

Sanctions and Misallocation. How Sanctioned Firms Won and Russians Lost.

Geopolitics and Economics - Kiel-CEPR Conference

Dzhamilya Nigmatulina

HEC Lausanne and LSE

November 30, 2023

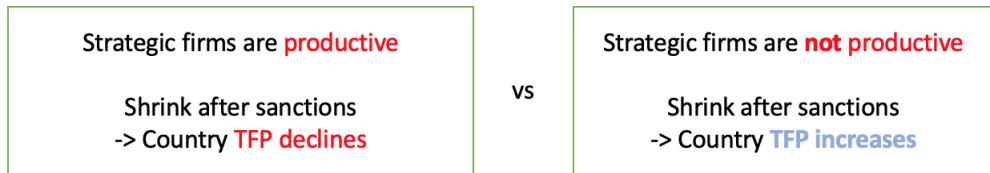
Motivation

"Comprehensive economic sanctions have an indiscriminate impact on a country and can entail severe negative humanitarian consequences for the civilian population and third countries." (State Secretariat for Economic Affairs SECO, Switzerland)

- ▶ "Smart sanctions" - hurt the elites and not the average citizen.
- ▶ The US has over 70 countries under such sanctions today ([Felbermayr et al. 2020](#)).
- ▶ But: little evidence on how targets respond and on collateral damage on the rest of the economy.
- ▶ Evidence on targeted sanctions - sanctions against specific strategic firms in 2014-2020 in Russia. Data on 600,000 Russian firm balance sheets.

Motivation

- ▶ Sanctions target strategic, "important" firms $\Rightarrow$ the impact of sanctions on the rest of the country is ex-ante non-trivial:



- ▶ Government may respond endogenously to protect targeted firms, reallocating resources towards targets
- ▶ The sanctions episode 2014-2020 in Russia - an ideal setting

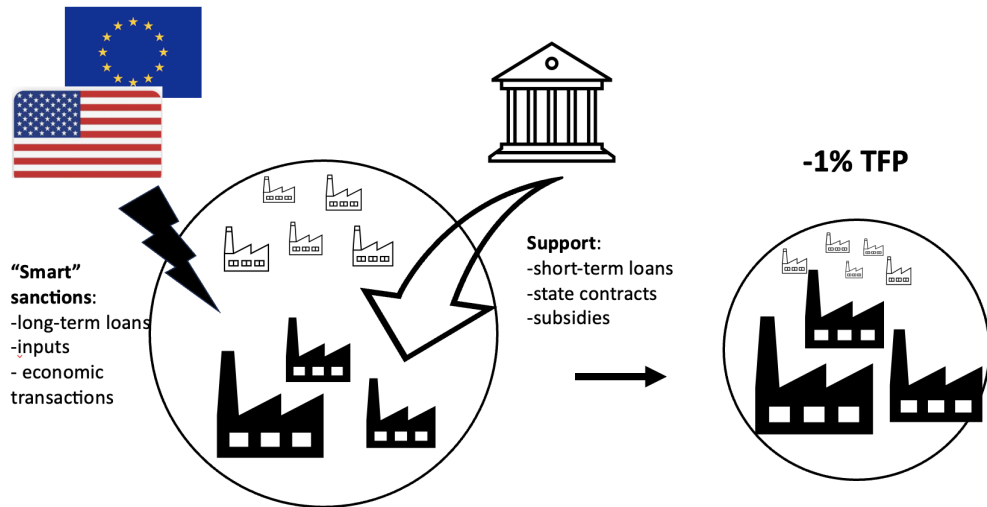
This Paper

- ▶ How sanctions affect the sanctioned firms and the overall economy?
- ▶ **D-i-D** The role of sanctions+government response on firms.
 - ▶ A natural experiment of US sanctions, rolled out in 2014 - 2020
- ▶ **Misallocation framework** Use a framework to get 1) sufficient statistic for being "over-" or "under-resourced" for each firm
- ▶ **D-i-D + Framework** Feed back the estimates from the D-i-D into three different frameworks to estimate the aggregate effect of sanctions on country's TFP: (use Hsieh and Klenow (2009), Levinsohn and Petrin (2012), and Baquae and Farhi (2020))

Findings

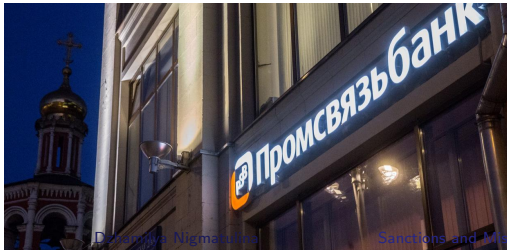
- ▶ US sanctions targeted over-resourced firms.
- ▶ Sanctioned firms saw a **boost** in capital, revenue, and assets after sanctions, linked to increased subsidies, contracts, and short-term loans.
- ▶ Instead of correcting resource misallocation, sanctions **worsened allocation** (due to government protection measures).
- ▶ The combination of sanctions and government intervention led to a GDP reduction of up to 1%.

Findings in a nutshell



Examples: Stroigazmontazh and Promsvyazbank

- ▶ Case 1:
 - ▶ 2014: Arakdy Rotenberg is sanctioned
 - ▶ 2015: Stroigazmontazh (owned by Rotenberg) wins the government contract of 223,1 bln roubles to build the bridge to Crimea.
- ▶ Case 2:
 - ▶ Promsvyazbank re-purposed to compensate the losses from sanctions of Russia's defence sector.



Contributions to the Literature

► The effects of sanctions

- **trade embargoes** Hsieh and Moretti 2006, Crozet & Hinz 2016, Hinz and Monastyrenko 2022, Haidar 2017, Chupilkin et al. 2023
- **"smart" sanctions** Ahn & Ludema 2020, Draca et al. 2019, Peeva 2022, Mamonov and Pestova 2022
- Quantify the effect of targeted trade and financial sanctions on government actions, and on the economy through aggregate TFP.

► Effects of political connections for firm-level outcomes Hsieh & Song 2015, Berkowitz et al. 2017, Brandt et al. 2018, Bussolo et al. 2019, Brown et al. 2006.

- Highlight a novel mechanism of how politically connected firms are (over-) protected from a negative shock

Roadmap

1. **Modelling misallocation** to quantify pre-existing distortions
2. **Data** : 600k firms and sanctions
3. **D-i-D**: Quasi-experiment of sanctions
4. **Frameworks + D-i-D**: Aggregate effects of sanctions on TFP
5. Counterfactual exercises: how large are the aggregate effects relative to baseline misallocation?

Misallocation Framework

- ▶ An efficient, or distortion-free, allocation would be one in which the marginal value product of inputs is equalised across production units.
- ▶ **Stylized example:**
 - ▶ An industry with two firms: Rosneft (SOE, politically connected), and a private firm, Lukoil
 - ▶ Rosneft's marginal value product of capital is \$5 and Lukoil's is \$10.
 - ▶ Taking one unit of capital from Rosneft to Lukoil will increase the output in the industry by \$5.
 - ▶ Reallocate up until the marginal value product of capital is the same between Rosneft and Lukoil to attain the highest output in the industry using existing inputs.

Misallocation Framework

- I model misallocation as implicit taxes (or "wedges") on the prices of inputs

$$\pi_i = p_i F_i(K_i, L_i) - (1 + \tau_i^L)wL_i - (1 + \tau_i^K)rK_i \quad (1)$$

- The profit-maximizing firm will equalize the marginal revenue product to the marginal cost of input.

$$\{K_i\} : p_i \frac{\partial F_i(K_i, L_i)}{\partial K_i} = (1 + \tau_i^K)r \equiv MRPK_i \quad (2)$$

$$\{L_i\} : p_i \frac{\partial F_i(K_i, L_i)}{\partial L_i} = (1 + \tau_i^L)w \equiv MRPL_i \quad (3)$$

- Key idea: in the absence of wedges (τ_i^L and τ_i^K), MRPK and MRPL should equalize, since if not, the inputs would flow to the firms that would generate more value added on the margin.

Assumption to calculate MRPK and MRPL

Cobb-Douglas firm production function

- ▶ allows to use share of capital and labor in revenue to back out MRPK and MRPL directly in the data

$$\{K_i\} : \alpha_s \frac{p_i F_i(K_i, L_i)}{K_i} = (1 + \tau_i^K) r \equiv MRPK_i \quad (4)$$

$$\{L_i\} : (1 - \alpha_s) \frac{p_i F_i(K_i, L_i)}{L_i} = (1 + \tau_i^L) w \equiv MRPL_i \quad (5)$$

Firm data

- ▶ ~600k firms from Spark Database
- ▶ balance-sheet, tax, employment, ownership information and government contracts at the firm-by-year level.
- ▶ private and state-owned firms covering manufacturing, agriculture and services sectors.
- ▶ years 2012-2020
- ▶ representative panel of medium and large firms
- ▶ these firms' value added covers 61% of Russian value added (and revenues more than 1.5 times of the Russian GDP)

Coverage of the Russian economy

Sanctioned vs non-sanctioned

- ▶ The US imposed two types of sanctions in years 2014-2020 in a staggered fashion
 - ▶ **Input sanctions** or "SSI" (ban on long-term loans and other imported inputs), against firms
 - ▶ **Blocking sanctions** or "SDN" (ban on any transaction, e.g. export, import, lending, issuing stock, leasing), against individuals and firms
- ▶ **How were targets chosen?** "oligarchs who profit from [Russia's] corrupt system", those operating in Russia's arms or related materiel sector; entities owned or controlled by a senior Russian government official, entities and individuals operating in specified sectors of the Russian economy (Congressional Research Service, 2020)

Sanctions Data

- ▶ The SSI and SDN sanctions extend on any firm owned by a sanctioned individual or firm by more than 50 per cent ("OFAC rule of 50")
- ▶ A firm is sanctioned if
 - ▶ the firm is listed by the US Department of Treasury
 - ▶ the firm is a historical majority-owned subsidiary of the above
 - ▶ if the firm is owned by or a subsidiary of the firm owned by an SDN individual (using First, Middle and Last name match) with confirmed ownership at the time of imposition of sanctions
- ▶ I study both types of sanctions, input sanctions and blocking sanctions, together and separately.

Sanctions by type and ownership

Sanction type	Number	Ownership
		Share state-owned
SDN	277	19%
SSI	397	12%
SSI and SDN	458	17%
Total	1,132	16%

Table: 1. Sanctions by ownership

In the overall firm sample, only 4% of all firms are SOEs.

Existing distortions. Sanctioned vs non-sanctioned firms

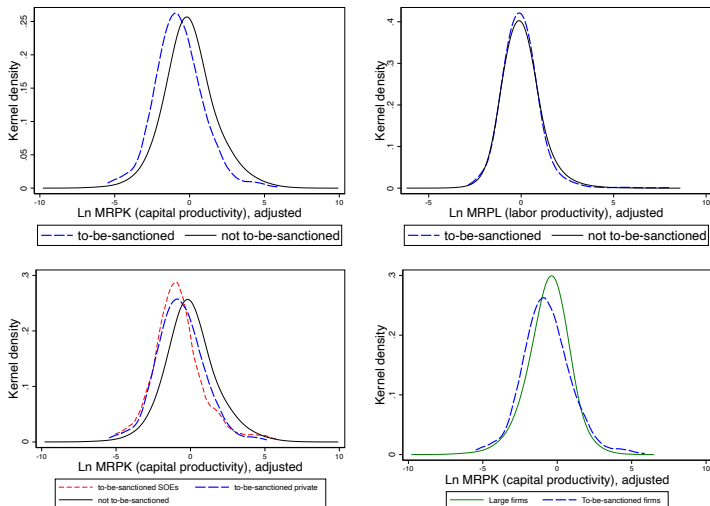


Figure: Firms before 2015 (time-invariant component, de-meanned by 4-digit industry)

Estimating Equation

$$Y_{ijt} = \phi_i + \gamma_{jt} + \theta_{st} + \beta_1 Sanction_{it} + u_{ijt} \quad (6)$$

- ▶ Y_{it} is $\ln(MRPK_{ijt})$, $\ln(K_{ijt})$, $\ln(ValueAdded_{ijt})$, $\ln(Revenue_{ijt})$ and other firm-level variables.
 - ▶ $Sanctions_{it}$ is the time-variant sanctions dummy at firm-level
 - ▶ ϕ_i is firm FE
 - ▶ γ_{jt} is a 4-digit industry-year FE
 - ▶ θ_{st} size-by-year fixed effects
-
- ▶ Cluster the errors two-way: by firm and 4-digit-industry-by-year.

Sanctions raised inputs

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Ln Assets	Ln Assets	Ln Book Value of Capital	Ln Book Value of Capital	Ln Materials	Ln Materials	Ln payment to labor	Ln payment to labor
Any Sanction	0.302*** (0.049)	0.290*** (0.054)	0.316*** (0.057)	0.274*** (0.063)	0.225*** (0.053)	0.235*** (0.060)	0.115* (0.047)	0.113* (0.052)
Any Sanction $\times$ SOE		0.075 (0.109)		0.250* (0.121)		-0.063 (0.104)		0.015 (0.091)
Firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Industry-year FE	✓	✓	✓	✓	✓	✓	✓	✓
Size-year FE	✓	✓	✓	✓	✓	✓	✓	✓
Firms	641082	641082	678994	678994	180433	180433	175682	175682
Sanctioned firms	932	932	928	928	922	922	921	921
Industries	860	860	862	862	764	764	765	765
Observations	3313542	3313542	3852607	3852607	865618	865618	846356	846356
R-squared	.949	.949	.89	.89	.868	.868	.9	.9

Clustering: Firm and industry-by-year

Table: 2. Average effects of firm-specific sanctions on inputs

Pre-trends: capital

Pre-trends: materials

Pre-trends: labor

Pre-trends within treated: capital

Pre-trends within treated: materials

Pre-trends within treated: labor

De Chaisemartin and d'Haultfoeuille estimator: capital

Sanctions raised outputs

	(1) Ln Value Added	(2) Ln Value Added	(3) Ln Revenue	(4) Ln Revenue	(5) Ln Profit	(6) Ln Profit
Any Sanction	0.089* (0.040)	0.095* (0.045)	0.203*** (0.054)	0.204*** (0.058)	0.115* (0.051)	0.095 (0.055)
Any Sanction $\times$ SOE		-0.038 (0.098)		-0.005 (0.127)		0.119 (0.122)
Firm FE	✓	✓	✓	✓	✓	✓
Industry-year FE	✓	✓	✓	✓	✓	✓
Size-year FE	✓	✓	✓	✓	✓	✓
Firms	150236	150236	635156	635156	570951	570951
Sanctioned firms	828	828	916	916	865	865
Industries	745	745	842	842	835	835
Observations	675118	675118	3577822	3577822	2789693	2789693
R-squared	.872	.872	.858	.858	.837	.837

Clustering: Firm and industry-by-year

Table: 3. Average effects of firm-specific sanctions on outputs

Pre-trends: revenue

Pre-trends within treated: revenue

De Chaisemartin and d'Haultfoeuille estimator: revenue

Sanctions worsened misallocation of capital

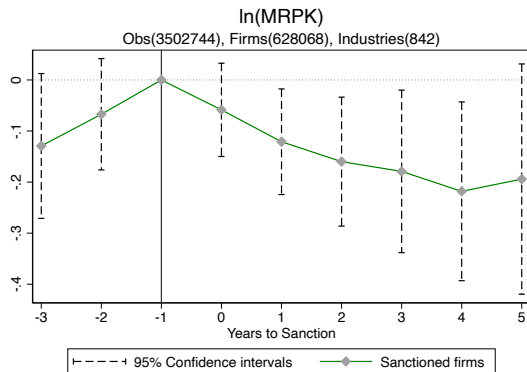
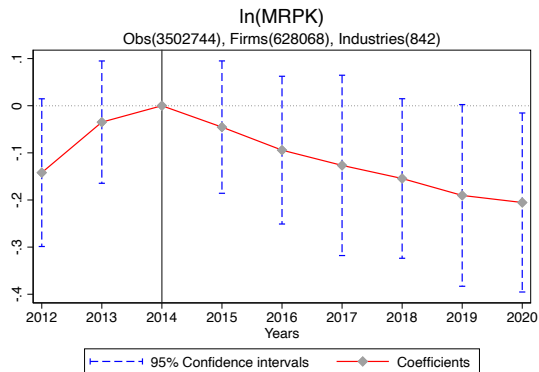


Figure: Event study relative to 2014 and relative the year of treatment: MRPK.

Regression table: MRPK

De Chaisemartin and d'Haultfoeuille estimator: MRPK

Channels: contracts and subsidies increased

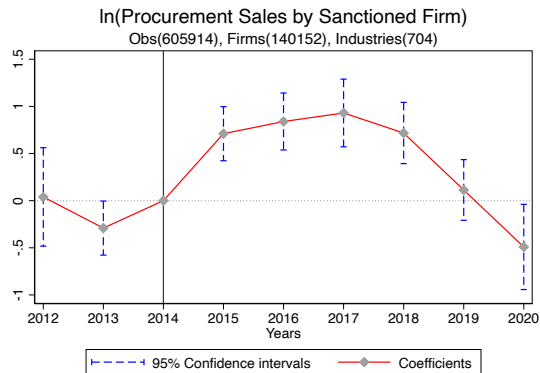
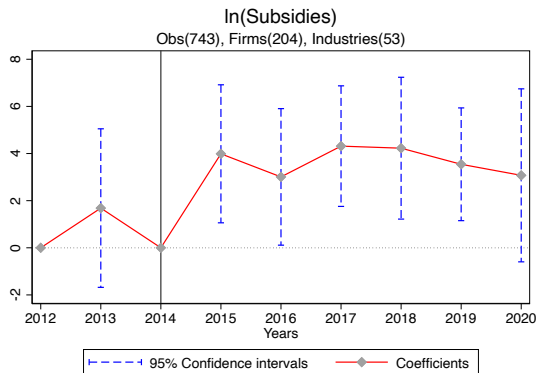
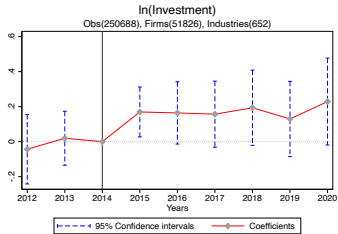
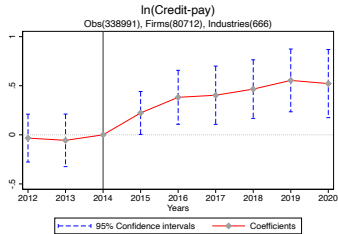
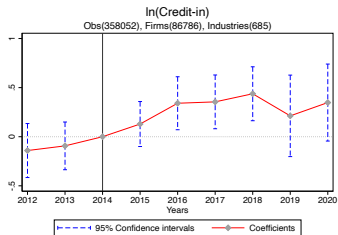
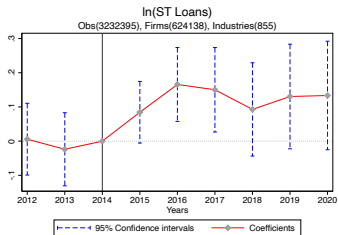
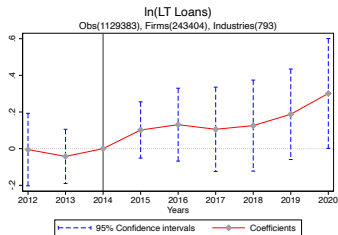


Figure: Event study relative to year 2014: Subsidies and Contracts.

Channels: short-term loans, investment and cash-flows increased



Regression: Loans

Robustness Checks

- ▶ Main results, gradually adding FE result
- ▶ Firm exit result
- ▶ Spillovers result
- ▶ SSI versus SDN sanctions result
- ▶ Heterogeneity of effects result
- ▶ Heterogeneity of effects by strategic status result
- ▶ Effect on A_i (or $TFPQ_i$) result
- ▶ Raw mean changes, treatment and control result
- ▶ Baseline result with alternative control groups result

Aggregate effects?

- ▶ Use three frameworks to aggregate the effects from the D-i-d and be able to compare to other papers:
 - ▶ Hsieh and Klenow model as baseline (shortcut and full model)
 - ▶ Levinsohn and Petrin (2012), as reformulated by Baquae and Farhi (2019)
 - ▶ Full Baquae and Farhi (2020)
- ▶ I calibrate the frameworks to the Russian economy (and Russian distortions, corrected for measurement error)
- ▶ I plug the estimates from the regressions on inputs and change in MRPK (proxy for wedges) to get ΔTFP .
- ▶ **Why not get ΔGDP ?** Empirically, it is impossible to causally separate the aggregate K changing in Russia due to sanctions (from the oil price shock, currency devaluation, other Macro effects)

Hsieh and Klenow: Intuitive Shortcut

Shortcut (for intuition): if A_i and $TFPR_i$ are jointly lognormally distributed (and the physical productivity (A_i) of the firms stays the same):

$$\Delta \log TFP_s = -\frac{\sigma}{2} * VAR(\log TFPR_i + \alpha \Delta \log MRPK_i) \quad (7)$$

- ▶ $\Delta \log MRPK_i$ is taken from **Table 9, column 1**.
- ▶ $\log TFPR_i \equiv \log\left(\frac{p_i F_s(K_i, L_i)}{K_i^{\alpha_s} L_i^{1-\alpha_s}}\right) \propto \log(MRPK_i^{\alpha_s} * MRPL_i^{1-\alpha_s})$ is obtained by regressing $\log TFPR_{it}$ on year and firm fixed effects using the pre-period sample.
- ▶ ΔTFP is a geometric average of TFP_s using sectoral shares of value added in total GDP (θ_s) as weights.

Full model

Hsieh and Klenow: Intuitive Shortcut

Shortcut (for intuition): if A_i and $TFPR_i$ are jointly lognormally distributed (and the physical productivity (A_i) of the firms stays the same):

$$\Delta \log TFP_s = -\frac{\sigma}{2} * VAR(\log TFPR_i + \alpha \Delta \log MRPK_i) \quad (7)$$

- ▶ $\Delta \log MRPK_i$ is taken from **Table 9, column 1**.
- ▶ $\log TFPR_i \equiv \log\left(\frac{p_i F_s(K_i, L_i)}{K_i^{\alpha_s} L_i^{1-\alpha_s}}\right) \propto \log(MRPK_i^{\alpha_s} * MRPL_i^{1-\alpha_s})$ is obtained by regressing $\log TFPR_{it}$ on year and firm fixed effects using the pre-period sample.
- ▶ ΔTFP is a geometric average of TFP_s using sectoral shares of value added in total GDP (θ_s) as weights.

Aggregate results

Framework	ΔTFP
Hsieh and Klenow (2009), jointly log-normal assumption	-0.65%
Hsieh and Klenow (2009), full model	-0.16%
Levinsohn and Petrin (2012)	-1.11%
Baqaee and Farhi (2020)	-0.22%

Table: Change in aggregate TFP due to the joint effect of sanctions and government support

Levinsohn and Petrin

Baqaee and Farhi

Conclusion

- ▶ "Smart" sanctions have unintended effects
- ▶ The government of a sanctioned country shields the targeted firms from the "smart" sanctions to the extent they **benefit rather than lose** from being targeted
- ▶ Allocation of resources worsened.
- ▶ Subsidies and contracts were likely allocated at the expense of everyone else.

Result:

- ▶ **Did sanctions bring collateral damage?** Nothing but collateral damage (but, it was self inflicted)
- ▶ Were sanctions "effective"? No: elites became empowered, rather than "split"

VoxEU summary



Paper & updates



Full model of the economy

► Level 1

$$Y_{si} = A_{si} K_{si}^{\alpha_s} L_{si}^{1-\alpha_s} \quad (8)$$

► Level 2

$$Y_s = \sum_i \left(Y_{si}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \quad (9)$$

► Level 3

$$Y = \prod_{s=1}^S Y_s^{\theta_s} \quad (10)$$

where $\sum_i \theta_s = 1$

TFP from the model structure

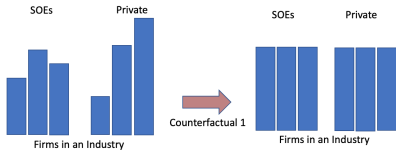
- ▶ Country TFP is the Cobb-Douglas average of the Solow residual in each sector after accounting for total inputs used in each sector.

$$Y = \prod_{s=1}^S (TFP_s K_s^{\alpha_s} L_s^{1-\alpha_s})^{\theta_s} \quad (11)$$

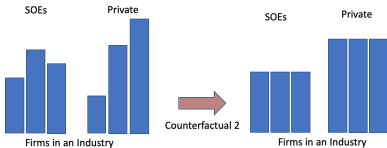
◀ back

Counterfactuals: Measuring the contribution of wedges between groups of firms to misallocation

- **Counterfactual 1** Equalize MRPK and MRPL within each four-digit industry, keeping total industry capital and labour fixed, calculate the TFP in each industry. [formula](#)



- **Counterfactual 2** I equalize MRPL and MRPK only within ownership-by-industry groups [formula](#)



- Compare the resulting aggregate TFP's.

Counterfactual Results: TFP gap due to SOEs

TFP*: Equalize all wedges within industries

TFP_c: Equalize wedges within status-industry groups

Measures	Count	TFP/TFP*	TFP _c /TFP*	Gap due to between-group wedge
To-be-sanctioned versus not	57,279	49.9%	84.7%	30.5%

Table: Counterfactual exercises

- ▶ The sanctioned vs non-sanctions wedge explains $[(100-84.7)/(100-49.9)=30.5\%]$ of the distance to the frontier.
- ▶ Sanctions explain about 1% of the "sanctioned group"-driven distance to the frontier

◀ back

Event study on capital

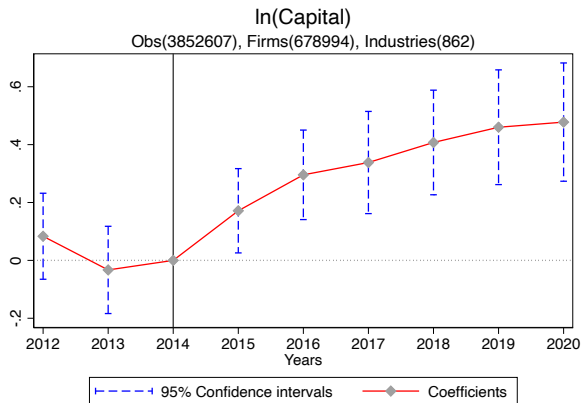


Figure: Event study relative to year 2014: capital.

Regression on Contracts and Subsidies

	(1) Get a Subsidy	(2) Ln Subsidy Volume	(3) Become a Supplier	(4) Ln Contract Volume
Any Sanction	0.010** (0.003)	1.130 (0.657)	0.047*** (0.013)	0.311* (0.122)
Firm FE	✓	✓	✓	✓
Industry-year FE	✓	✓	✓	✓
Size-year FE	✓	✓	✓	✓
Firms	686641	169	686641	140152
Sanctioned firms	935	12	878	591
Industries	862	26	862	704
Observations	3944233	620	3944233	605914
R-squared	.446	.701	.504	.763

Clustering: Firm and industry-by-year

Table: . Average effects of sanctions: Contracts and Subsidies

Event study on Contracts

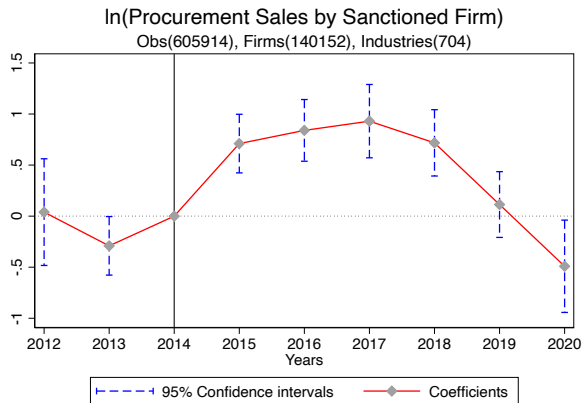


Figure: Event study relative to year 2014: Contracts.

Event study on Subsidies

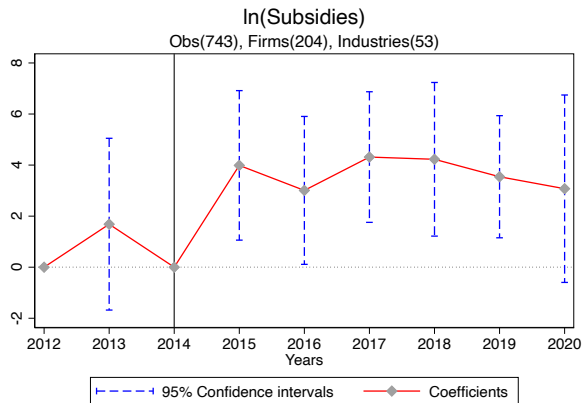


Figure: Event study relative to year 2014: Subsidies.

Regression on Loans

	(1) ln LT Loans	(2) ln ST Loans	(3) ln Investment	(4) ln Credit cash-in	(5) ln Credit cash-out
Any Sanction	0.142 (0.086)	0.097** (0.046)	0.102 (0.068)	0.278*** (0.092)	0.365*** (0.092)
Firm FE	✓	✓	✓	✓	✓
Industry-year FE	✓	✓	✓	✓	✓
Size-year trends	✓	✓	✓	✓	✓
Firms	243404	624138	51826	86786	80712
Sanctioned firms	858	932	741	610	604
Industries	793	855	652	685	666
Observations	1129383	3232395	250688	358052	338991
R-squared	.846	.89	.764	.805	.806

Clustering: Firm and industry-by-year

◀ back

SSI sanctions versus SDN sanctions [◀ back](#)

	(1) Ln Book Value of Capital	(2) Ln Revenue	(3) Ln MRPK	(4) Ln Book Value of Capital	(5) Ln Revenue	(6) Ln MRPK
SSI Sanction	0.350*** (0.077)	0.201** (0.083)	-0.112 (0.088)	0.293*** (0.084)	0.233*** (0.087)	-0.050 (0.098)
SDN Sanction	0.350*** (0.074)	0.168*** (0.057)	-0.160** (0.064)	0.334*** (0.080)	0.124** (0.062)	-0.169** (0.074)
SDN Sanction × SSI Sanction	-0.144 (0.114)	0.006 (0.131)	0.132 (0.125)	-0.141 (0.126)	0.058 (0.149)	0.198 (0.140)
SSI Sanction × SOE				0.399** (0.172)	-0.220 (0.255)	-0.398** (0.172)
SDN Sanction × SOE				0.092 (0.164)	0.239* (0.136)	0.041 (0.122)
SDN Sanction × SSI Sanction × SOE				-0.117 (0.262)	-0.219 (0.314)	-0.253 (0.265)
Firm FE	✓	✓	✓	✓	✓	✓
Year FE						
2-digit industry-yr FE						
4-digit industry-yr FE	✓	✓	✓	✓	✓	✓
Size-year FE	✓	✓	✓	✓	✓	✓
Firms	678994	635156	628068	678994	635156	628068
Sanctioned firms	928	916	910	928	916	910
Industries	862	842	842	862	842	842
Observations	3852607	3577822	3502744	3852607	3577822	3502744
R-squared	.889	.858	.842	.889	.858	.842

Clustering: Firm and industry-by-year

Robustness to different fixed effects

	(1) Ln Book Value of Capital	(2) Ln Revenue	(3) Ln Book Value of Capital	(4) Ln Revenue	(5) Ln Book Value of Capital	(6) Ln Revenue	(7) Ln Book Value of Capital	(8) Ln Revenue
Any Sanction	0.266*** (0.056)	0.173*** (0.051)	0.297*** (0.057)	0.153*** (0.051)	0.241*** (0.055)	0.113** (0.050)	0.209*** (0.056)	0.122** (0.051)
Firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Year FE			✓	✓				
2-digit industry-yr FE					✓	✓		
4-digit industry-yr FE							✓	✓
Size-year trends								
Firms	1126137	1140294	1126137	1140294	1126134	1140290	1126077	1140215
Sanctioned firms	1244	1277	1244	1277	1244	1277	1244	1277
Industries	919	910	919	910	917	908	872	862
Observations	5369531	5270905	5369531	5270905	5369511	5270885	5369158	5270507
R-squared	.883	.848	.883	.848	.884	.85	.885	.85

Clustering: Firm and industry-by-year

Table: ?? Robustness of the main results to the different fixed effects

Event study on materials

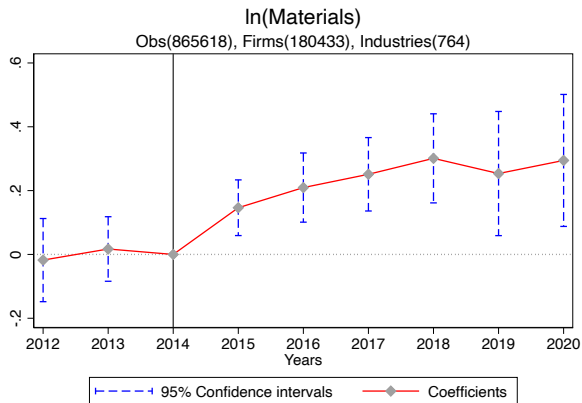


Figure: Event study relative to year 2014: materials.

Event study on labor

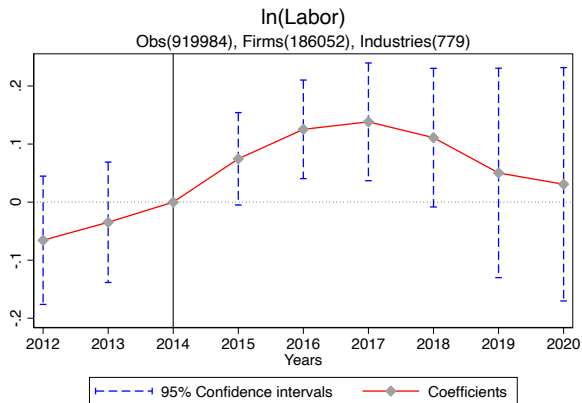


Figure: Event study relative to year 2014: labor.

Event study on capital, within sanctioned

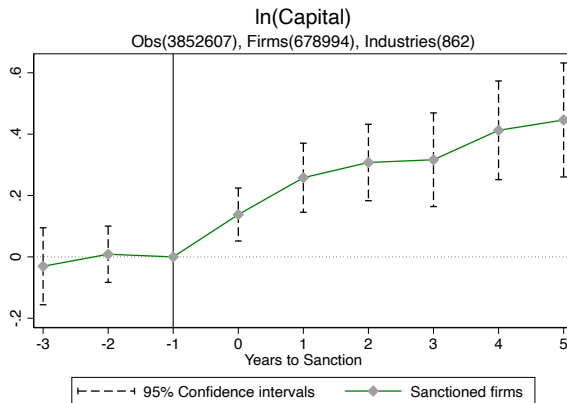


Figure: Event study relative to year 2014: capital.

Event study on materials, within sanctioned

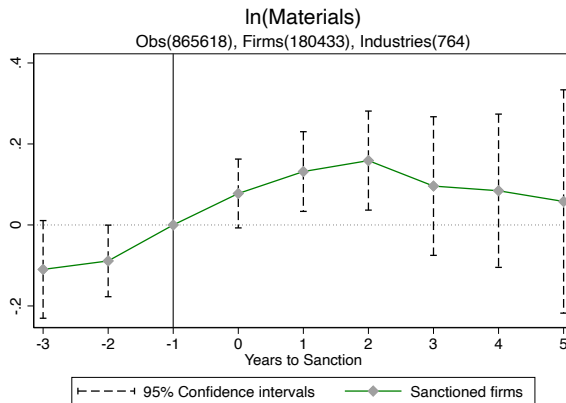


Figure: Event study relative to year 2014: materials.

Event study on labor, within sanctioned

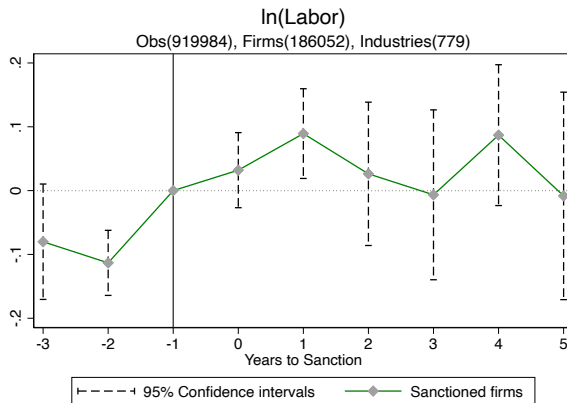


Figure: Event study relative to year 2014: labor.

Event study on Capital, De Chaisemartin and Haultfoeuille estimator

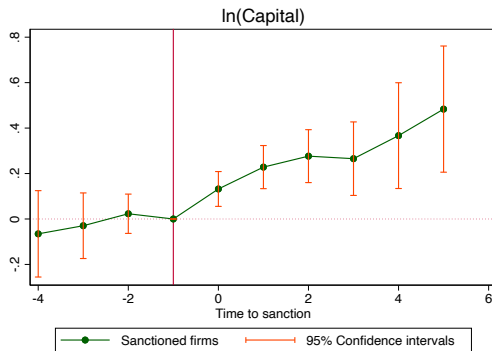


Figure: Event study relative to the year of sanctioning: capital.

Event study on Revenue, De Chaisemartin and Haultfoeuille estimator

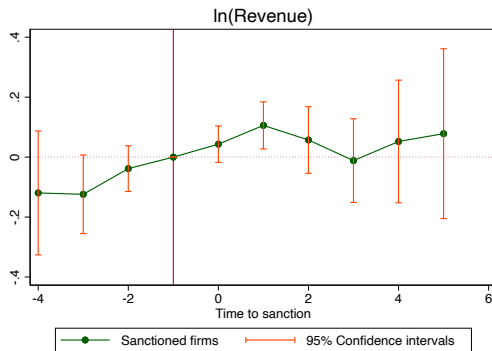


Figure: Event study relative to the year of sanctioning: revenue.

Event study on MRPK, De Chaisemartin and Haultfoeuille estimator

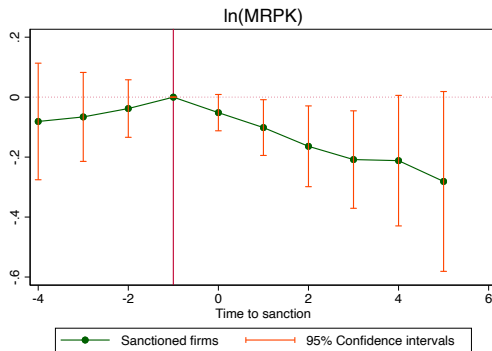


Figure: Event study relative to the year of sanctioning: MRPK.

Regression on MRPK

	(1) Ln MRPK	(2) Ln MRPK	(3) Ln MRPL	(4) Ln MRPL	(5) Ln MRPM	(6) Ln MRPM
Any Sanction	-0.081 (0.055)	-0.043 (0.063)	0.061 (0.045)	0.065 (0.049)	-0.026 (0.041)	-0.036 (0.043)
Any Sanction $\times$ SOE		-0.229* (0.106)		-0.023 (0.119)		0.054 (0.114)
Firm FE	✓	✓	✓	✓	✓	✓
Industry-year FE	✓	✓	✓	✓	✓	✓
Size-year FE	✓	✓	✓	✓	✓	✓
Firms	628068	628068	170779	170779	173779	173779
Sanctioned firms	910	910	903	903	902	902
Industries	842	842	761	761	759	759
Observations	3502744	3502744	815750	815750	826218	826218
R-squared	.842	.842	.809	.809	.619	.619

Clustering: Firm and industry-by-year

Table: 9. Average effects of firm-specific sanctions on misallocation

Event study on revenue

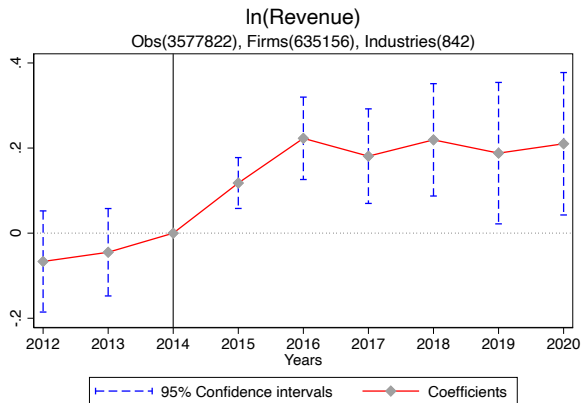


Figure: Event study relative to year 2014: labor.

Event study on revenue, within sanctioned

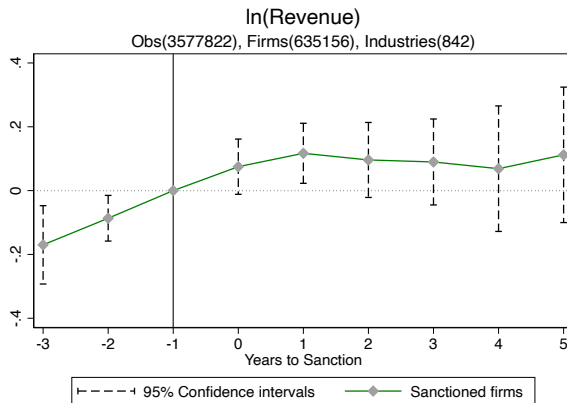


Figure: Event study relative to year 2014: revenue.

TFPR formula

Assuming Cobb-Douglas production function (with the same exponents within an industry s), I also define a summary measure of the wedges with respect to both inputs:

$$TFPR_i \equiv \frac{p_i F_s(K_i, L_i)}{K_i^{\alpha_s} L_i^{1-\alpha_s}} \propto MRP K_i^{\alpha_s} * MRPL_i^{1-\alpha_s} \quad (12)$$

◀ back

Wedges between SOEs and private firms

- ▶ One can derive group wedges by equalizing all wedges within a group and only keeping the wedges across groups.
- ▶ This is equivalent to redistributing group capital and labor efficiently within the group

$$TFPR_{priv} = \frac{\left(\sum \left(\frac{A_i}{\kappa} \right)^{\frac{1-\eta}{\eta}} \right)^{\eta}}{(K_{priv})^{\alpha\eta} (L_{priv})^{(1-\alpha)\eta}} \quad (13)$$

Where $\eta = 1/\sigma$

◀ back

Framework

- Model a-la Hsieh and Klenow: misallocation across firms within industry

$$\pi_i = P_i Q_i - (1 + \tau_i^L) w L_i - (1 + \tau_i^K) r K_i \quad (14)$$

$$\max_{L_i, K_i} \pi_i = P_i Q_i^{\frac{1}{\sigma}} (A_i K_i^\alpha L_i^{1-\alpha})^{\frac{\sigma-1}{\sigma}} - (1 + \tau_i^L) w L_i - (1 + \tau_i^K) r K_i$$

$$\{L_i\} : (1 - \alpha) \left(\frac{\sigma - 1}{\sigma} \right) \frac{P_i Q_i}{L_i} = (1 + \tau_i^L) w \equiv MRPL_i \quad (15)$$

$$\{K_i\} : \alpha \left(\frac{\sigma - 1}{\sigma} \right) \frac{P_i Q_i}{K_i} = (1 + \tau_i^K) r \equiv MRPK_i \quad (16)$$

Framework

- ▶ One can define a summary statistic of both labor and capital wedges, name it "TFPR"

$$TFPR_i \equiv \frac{P_i Q_i}{K_i^\alpha L_i^{1-\alpha}} \propto MRP K_i^\alpha * MRPL_i^{1-\alpha} \quad (17)$$

- ▶ Knowing the elasticity of substitution, one can get an expression for the firm TFP (or productivity) object, the "TFPQ":

$$TFPQ_i \equiv TFP_i \equiv A_i \propto \frac{(P_i Q_i)^{\frac{\sigma}{\sigma-1}}}{K_i^\alpha L_i^{1-\alpha}} \quad (18)$$

Where $\eta = 1/\sigma$ [◀ back](#)

Framework

@hookitemize

The overall industry productivity depends on the variance of MRPK and MRPL (or the variance of the TFPR).

The lower is the variance, the higher is the aggregate industry TFP

$$TFP_s = \left(\sum_i \left(A_i \left(\frac{\overline{MRPL}}{MRPL_i} \right)^{1-\alpha} \left(\frac{\overline{MRPK}}{MRPK_i} \right)^\alpha \right)^{\sigma-1} \right)^{\frac{1}{\sigma-1}} \quad (19)$$

$$TFPe_s = \left(\sum_i (A_i^{\sigma-1}) \right)^{\frac{1}{\sigma-1}} \quad (20)$$

In which sectors SOEs are more productive

Out of 80 sectors, TFPR is higher for SOEs in the following sectors only:

- ▶ Manufacture of textiles
- ▶ Provision of services in the field of elimination of the consequences of pollution
- ▶ Film, video and television program production, sound recording and sheet music
- ▶ Activities auxiliary to financial services and insurance

◀ back

Regression Results, Entry and Exit [◀ back](#)

	(1) Stop existing shr	(2) Stop reporting shr	(3) Exist dummy	(4) Report dummy
Any Sanction	-0.018*** (0.002)	-0.047*** (0.004)	0.003* (0.001)	0.054*** (0.007)
Firm FE			✓	✓
Industry-year FE	✓	✓	✓	✓
Size-year FE			✓	✓
Firms			721884	721884
Sanctioned firms			936	936
Industries	247	247	874	874
Observations	3508	3508	4196031	4196031
R-squared	.568	.566	.514	.693

Clustering: Columns (1) and (2) 4-digit industry; columns (3)-(6) firm and industry-by-year

Table: Average effects of sanctions: endogenous exit

Heterogeneity

	(1) Ln Revenue	(2) Ln Book Value of Capital	(3) Ln Revenue	(4) Ln Book Value of Capital	(5) Ln Revenue	(6) Ln Book Value of Capital	(7) Ln Revenue	(8) Ln Book Value of Capital	(9) Ln Revenue	(10) Ln Book Value of Capital
Any Sanction	0.209*** (0.062)	0.307*** (0.067)	0.177** (0.082)	0.273*** (0.073)	0.250*** (0.065)	0.348*** (0.066)	0.217*** (0.061)	0.341*** (0.063)	0.147** (0.065)	0.306*** (0.070)
Any Sanction × Direct	-0.019 (0.113)	0.029 (0.120)								
Any Sanction × SDN			0.044 (0.096)	0.073 (0.089)						
Any Sanction × minority					-0.148* (0.089)	-0.180** (0.087)				
Any Sanction × energy							-0.096 (0.109)	-0.163 (0.148)		
Any Sanction × exporter									0.228** (0.093)	0.039 (0.102)
Firm FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Industry-year FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Size-year FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Firms	635156	678994	635156	678994	635156	678994	635156	678994	635156	678994
Sanctioned firms	916	928	916	928	916	928	916	928	916	928
Industries	842	862	842	862	842	862	842	862	842	862
Observations	3577822	3852607	3577822	3852607	3577822	3852607	3577822	3852607	3577822	3852607
R-squared	.858	.89	.858	.89	.858	.89	.858	.89	.858	.89

Clustering: Firm and industry-by-year

Table: Heterogeneity

Strategic Firms

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Ln Revenue	Ln Book Value of Capital	Ln Revenue	Ln Book Value of Capital	Ln Revenue	Ln Book Value of Capital	Ln Revenue	Ln Book Value of Capital	Ln Revenue	Ln Book Value of Capital
Any Sanction	0.198*** (0.060)	0.303*** (0.063)	0.156** (0.063)	0.291*** (0.066)	0.159*** (0.056)	0.290*** (0.059)	0.150** (0.065)	0.286*** (0.068)	0.163** (0.068)	0.271*** (0.073)
Any Sanction × Military	0.044 (0.096)	0.114 (0.113)								
Any Sanction × Military ²			0.263*** (0.096)	0.139 (0.101)						
Any Sanction × System					0.615*** (0.161)	0.380** (0.185)				
Any Sanction × Strategic							0.240** (0.103)	0.140 (0.112)	0.225** (0.111)	0.022 (0.111)
Any Sanction × SOE									-0.100 (0.187)	0.124 (0.162)
Any Sanction × SOE × Strategic									0.107 (0.226)	0.297 (0.256)
Firm FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Industry-year FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Size-year FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Firms	635156	678994	635156	678994	635156	678994	635156	678994	635156	678994
Sanctioned firms	916	928	916	928	916	928	916	928	916	928
Industries	842	862	842	862	842	862	842	862	842	862
Observations	3577822	3852607	3577822	3852607	3577822	3852607	3577822	3852607	3577822	3852607
R-squared	.858	.89	.858	.89	.858	.89	.858	.89	.858	.89

Clustering: Firm and industry-by-year

Table: Heterogeneity: Strategic Firms

Data coverage of the economy in 2018

Sample	Count	Share of Value Added	Share of Revenue	Share of employment	Share of Value Added in Russian GDP	Share of Revenue in Russian GDP	Share of Russian employment
All firms	946,956	100	100	100	61	218	30
Firms with all variables	154,825	92	75	68	56	164	21
Private firms	942,542	89	93	94	54	202	29
State-owned firms	4,414	11	7	6	7	16	2
Sanctioned firms	1,046	21	13	4	13	28	1

Table: Sample used for analysis

None or minor spillovers to procurement sellers after sanctions

	(1) ln(Contract Volume)	(2) Sell dummy	(3) Contract Count
Any Sanction	-0.033 (0.046)	-0.001 (0.000)	-0.004 (0.002)
Buyer FE	✓	✓	✓
Seller FE	✓	✓	✓
Buyer Industry-year FE	✓	✓	✓
Buyers	8655	8667	8667
Sellers	71890	72249	72249
Sanctioned buyers	576	576	576
Industries of buyers	406	406	406
Observations	526162	530079	530079
R-squared	.595	.233	.216
Clustering: Buyer and Industry of buyer-by-year			

back

How I calculate the change in practice.

- ▶ Create sanctioned and non-sanctioned groups within each industry, equalizing wedges between firms in the group.
- ▶ Allocate capital to the sanctioned group, reducing its MRPK by 10% (Table 9).
- ▶ Assign remaining capital to the non-sanctioned group.
- ▶ Re-calculate new aggregate TFP for each industry and overall, comparing it to the TFP with initial wedge between sanctioned and non-sanctioned firms.
- ▶ Observed decline in TFP is approximately -0.1%.

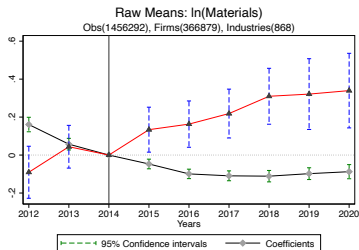
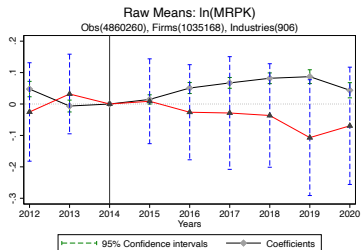
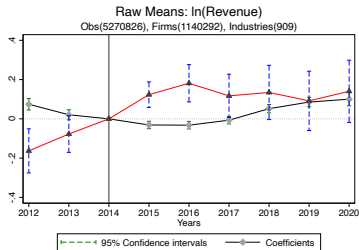
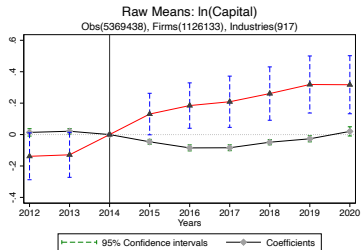
[back](#)

Effect on $TFPQ_i$

	(1) ln(Ai)	(2) ln(Ai)
Any Sanction	-0.041 (0.040)	-0.009 (0.042)
Any Sanction $\times$ SOE		-0.179 (0.101)
Firm FE	✓	✓
Industry-year FE	✓	✓
SOE-year FE	✓	✓
Firms	134323	134323
Sanctioned firms	811	811
Industries	715	715
Observations	603840	603840
R-squared	.739	.739

Raw mean changes (no time fixed effects)

[back](#)



Hsieh and Klenow: Full model

- ▶ "Horizontal economy", representing each sector s
- ▶ TFP_s can be expressed as a function of MRPK and MRPL of each company.

$$TFP_s = \left(\sum_i \left(A_i \left(\frac{\overline{MRPL}}{\overline{MRPL}_i} \right)^{1-\alpha_s} \left(\frac{\overline{MRPK}}{\overline{MRPK}_i} \right)^{\alpha_s} \right)^{\sigma-1} \right)^{\frac{1}{\sigma-1}} \quad (21)$$

- ▶ Plug the changes of $\overline{MRPK}_i$ from Table 9 and calculate the $\% \Delta TFP_s$

Parameter	Source
α_s	1-labor share in value added for each s
σ	7 (Hsieh and Song 2016)

[Full model](#)[Expression for country TFP](#)[Profit maximization](#)[A_i](#)[How I calculate the TFP change in practice.](#)[back](#)

Hsieh and Klenow: Full model

- ▶ "Horizontal economy", representing each sector s
- ▶ TFP_s can be expressed as a function of $MRPK$ and $MRPL$ of each company.

$$TFP_s = \left(\sum_i \left(A_i \left(\frac{\overline{MRPL}}{\overline{MRPL}_i} \right)^{1-\alpha_s} \left(\frac{\overline{MRPK}}{\overline{MRPK}_i} \right)^{\alpha_s} \right)^{\sigma-1} \right)^{\frac{1}{\sigma-1}} \quad (21)$$

- ▶ Plug the changes of $MRPK_i$ from Table 9 and calculate the $\% \Delta TFP_s$

Parameter	Source
α_s	1-labor share in value added for each s
σ	7 (Hsieh and Song 2016)

Full model

Expression for country TFP

Profit maximization

A_i

How I calculate the TFP change in practice.

back

Baquaee and Farhi (2019) and Levisohn and Petrin (2012)

Like Bau and Matray (2023), I adapt their version of the expression to aggregate the changes of capital inputs between distorted producers. (I assume that the change in A_i is 0)

$$\Delta \log(TFP_s) \approx \sum_{i \in s} \lambda_i \alpha_i^K \frac{\tau_i^K}{1 + \tau_i^K} \Delta \log K_i \quad (22)$$

where $i \in s$ is a set of firms and s is the set of industries. [◀ back](#)

$$\frac{d \log TFP}{d \log \mu_k} = -\tilde{\lambda}_k - \sum_f \tilde{\Lambda}_f \frac{d \log \Lambda_f}{d \log \mu_k} \quad (23)$$

where

- ▶ k is a firm
- ▶ $\tilde{\lambda}_k$ is the "cost-based Domar weight", a share of firm k in the economy's costs.
- ▶ $\tilde{\lambda}_k$ is defined by $\tilde{\lambda}_k \equiv b' \tilde{\Psi} \equiv b'(I - \tilde{\Omega})^{-1}$, where $\tilde{\Omega}$ is a cost-based input-output matrix, whose cell in row i and column j ($\tilde{\Omega}_{ij}$) is the share of firm's j 's sales in firm i 's costs.
- ▶ $\tilde{\Lambda}_f$ is the "cost-based Domar weight" of the factor j , which in my case is capital or labor.
- ▶ Λ_f is the Domar weight of factor f , or the sales share of the factor in GDP.

Alternative Control Groups

(1r)2-3(1r)4-5(1r)6-7(1r)8-9	SOEs (controls)		Strategic Firms (controls)		Exporters (controls)		Minority Subsidiaries (controls)	
	(1) Ln Book Value of Capital	(2) Ln Revenue	(3) Ln Book Value of Capital	(4) Ln Revenue	(5) Ln Book Value of Capital	(6) Ln Revenue	(7) Ln Book Value of Capital	(8) Ln Revenue
Any Sanction	0.353*** (0.063)	0.182*** (0.059)	0.334*** (0.058)	0.222*** (0.052)	0.269*** (0.056)	0.185*** (0.051)	0.271*** (0.065)	0.123** (0.056)
Firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Industry-year FE	✓	✓	✓	✓	✓	✓	✓	✓
Size-year trend	✓	✓	✓	✓	✓	✓	✓	✓
Firms	4799	4713	2241	2226	27569	27569	1273	1247
Sanctioned firms	863	856	864	856	869	862	889	883
Industries	399	393	365	362	668	663	248	241
Observations	30920	30243	15024	14931	195255	195412	7546	7285
R-squared	.00341	.000935	.00641	.00352	.000285	.000178	.00637	.00128

Clustering: Firm and industry-by-year

[back](#)