Who wins wars?

Jonathan Federle, Dominic Rohner, and Moritz Schularick

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Motivation

Interstate wars require substantial resources. . .

- Countries with more wealth and more military assets tend to get their way (Beckley 2018, Mearsheimer 2001, Nye 2011, Wohlforth 1993)
- State capacity and fiscal revenues affect war outcomes (Gennaioli and Voth, 2015)

. . . but the causal role of money in winning wars is notoriously difficult to measure

- Military expenditures as an endogenous choice variable
- Numerous observable and unobservable confounders

What we do

Systematic analysis of **700+ militarized interstate disputes** between **1977–2013**

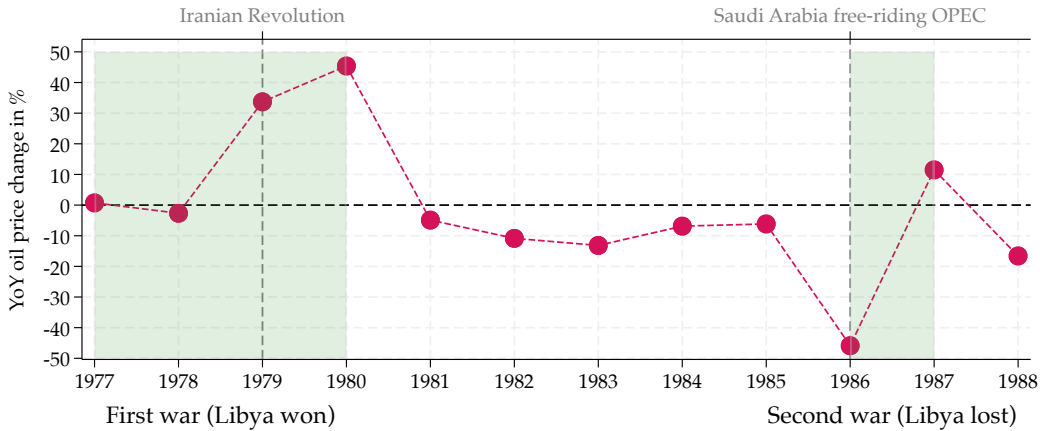
Exploit exogenous price changes of about 300 products during conflicts to assess the role of money

⇒ **Money drives war outcomes**

- Key result: 10% windfall gain relative to GDP increases chances of winning instead of ending up in a draw by 3.2%
- Mechanism: As export revenues appreciate, so do government revenues and military expenditures.

A case study of the Chadian-Libyan wars

How oil prices directed the course of a war



⇒ **Libya needed oil revenues to finance the war** Narratives

Are the Chadian-Libyan wars an exception?

Various other historical examples...

- Sierra Leone v Nigeria ('97-'98): Demand shock induced by Asian economic crisis led to oil price drop (Oxford Energy Forum 2009), affecting Nigeria's economic condition and its ability to sustain defense expenditures (SIPRI research report no 17, p. 88).
- Uganda v Tanzania ('78-'79): World coffee prices dropped. "It appears that smuggling, sagging production, and plummeting world prices did more to bankrupt Uganda than did the U.S. embargo." (Foreign Policy, 1980)

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...warrant a systematic analysis

- We examine more than 700 militarized interstate conflicts since 1977
- A 10% windfall gain for one conflict party relative to its GDP increases its probability of winning instead of ending up in a draw by 3.2% (likewise ending up in a draw instead of losing)

Related literature

Commodity price fluctuations affect...

- government revenues (Caselli and Michaels, 2013), and
- course and incidence of civil war (Dube and Vargas, 2013; Bazzi and Blattman, 2014; Berman et al., 2017; McGuirk and Burke, 2020; Gehring, Langlotz and Kienberger, 2023)

Economic power and interstate war outcomes

- Economic factors matter for projection of power in interstate conflicts (Wohlforth 1993, Mearsheimer 2001, Nye 2011)
- Measuring the power of nations (Singer, 1988) and its association with war outcomes (Wayman, Singer and Goertz, 1983; Beckley, 2018)
- Tax revenues and state capacity and war outcomes (Gennaioli and Voth 2015)

$\Rightarrow$ **Measures depend endogenously on choice variables**

Data and basic facts

Annual observations: 1977–2013

Trade data at 3-digit SITC level

- Prices backed out from Comtrade details
- Revenues from Harvard Atlas of Economic Complexity details

Macroeconomic variables from various sources:

- Military expenditures, GDP, external debt, and inflation from World Bank
- Government revenues from IMF (Mauro et al., 2015)
- Population data from Maddison project (Bolt and Luiten van Zanden, 2020)

Militarized interstate disputes and outcomes from the Correlates of War Project (Jones, Bremer and Singer (1996); Maoz et al. (2019)) mapped into today's countries using concordance tables of Federle et al. (2024)

Dyadic conflicts: Outcomes and narratives

Conflict outcomes at the dyadic level based on extensive narratives coding rules example

- We define the winner of a conflict as the country that achieved a favorable change following military actions or in exchange for stopping military threats and attacks
- We define as "draw" those conflicts where the outcome does not favor either side in the dispute or each side in the dispute agrees to make concessions in roughly equal parts

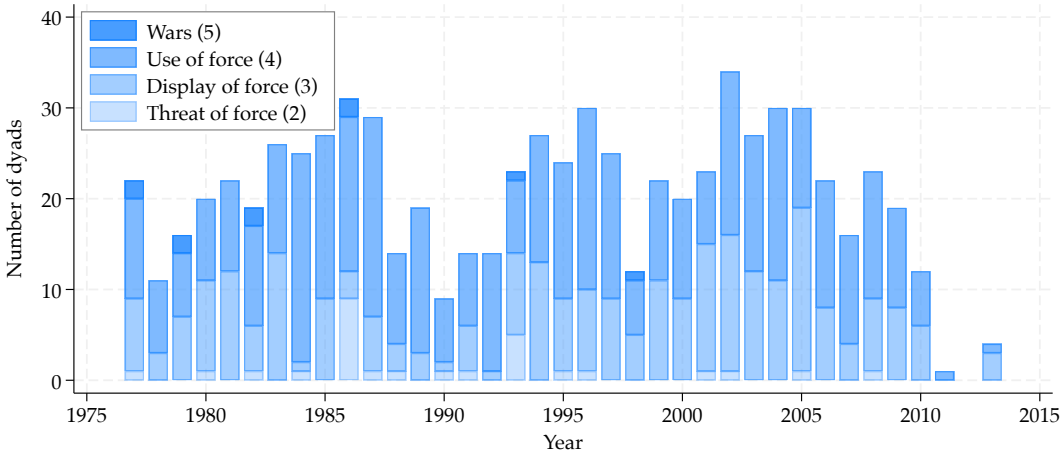
Ensure dyads are unique by keeping only those where country code of country A is higher than that of country B, e.g.,

#	Country A	Country B	Conflict Start	Outcome
1	USA	AFG	2001	Country A won
~~2~~	~~AFG~~	~~USA~~	~~2001~~	~~Country B won~~

Dyadic conflicts: Severity and distribution, 1977–2013

Conflicts vary by maximum levels of hostilities

Military expenditures by severity | Military expenditures across winners and losers



Windfalls and conflict outcomes

Defining absolute windfall gains

We have a set of **conflict-specific variables**...

- D dyadic conflicts with $d \in [1 \dots D]$
- Conflict start year t_d and duration l_d in years
- A pair of opponent countries per dyad $o_d = \{o_d^a, o_d^b\}$, each abbreviated as a or b

Defining absolute windfall gains

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...and a set of **trade-specific variables**

- C is the set of different commodities, each traded at price $p_{c,t}$ in year t
- $X_{c,t}^a$ denotes opponent a's value of net exports of commodity c in year t

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$$\Delta V_d^a = \underbrace{\sum_{i=0}^{l_d-1} \underbrace{\sum_{c \in C} \overbrace{\left(\frac{p_{c,t_d+i}}{p_{c,t_d-1}} - 1\right)}^{\text{Returns on commodity } c} * \overbrace{X_{c,t_d-1}^a}^{\text{Pre-conflict net exports of } c \text{ by } a}}_{\text{...of all commodities}}}_{\text{...over all years in which the conflict is ongoing}} . \quad (1)$$

ΔV_d^a is the appreciation of a's pre-conflict net exports due to price changes during d

Defining relative windfall gains

Recall: Each dyadic conflict d comprises...

- An opponent pair a and b
- A start year t_d
- a and b experience absolute windfall gains (losses) of ΔV_d^a and ΔV_d^b over the course of conflict d

$$W_d = \frac{\Delta V_d^a}{GDP_{t_d-1}^a} - \frac{\Delta V_d^b}{GDP_{t_d-1}^b} \tag{2}$$

For a dyadic war d, W_d equals 0.01 if the value changes of net exports of party A relative to its GDP are 1 percentage point larger than those of country B.

Sample

We run our estimations on two samples:

1. all disputes
2. excluding extremely large disputes with more than 10 wars as we presume our bilateral windfall measure to lose meaning for huge coalitions (e.g. 55 dyads in second Gulf War)

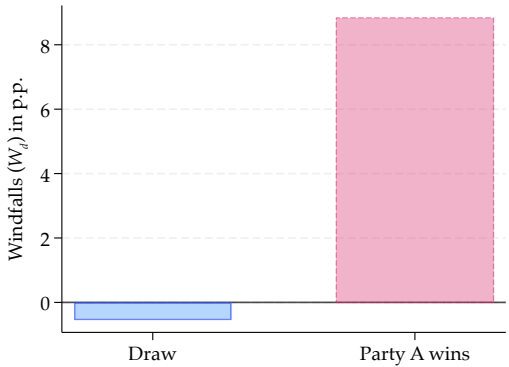
In our baseline, report results where we exclude large wars but present extensive robustness tests on variations details

		Start year		Duration (days)		Windfalls W_d			
	Wars	Min	Max	Mean	SD	Mean	SD	Min	Max
Baseline	742	1977	2013	119	278	.009	.168	-1.464	3.264
All disputes	885	1977	2013	140	350	.009	.162	-1.464	3.264

Substantial variation in windfall gains around wars, but zero on average. Also no indication of wars systematically increasing commodity prices details

Descriptives

Windfalls W_d conditional on war outcome



$\Rightarrow$ **Windfalls in draw smaller than those in case of a victory by party A, as implied by both a one-sided t-test ($p < 0.001$) and a Welch test ($p = 0.068$)**

Empirics and main results

Empirical framework (OLS)

Point of departure: simple ordinary least squares

$$q_{ot} = \beta\ W_{ot} + \mu_{ot} + FE_o + FE_t + \varepsilon_{ot} \tag{3}$$

where the dependent variable is defined as

$$q_{ot} = \begin{cases} 1, & \text{if opponent } a \text{ won} \\ 0, & \text{if the war ended in a draw} \\ -1, & \text{if opponent } a \text{ lost} \end{cases} \tag{4}$$

Also...

- FE_o and FE_t are dyad and start-year fixed effects
- W_{ot} is the windfall difference as discussed in previous slides
- Only include dyads where iso code of country $a >$ iso code of country b (e.g., RUS-UKR would be included, UKR-RUS not)
- μ_{ot} is a vector of controls comprising log differences in opponents pre-conflict population and GDP
- Standard errors clustered at the dyad level

Result: windfall gains affect war outcomes

	Conflict outcome (q_{pt})			
	(1)	(2)	(3)	(4)
Windfalls (W_{pt})	0.251***	0.254***	0.296***	0.320***
	(0.0777)	(0.0755)	(0.0824)	(0.0842)
Controls		✓	✓	✓
Dyad fixed effects			✓	✓
Year fixed effects				✓
Adj. R^2	0.021	0.021	0.083	0.082
N dyads (clusters)	226	212	121	121
N	742	688	597	596

Note: Standard errors clustered at dyad level and reported in round brackets. Controls comprise log differences of the opponent's GDP and population, respectively. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Interpretation: Holding the windfalls of the party B constant...

- an increase in windfalls for party A relative to its GDP by 10 percentage points increases its chances of falling into the next-better outcome category by 3.2% (i.e., *lose* $\rightarrow$ *draw* or *draw* $\rightarrow$ *win*).

Robustness and further evidence

Further specifications/evidence

- Only consider commodities with export and import shares $< 10\%$ details
- Also include excessively large wars details
- Ordered logit details

Other robustness tests

- Two placebo tests: shuffling windfall gains and randomizing war start years
- Account for varying war length in a weighted regression details
- Alternative measure of windfalls details
- Excluding "yield outcome" details
- Restricting to conflicts of hostility ≥ 3 and ≥ 4

Control for outliers

- Dropping conflicts , dyads , countries , and entire product groups , one at a time

Inspecting the mechanism: Windfalls and the economy

Empirical framework: Unconditional effects of windfalls on the economy

Now: **Annual windfall shocks**, relative to the countries' pre-shock GDP and given by

$$\varepsilon_{i,t} = \frac{\text{YoY Windfalls}_{i,t}}{GDP_{i,t-1}} \,. \tag{5}$$

Then, we estimate a set of simple **ordinary least squares regression**

$$x_{i,t} = \alpha_i + \eta_t + \psi^+ \varepsilon^+_{i,t} + \psi^- \varepsilon^-_{i,t} + u_{i,t} \,, \tag{6}$$

where

- $x_{i,t}$ is two-period change of either **military expenditures**, **government revenues**, or **external debt**, relative to the pre-shock GDP,
- α_i and η_t are country and time fixed effects, and
- $\varepsilon^+_{i,t}$ and $\varepsilon^-_{i,t}$ are signed versions of the windfall variable,
- $u_{i,t}$ is the error term

Results: Unconditional effects of windfalls on the economy

	Military expenses	Gov. revenue	Ext. debt
Windfall (pos.)	0.0482*	0.325***	-0.136**
	(0.0254)	(0.0963)	(0.0594)
Windfall (neg.)	-0.000737	0.0421	-0.00293
	(0.00149)	(0.0396)	(0.00941)
Difference	0.049*	0.282***	-0.133**
F-Statistic	3.871	9.634	6.196
Country fixed effects	✓	✓	✓
Year fixed effects	✓	✓	✓
Adj. R^2	0.136	0.141	0.230
N	4,329	1,690	3,511

Note: Standard errors twoway clustered at country year level and reported in round brackets. P-values reported in curly brackets.

Windfalls increase government revenues, decrease external debt, and increase military expenditures

Empirical framework: Zooming into times of conflict

Now: allow coefficients to differ in times of conflict and peace

$$\cdots + \psi_c^+ \, conflict_{i,t} \varepsilon_{i,t}^+ + \psi_p^+ (1 - conflict_{i,t}) \varepsilon_{i,t}^+ +$$
$$\psi_c^- \, conflict_{i,t} \varepsilon_{i,t}^- + \psi_p^- (1 - conflict_{i,t}) \varepsilon_{i,t}^- + \dots ,$$

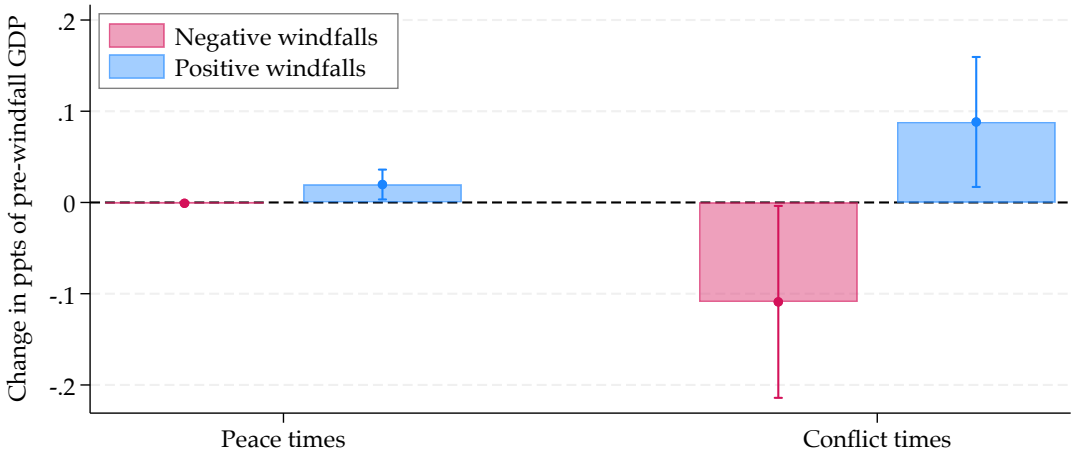
Then...

- ψ_w^+ and ψ_p^+ yields the change of the outcome variable to *positive* windfall shock in times of war and peace, respectively
- ψ_w^- and ψ_p^- yields the change of the outcome variable to *negative* windfall shock in times of war and peace, respectively

Results: Zooming into times of conflict

Response of military expenditures to 1 percentage point windfall gain relative to GDP

Revenues/Debt during conflict | Full table



Conclusion

Conclusion

Global commodity prices significantly shape war outcomes via...

- government revenues, which in turn feed into
- military expenditures

$\Rightarrow$ **Money wins wars!**

Implications

- Sanctions may directly impair military capacity of countries
- Dominant suppliers may deliberately shape the geoeconomic landscape even without being formally involved in war
- Corroborates Gorodnichenko et al. (2024) and Garicano, Rohner and di Mauro (2022), who argue that Russia's ongoing war effort in Ukraine is significantly underpinned by export revenues.

Outlook: Political economy of windfalls $\Rightarrow$ Heterogeneous effects across regimes?

Appendix

Chadian-Libyan wars

How Libya's dependency on oil exports influenced war outcomes

Back

War I. 1977-1980

- Libyan occupation of the Aouzou Strip in Chad. Significant military engagements and support for various rebel groups aiming to overthrow the Chadian government.
- Oil supply shock: Iranian revolution
- "By 1980, oil revenues were over US $20 bn [...] permitting large allocations to consumption, defence, and international ventures" (Allan, 1983)

War II. 1986-1987:

- Decisive Battle of Aouzou and withdrawal of Libyan forces from Chad in 1987
- Oil supply shock: Saudi Arabia drove prices to Cournot level (Griffing and Neilson 1993)
- "inability of oil-exporting Libya to pay in cash for its Soviet arms purchases as a result of the dramatic drop in global oil prices at a time when the Soviets needed hard currency further diminished Tripoli's attractiveness for Moscow" (Ronen 2014)

Conflict outcomes: Coding rules

Back

Victory "A victory can be identified whenever one or more state(s) are able to secure a favorable change through the application of successful military actions which directly leads to a forced alteration of the pre-dispute status quo"

Yield "Whenever a state offers concessions that alter the status quo in exchange for not being militarily threatened or to stop further military attacks, the "losing" state has yielded to the pressure imposed by the "winning" state."

Stalemate "A stalemate [...] is identified when the outcome does not favor either side in the dispute"

Compromise "A compromise is defined as a situation in which each side in the dispute agrees to give up some demands or make concessions with regard to the status quo."

Released "It is identified whenever the seizure of material or personnel culminates with their release from captivity."

Unclear "An unclear outcome exists whenever the historical sources provided either conflicting interpretations or ambiguous information about post-dispute status quo."

*Green = Our definition of winning/losing, Red = Our definition of a draw, Grey = excluded

Conflict outcomes: An example narrative

Conflict between USA, UK, and Kuwait in 1996

Back

"The dispute began when Iraq amassed 30,000 to 40,000 troops a few miles south of Erbil, a village outside the Kurdish zone in northern Iraq. [...] Iraq moved into the northern flight exclusion zone in order to aid their Kurdish allies in attacking a rival Kurdish faction. [...] The United States launched several attacks on Iraqi military sites in the southern no-flight zone and increased its presence in the region. [...] Iraq slowly withdrew its forces from the northern flight exclusion zone, largely in response to American pressure."

As Iraq yielded to the pressure imposed by the U.S., it is coded to have lost the conflict

Commodity prices

Back

Bilateral trade data on 304 SITC 3-digit products between 1976 and 2013 from **Comtrade**.

For each year t, observations comprise exporter country i, importer country j, the type of commodity c, the transaction net weight $w_{c,t}^{i\to j}$, and the free on board value $F_{c,t}^{i\to j}$. Thus, the price that country i paid j for commodity c in year t can be recovered by

$$p_{c,t}^{i\to j} = \frac{F_{c,t}^{i\to j}}{w_{c,t}^{i\to j}} \tag{7}$$

We define the country-invariant price series of each commodity, $p_{c,t}$, as the median price paid for commodity c across all trades in period t.

Commodity prices

Back

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To account for illiquid goods and reporter biases:

- Drop goods in top percentile in terms of price volatility (based on yoy returns)
- Drop prices of commodities for which we have less than 5 reporter countries in a given year

Trade data and product prices

Back

We also source bilateral trade data from the **Harvard Atlas of Economic complexity**

Harvard Atlas adjusts for misreporting of trade data in two steps

1. Estimate an index of reporting reliability for reporter countries leveraging the fact that the same trade flows are usually reported twice (by the importer and exporter country)
2. Adjust the trade flows based on the reporting reliability of the countries involved

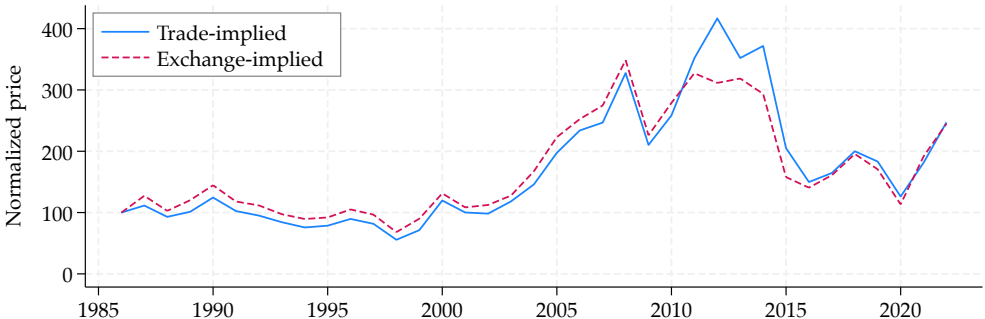
But: Does only comprise aggregate values and no data on net weights or quantities traded

- Use Comtrade to construct price indices of commodities
- Use Harvard Atlas to asses pre-war tade levels

Cross-validation using oil prices

Blue solid line: our price measure for SITC 333, red dashed line: WTI spot price, both inflation adj.

Back



Results

Exclude commodities where parties have import or export shares $> 10\%$

Back

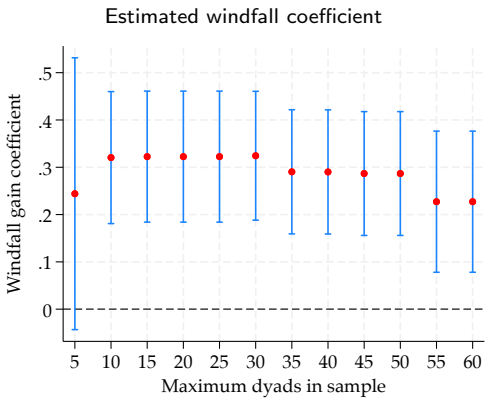
	Conflict outcome (q_{pt})			
	(1)	(2)	(3)	(4)
Windfalls (W_{pt})	0.243***	0.241***	0.248***	0.264***
	(0.0609)	(0.0601)	(0.0687)	(0.0712)
Controls		✓	✓	✓
Dyad fixed effects			✓	✓
Year fixed effects				✓
Adj. R^2	0.024	0.024	0.081	0.078
N dyads (clusters)	226	212	121	121
N	742	688	597	596

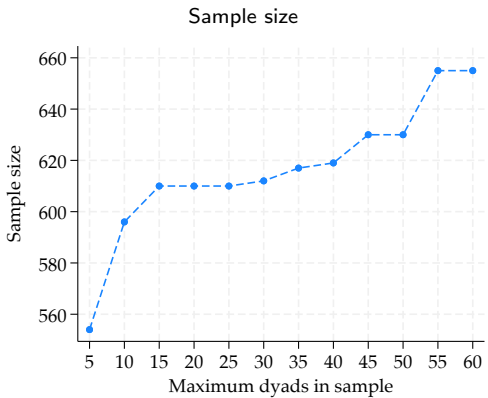
Note: Standard errors clustered at dyad level and reported in round brackets. Controls comprise log differences of the opponent's GDP and population, respectively. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Results

Also include large wars

Back to sample Back to robustness

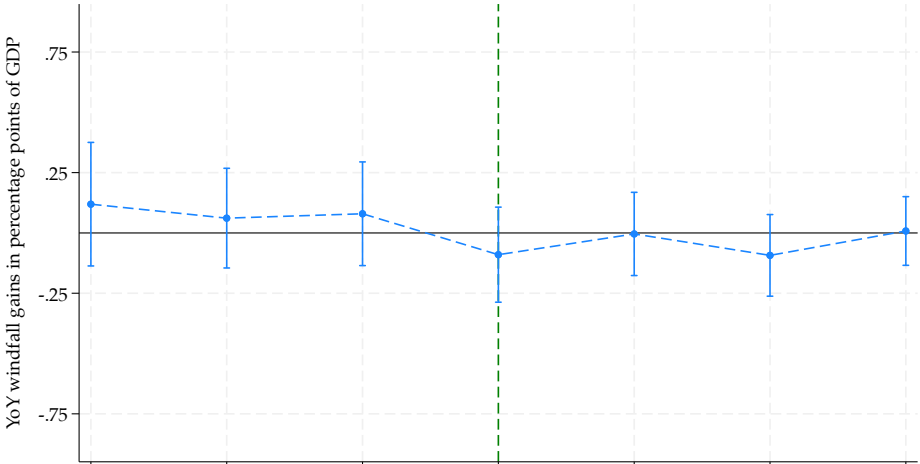




Are windfall gains exogenous to wars?

Figure shows annual windfall gains to prior-year GDP ratio in ppts relative to country average

Back to sample Back to robustness



Results

Ordered logit, coefficients as odds ratios / D_w scaled to denote 1% shock

Back

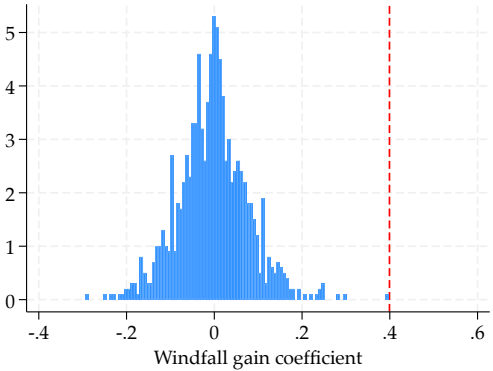
	Conflict outcome (q_{pt})			
	(1)	(2)	(3)	(4)
Windfalls (W_{pt})	1.020**	1.020***	1.048***	1.049***
	(0.00821)	(0.00784)	(0.0186)	(0.0185)
Controls		✓	✓	✓
Dyad dummies			✓	✓
Year dummies				✓
Pseudo R^2	0.021	0.025	0.384	0.382
N dyads (clusters)	226	212	121	121
N	742	688	597	596

Note: Coefficients are represented as odds ratios. Standard errors clustered at dyad level and reported in round brackets. Controls comprise log differences of the opponent's GDP and population, respectively. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Placebo: Randomly assigning war start years

Estimated coefficient reaches baseline in 0 out of 1k of simulations

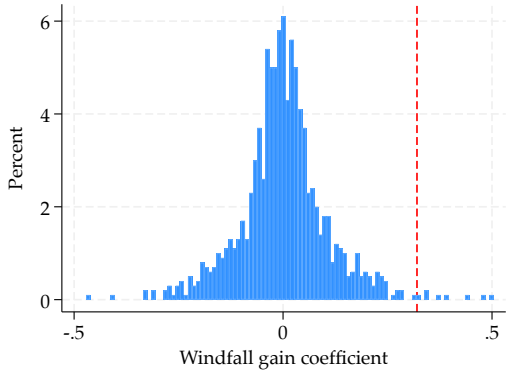
Back



Placebo: Shuffling windfall gains variable

Estimated coefficient reaches baseline in 3 out of 1k of simulations

Back



Weighted regression

Back

Problem: we only have annual observations of commodity prices, while wars vary in duration

E.g., if a conflict lasts from December 2012 until January 2013. Then the price gain variables comprise the entire commodity windfall gains incurred in 2012 and 2013. Yet we do not know "how much of the windfall gains" have been realized in December 2012 and January 2013
$\rightarrow$**The signal-to-noise ratio of our windfall gain measure varies with the length of the war and the number of years that it spans**

Solution: Weighted regression to account for the varying information content of our measure across dyads.

$$\omega_w = \frac{dur_w}{(year_w^{end} - year_w^{start} + 1) * 365} \tag{8}$$

As such, each observation w is assigned a weight ω which is given by the total duration of the conflict in days (dur_w) divided by the total number of days in the years that the war spans.

Results

Accounting for varying war length

	Conflict outcome (q_{pt})			
	(1)	(2)	(3)	(4)
Windfalls (W_{pt})	0.355***	0.352***	0.379***	0.393***
	(0.0732)	(0.0725)	(0.0992)	(0.0685)
Controls		✓	✓	✓
Dyad fixed effects			✓	✓
Year fixed effects				✓
Adj. R^2	0.160	0.181	0.334	0.493
N dyads (clusters)	226	212	121	121
N	742	688	597	596

Note: Standard errors clustered at dyad level and reported in round brackets. Controls comprise log differences of the opponent's GDP and population, respectively. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Not accounting for relative importance of windfalls

Back

Baseline measure adjusts windfalls for relative wealth of warring countries. Consider a war between Liechtenstein and Germany. A $\$100m$ windfall for Liechtenstein likely has different implications than a $\$100m$ windfall for Germany. How do our results behave if we do not account this?

Solution: Redefine windfall measure in a robustness test

Baseline:

$$D_w = \frac{\Delta V_w^a}{GDP_w^a} - \frac{\Delta V_w^b}{GDP_w^b} \tag{9}$$

Now without accounting for relative effects:

$$D_w = \frac{\Delta V_w^a - \Delta V_w^b}{GDP_w^a + GDP_w^b} \tag{10}$$

Results

Not accounting for relative importance of windfalls

Back

	Conflict outcome (q_{pt})			
	(1)	(2)	(3)	(4)
Windfalls (W_{pt})	0.399	0.412	0.525*	0.559*
	(0.322)	(0.318)	(0.304)	(0.288)
Controls		✓	✓	✓
Dyad fixed effects			✓	✓
Year fixed effects				✓
Adj. R^2	0.008	0.008	0.067	0.063
N dyads (clusters)	226	212	121	121
N	742	688	597	596

Note: Standard errors clustered at dyad level and reported in round brackets. Controls comprise log differences of the opponent's GDP and population, respectively. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Results

Excluding "yield" outcomes

Back

	Conflict outcome (q_{pt})			
	(1)	(2)	(3)	(4)
Windfalls (W_{pt})	0.296***	0.301***	0.356***	0.366***
	(0.0694)	(0.0675)	(0.0800)	(0.0821)
Controls		✓	✓	✓
Dyad fixed effects			✓	✓
Year fixed effects				✓
Adj. R^2	0.064	0.080	0.180	0.200
N dyads (clusters)	225	211	118	118
N	710	656	563	562

Note: Standard errors clustered at dyad level and reported in round brackets. Controls comprise log differences of the opponent's GDP and population, respectively. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Results

Restricting sample to conflicts with hostility levels ≥ 3

Back

	Conflict outcome (q_{pt})			
	(1)	(2)	(3)	(4)
Windfalls (W_{pt})	0.253***	0.257***	0.295***	0.317***
	(0.0777)	(0.0750)	(0.0832)	(0.0855)
Controls		✓	✓	✓
Dyad fixed effects			✓	✓
Year fixed effects				✓
Adj. R^2	0.021	0.023	0.080	0.083
N dyads (clusters)	218	204	118	118
N	714	660	574	573

Note: Standard errors clustered at dyad level and reported in round brackets. Controls comprise log differences of the opponent's GDP and population, respectively. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Results

Restricting sample to conflicts with hostility levels ≥ 4

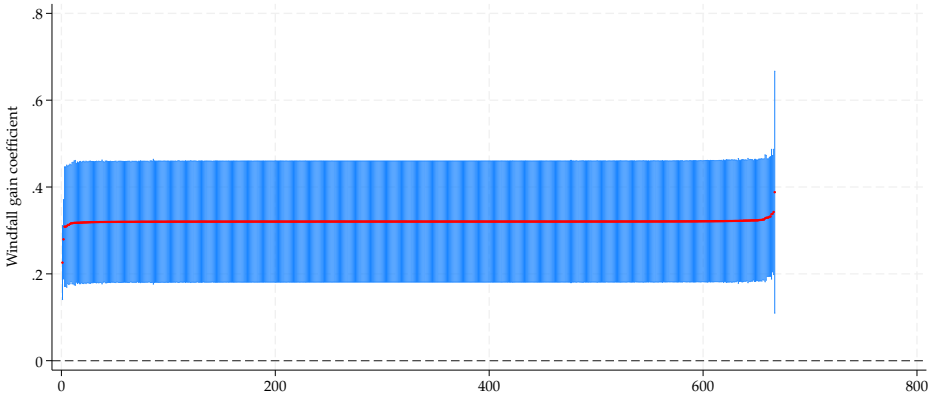
Back

	Conflict outcome (q_{pt})			
	(1)	(2)	(3)	(4)
Windfalls (W_{pt})	0.317***	0.321***	0.357***	0.389***
	(0.0789)	(0.0767)	(0.101)	(0.0942)
Controls		✓	✓	✓
Dyad fixed effects			✓	✓
Year fixed effects				✓
Adj. R^2	0.052	0.059	0.122	0.129
N dyads (clusters)	163	150	76	75
N	443	405	331	328

Note: Standard errors clustered at dyad level and reported in round brackets. Controls comprise log differences of the opponent's GDP and population, respectively. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

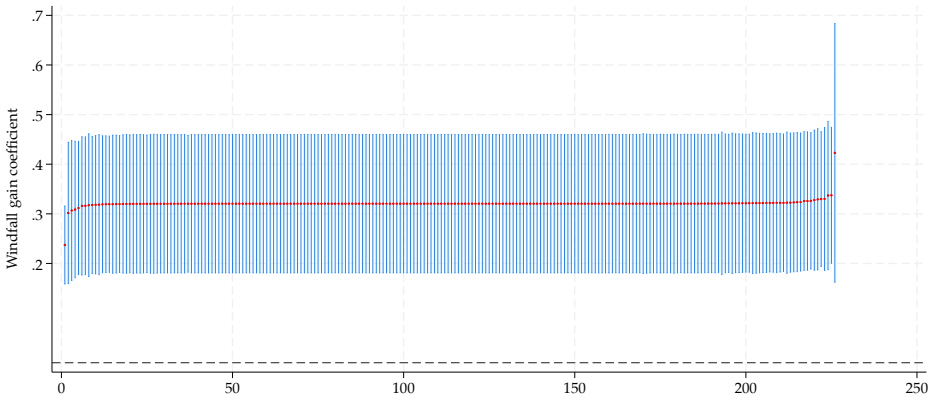
Dropping entire disputes, one at a time

Back



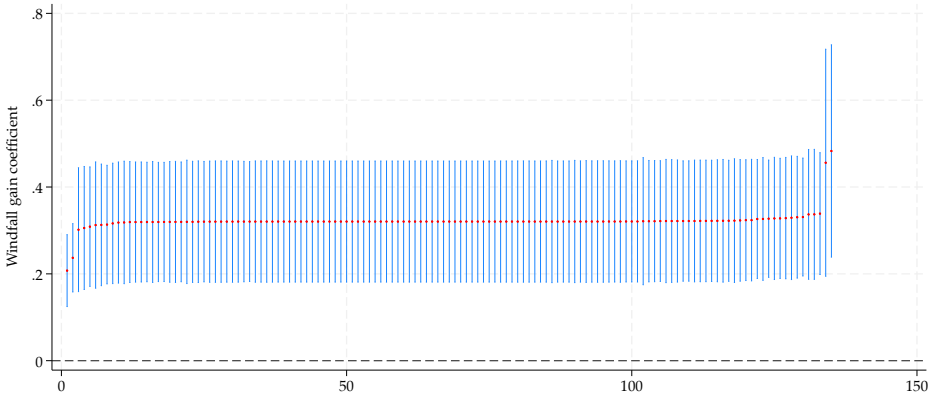
Dropping dyads in sample, one at a time

Back



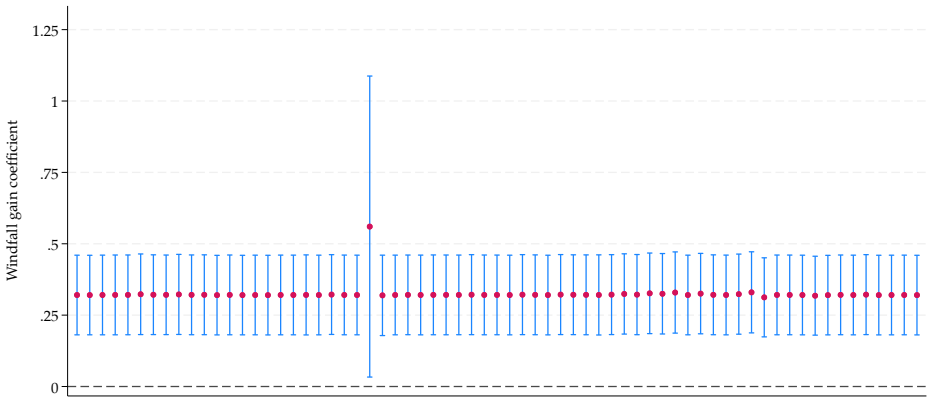
Dropping entire countries in sample, one at a time

Back



Dropping entire product groups in sample, one at a time

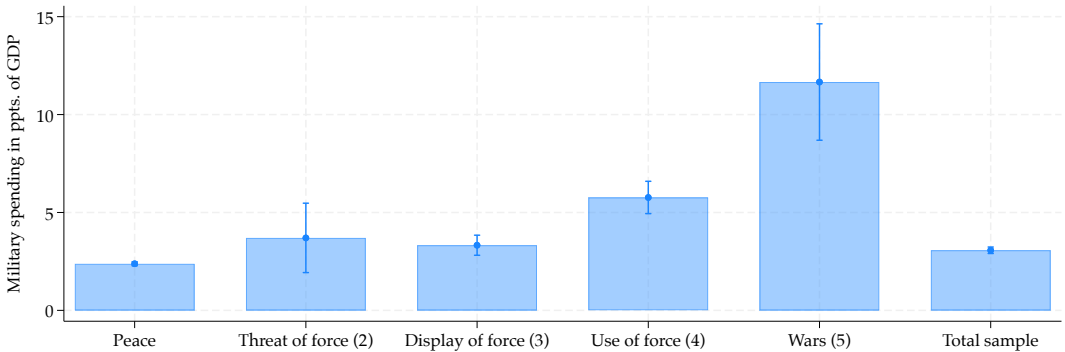
Back



Military expenditures in times of war and peace

Conflict episodes shaped by increased expenses

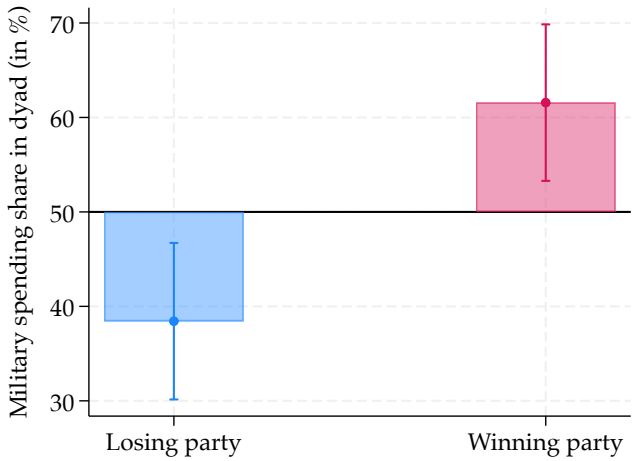
Back



Military expenditures across winners and losers

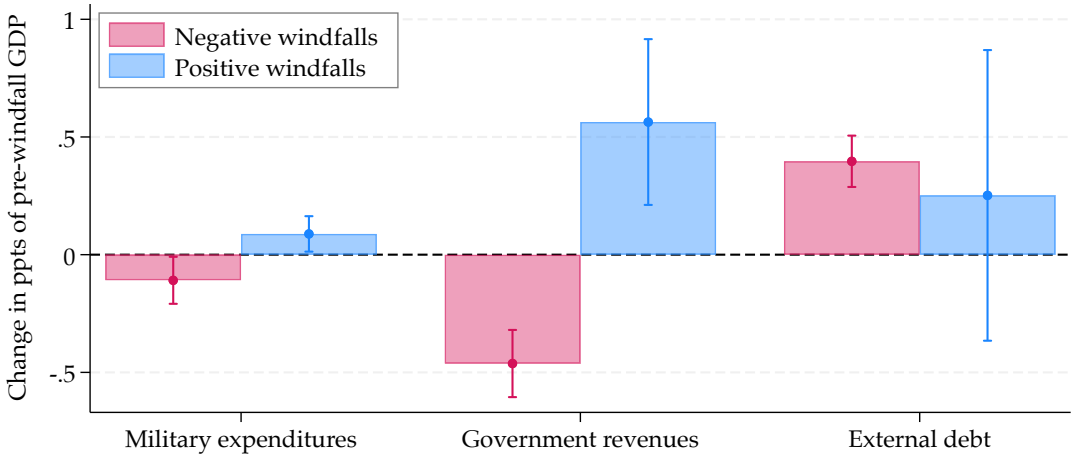
Winners pay 50% more on average

Back



Results: Zooming into times of conflict

Back



Zooming into times of conflict

Back

	Military expenses	Gov. revenue	Ext. debt
Windfall (+), conflict	0.0882*	0.563***	0.252
	(0.0455)	(0.210)	(0.372)
Windfall (-), conflict	-0.109*	-0.462***	0.397***
	(0.0603)	(0.0853)	(0.0657)
Windfall (+), peace	0.0197*	0.217**	-0.120**
	(0.0108)	(0.0961)	(0.0594)
Windfall (-), peace	-0.000865	0.0705**	-0.00988
	(0.000945)	(0.0274)	(0.0150)
War	0.000609	0.000459	0.00814
	(0.00134)	(0.00284)	(0.00863)
Country fixed effects	✓	✓	✓
Year fixed effects	✓	✓	✓
Adj. R^2	0.145	0.157	0.234
N	4,329	1,690	3,511

Note: Standard errors twoway clustered at country year level and reported in round brackets. P-values reported in curly brackets.