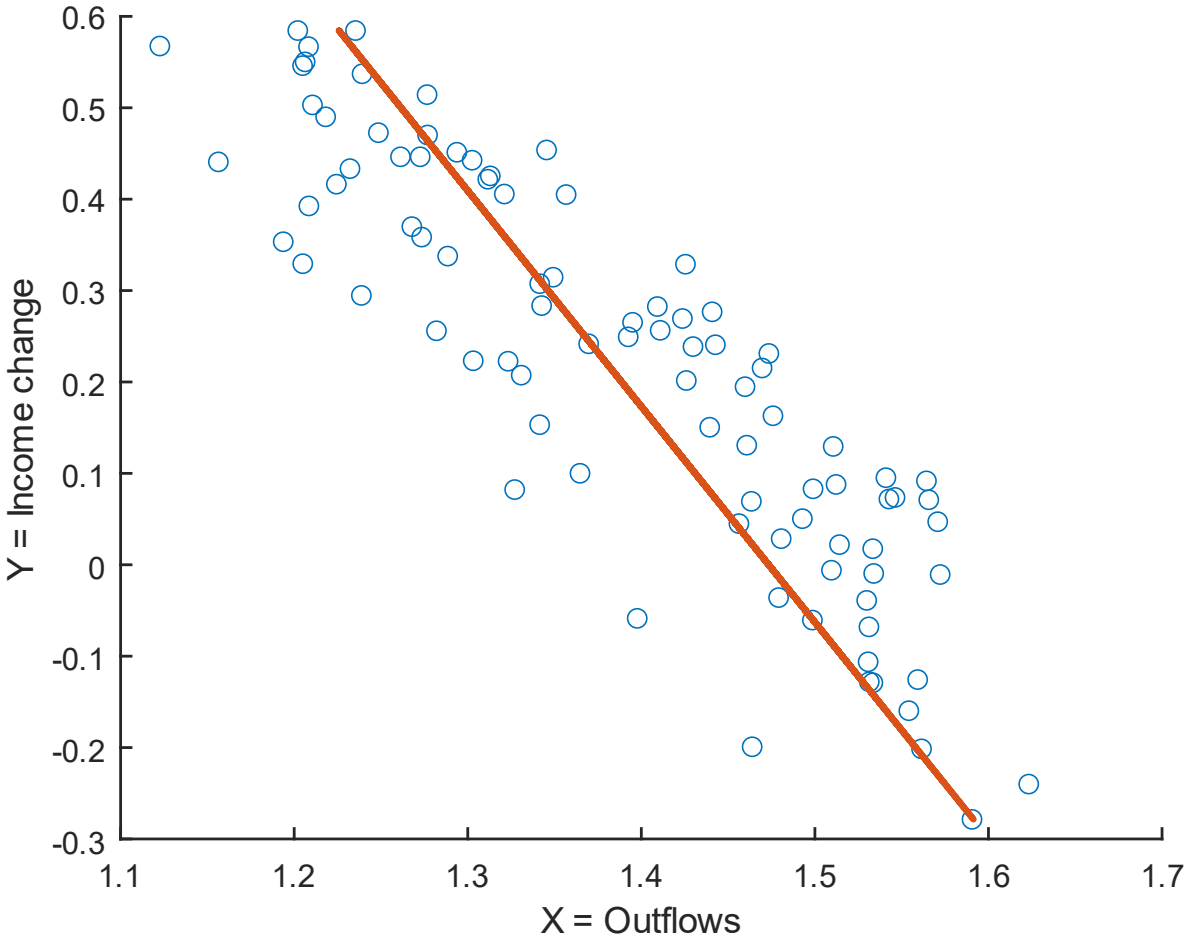
What is the impact of income change on migration outflows?



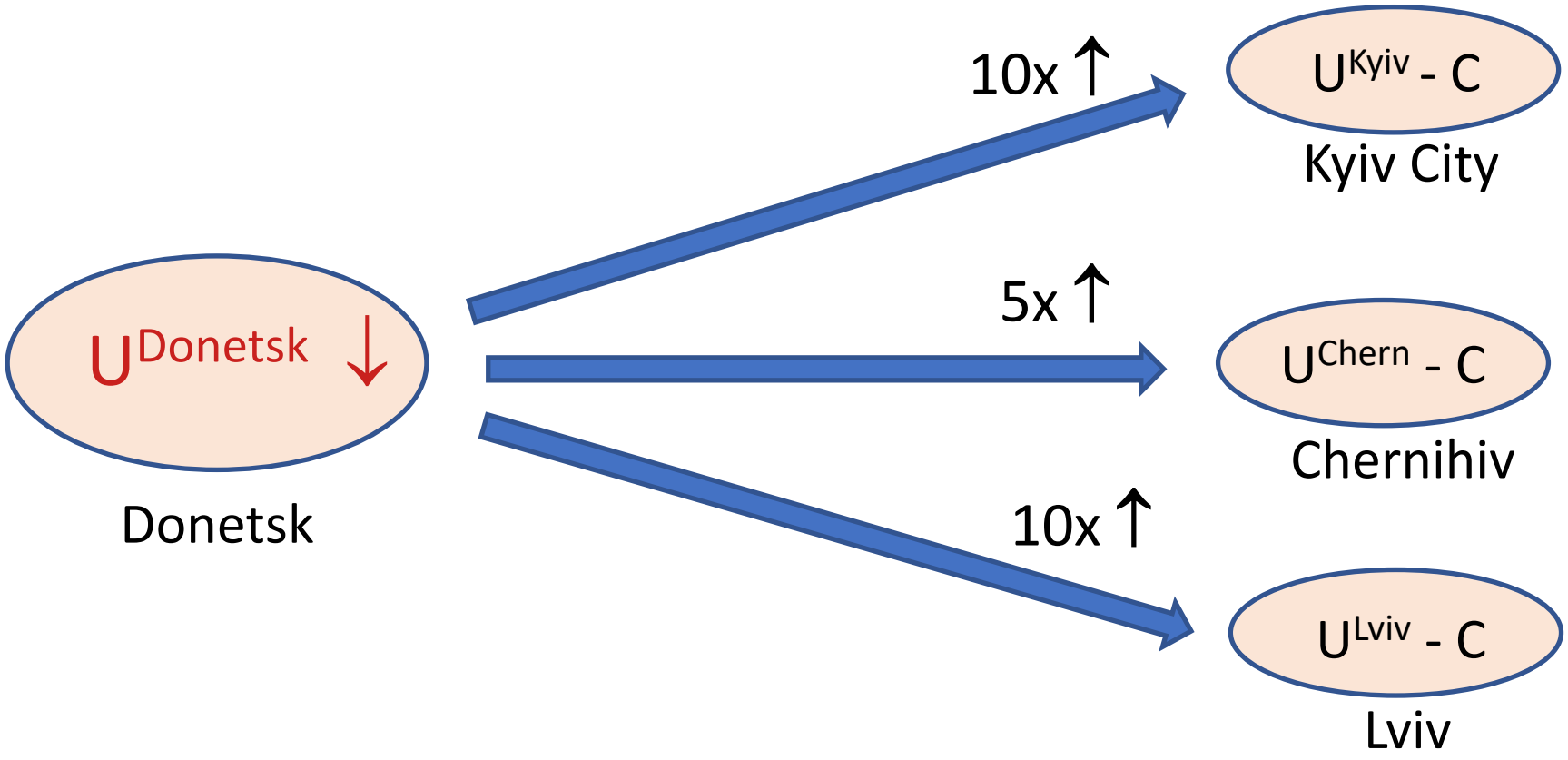
- Ukraine 2008-2012
- Instrumental variables
- Map income change to flows
- 10% increase in income in an oblast, reduces outflows by 6%
- Elasticity = 0.6 (*roughly*)

Extra Slides – Calculate welfare change from migration outflows

Invert the mapping in the previous graph from income to migration



- Note that migration probability ↑ by 700% in Eastern Ukraine
- What does it say about welfare?
- Now, consider the opposite: i.e. map flows to income change
- Flipping the previous graph provides a sufficient statistic



Average 7x ↑ in outflows —> **Very large ↓** in utility $U^{Donetsk}$

To make the residents equally worse off,
what would be the equivalent reduction in income?