Financial Constraints and Propagation of Shocks in Production Networks

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Motivation

- Small shocks that are amplifed and propagated through IO linkages cause sizable aggregate fluctuations (Acemoglu et al. (2012, *ECTA*)).
- In particular, supply shocks propagate downstream more powerfully than upstream (Acemoglu et al. (2015, *NBER Macro Annual*)).
- Does this theoretical prediction hold in practice?
- Knowing the answer matters for policy.

Research questions

- How does a cost-push shock propagate through a production network?
- Do financial constraints amplify its propagation?
- How do firms adjust their sourcing patterns in response to the shock?

Contribution

- Examining an *unexpected policy shock* using data on the universe of supplier-customer links in Turkey.
- Focusing on the role of financial constraints in shock propagation.
- Estimating short- and medium-run elasticity of substitution between domestic and imported inputs.

Preview of the results

- A cost-push shock has substantial direct and downstream consequences in a production network.
- Firms that face financial constraints tend to amplify the downstream propagation of the shock.
- Elasticity estimate of about 2 in the short- to medium-run.
  - for comparison: 0.2 found for a temporary shock (Boehm et al., 2018) and the range 0.5 - 10 typically assumed in macro studies.

Literature

- **Transmission of shocks through production networks:** Acemoglu et al. (2012, *ECTA*); Acemoglu et al. (2015, *NBER Macro Annual*); Barrot and Sauvagnat (2016, *QJE*); Carvalho et al. (2016); Tintelnot et al. (2017); Alfaro et al (2018).

- **Role of financial constraints in production networks:** Boissay and Gropp (2013, *RF*); Jacobson and von Schedvin (2015, *ECTA*); Bigio and La'O (2016).

- **Estimation of elasticity of substitution across intermediates:** Kasahara and Lapham (2013, *JIE*); Halpern et al. (2015, *AER*); Boehm et al. (forthcoming, *ReStat*).

Outline

- Policy context
- Propagation of the shock
- Role of financial constraints
- Elasticity estimation

Policy Context

Resource Utilization Support Fund (RUSF) in Turkey

- RUSF is a tax collected since 1988 when foreign credit is utilized to finance the cost of imported goods.
- Only imports with external financing are subject to RUSF.
- Payment methods subject to RUSF are open account (OA), acceptance credit (AC), and deferred letter of credit (DLC).
- RUSF applies to ordinary imports (processing imports have always been exempted).
- **On 13 October 2011, RUSF was *unexpectedly* raised from 3% to 6% of transaction value.**

▸ Details ▸ Imports by payment terms in 2011 ▸ Interest rates in Turkey

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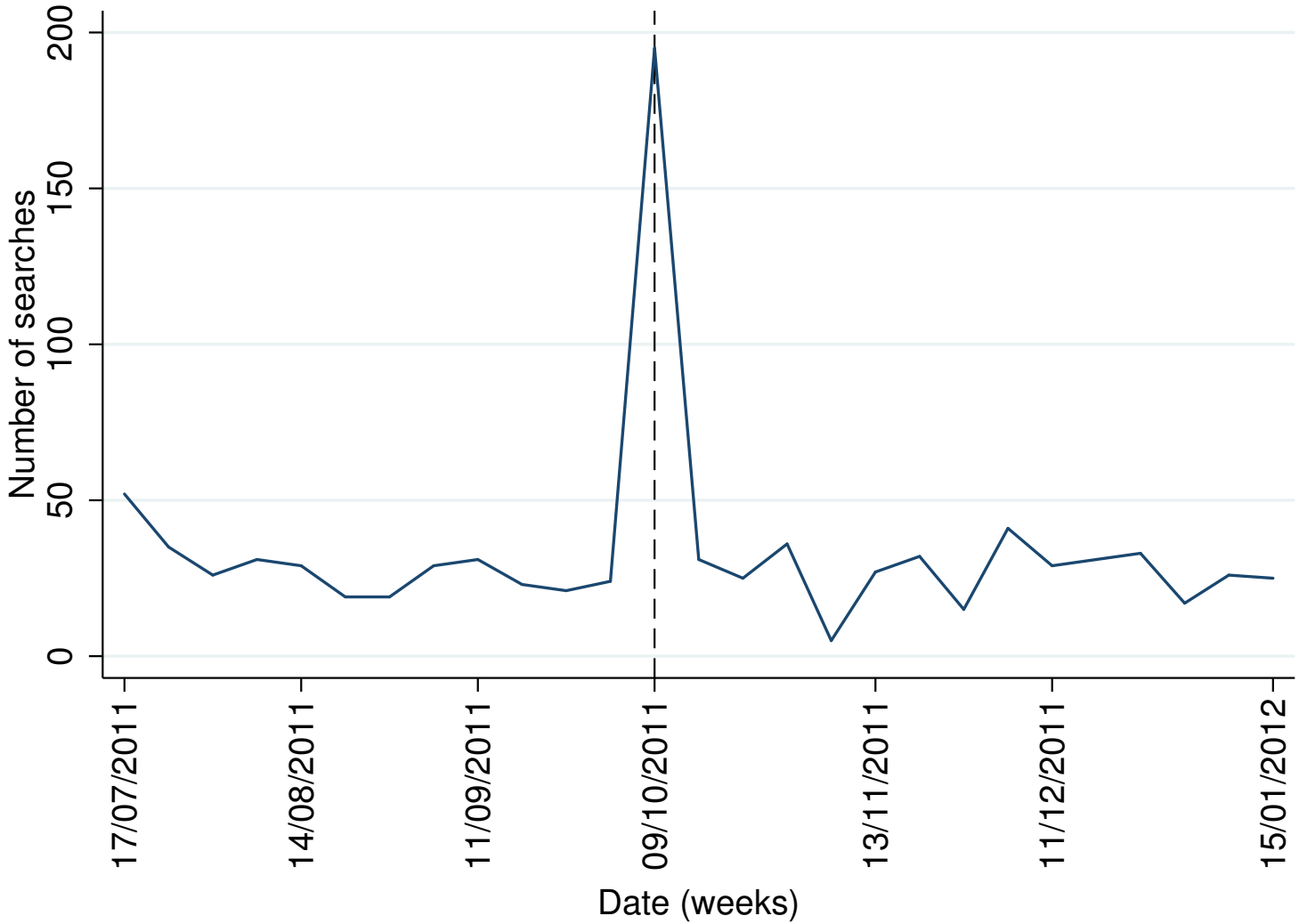
Did the shock matter?

- RUSF constitutes a significant cost item for importers.
- A report published by the Istanbul Chamber of Industry on the "Manufacture of leather and related products" industry in 2015 argues that
  - RUSF hurts competitiveness as the industry relies heavily on imported inputs and trade credit given firms' capital structure;
  - RUSF must be reduced to 1%;
  - RUSF must be removed for imported inputs that are not available in the domestic market.

Number of searches for KKDF on Google



Measuring Exposure to the Shock

Measuring variety exposure to the shock

- Construct *Exposure* using value of Turkey's ordinary imports in USD disaggregated by
  - importing firm,
  - 6-digit HS product,
  - source country,
  - payment method (e.g. CIA, OA, LC, etc.).
- Define the share of imports of (a product-country level) variety j coming with external financing at time $t = \{T-2, T-1, T\}$, where $T = 2012$:

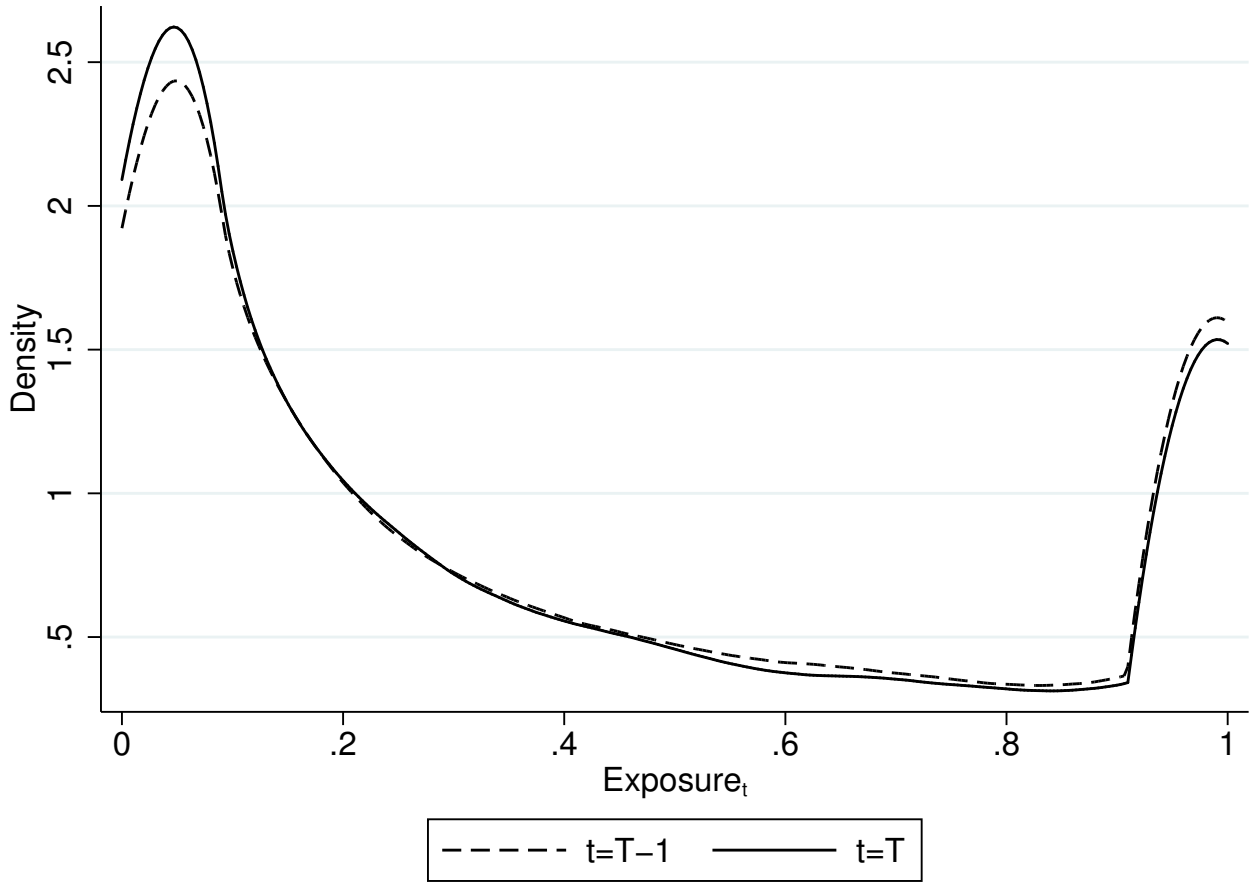
$$Exposure_{jt} = \frac{\sum_{m \in \{OA,AC,DLC\}} M_{jmt}}{\sum_{m} M_{jmt}}.$$

- $Exposure_{j,T-2}$ constructed for about
  - 150 source countries (all of them members of WTO),
  - 4,700 6-digit HS product codes,
  - 75,000 country-product pairs.

▸ Variation

Share of ordinary imports with external financing (variety level)

$\overline{Exposure}_{j,t=T-1} = 0.21$; $\overline{Exposure}_{j,t=T} = 0.18$



▸ Processing imports

Measuring firm-level direct exposure

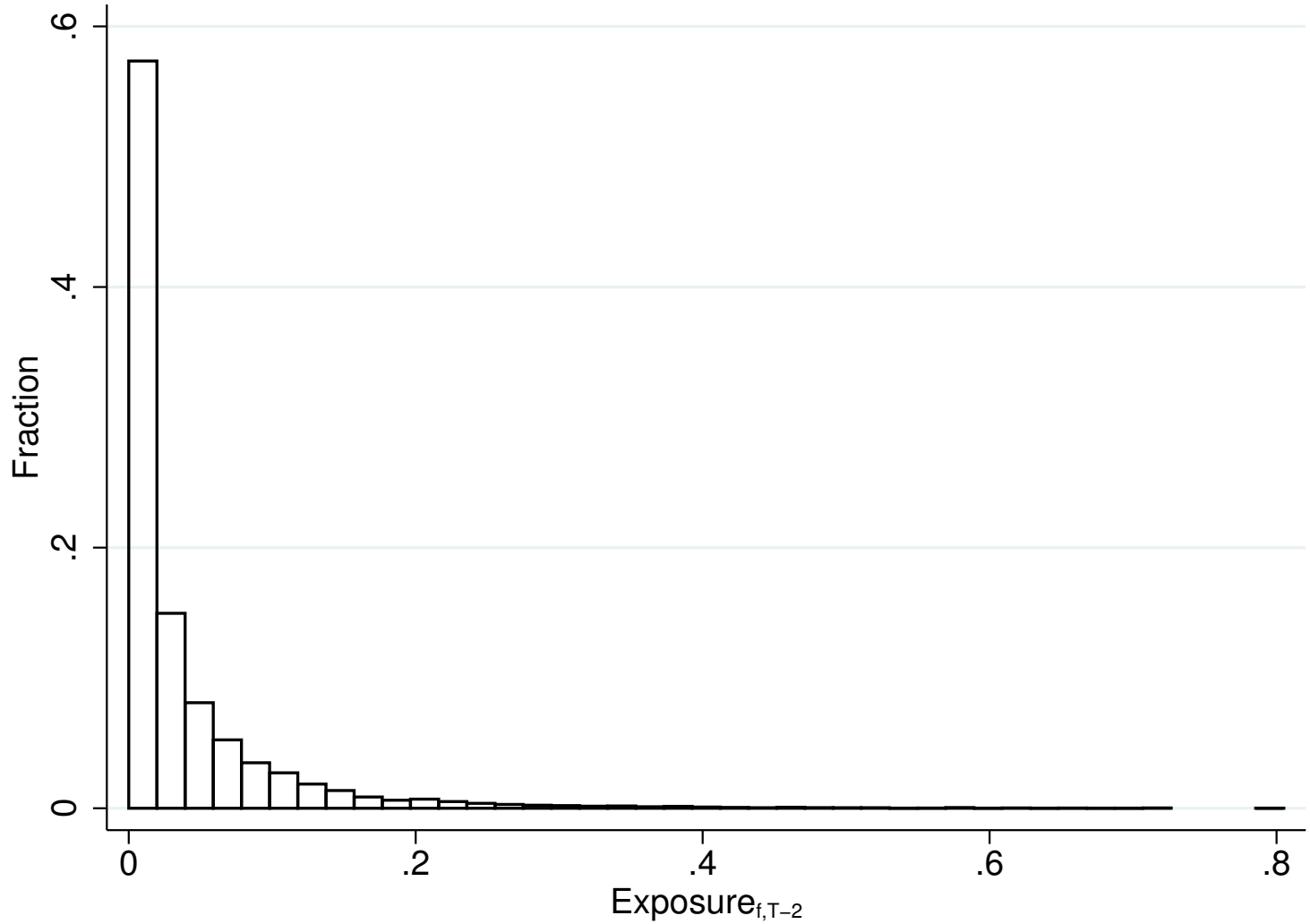
- A "Bartik-type" variable where **firm-level** exposure is predicted based on its import composition and the exposure of a given variety:

$$Exposure_{f,T-2} = \sum_j \omega_{fj,T-2} \times Exposure_{j,T-2}$$

- $\omega_{fj,T-2}$ is the share of imports of variety j in firm f's total costs at $t = T - 2$
- total costs = labor costs + domestic purchases + imports.

▸ Actual vs. Bartik

Firm-level direct exposure to the shock

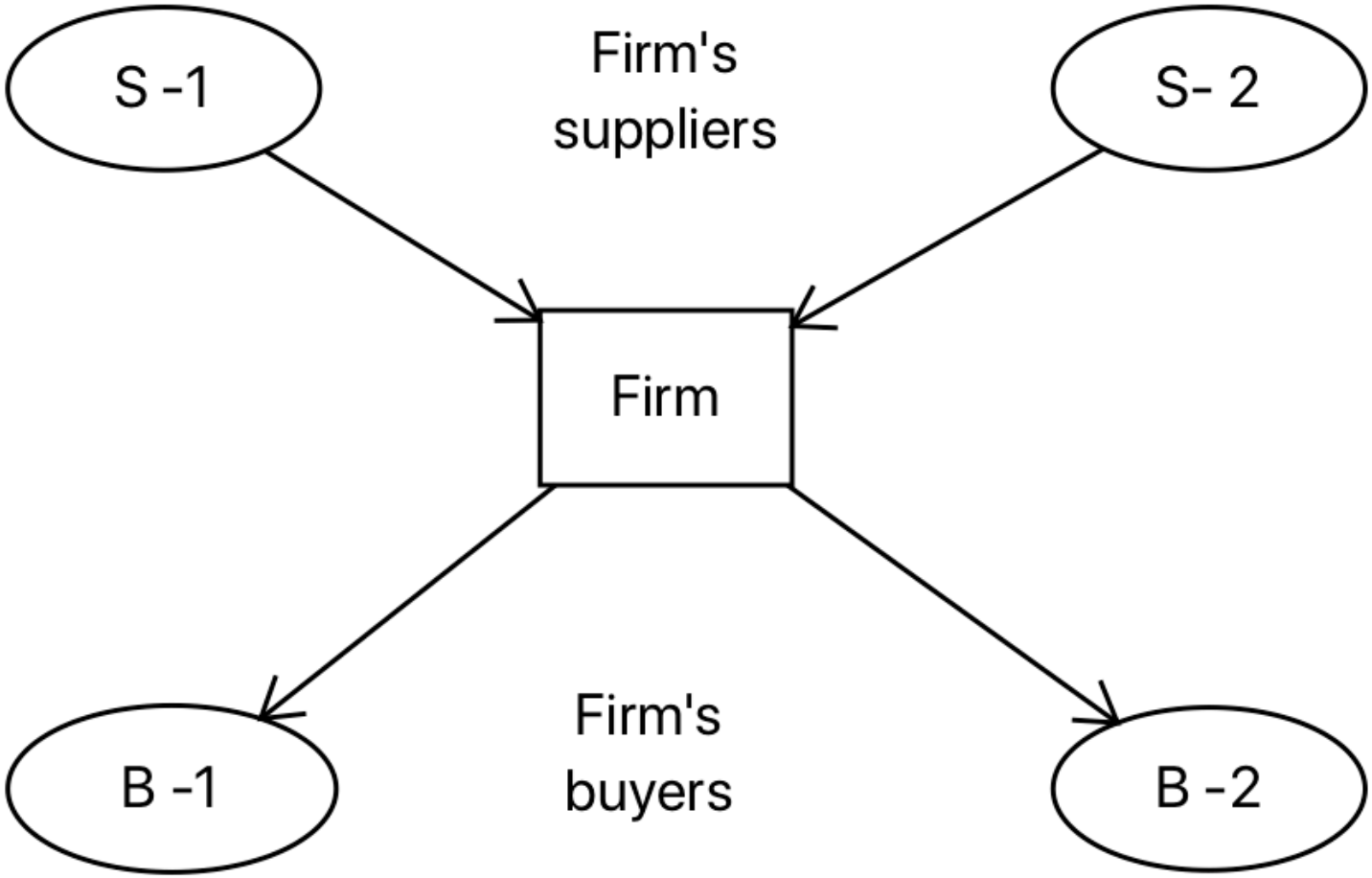


Measuring indirect exposure

- Data on business-to-business trade flows between domestic firms in Turkey:
  - based on VAT records collected by the Ministry of Finance,
  - almost the entire of buyer-supplier relationships in the domestic economy (transactions exceeding TL5,000 (USD2,650 as of end-2011) between a buyer-seller pair in a year),
  - information on the value of transactions.

- Approximately 600,000 firms observed between 2010-2014, generating about 6,000,000 buyer-seller connections.
  - Drop firms that do not report balance sheet/income statement – micro entities keep records using single-entry bookkeeping system;
  - Drop non-manufacturing firms.

Network structure: First-degree linkages



First-degree supplier/buyer exposure

- Construct first-degree supplier/buyer exposure as

$$Exposure_{f,T-2}^{Suppliers} = \sum_{s} \omega_{fs,T-2} \times Exposure_{s,T-2},$$

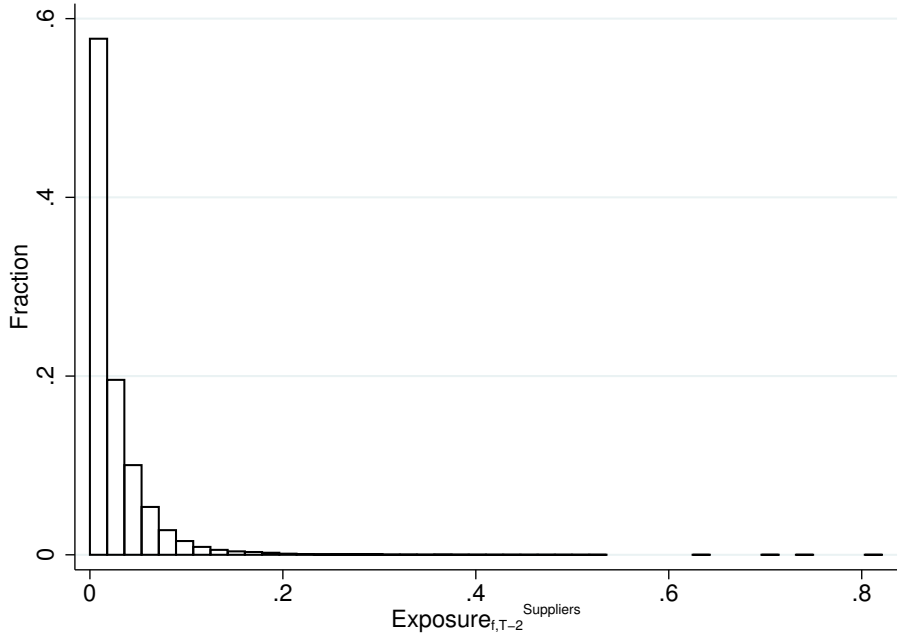
where $\omega_{fs,T-2}$ is the share of supplier s in firm f's total costs at $t = T - 2$

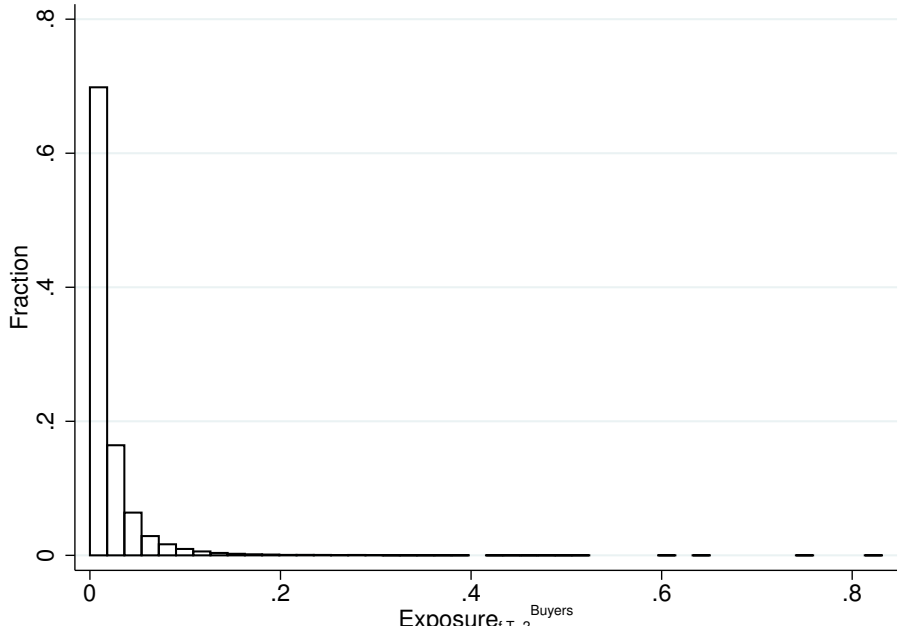
$$Exposure_{f,T-2}^{Buyers} = \sum_{b} \omega_{fb,T-2} \times Exposure_{b,T-2},$$

where $\omega_{fb,T-2}$ is the share of buyer b in firm f's total sales at $t = T - 2$

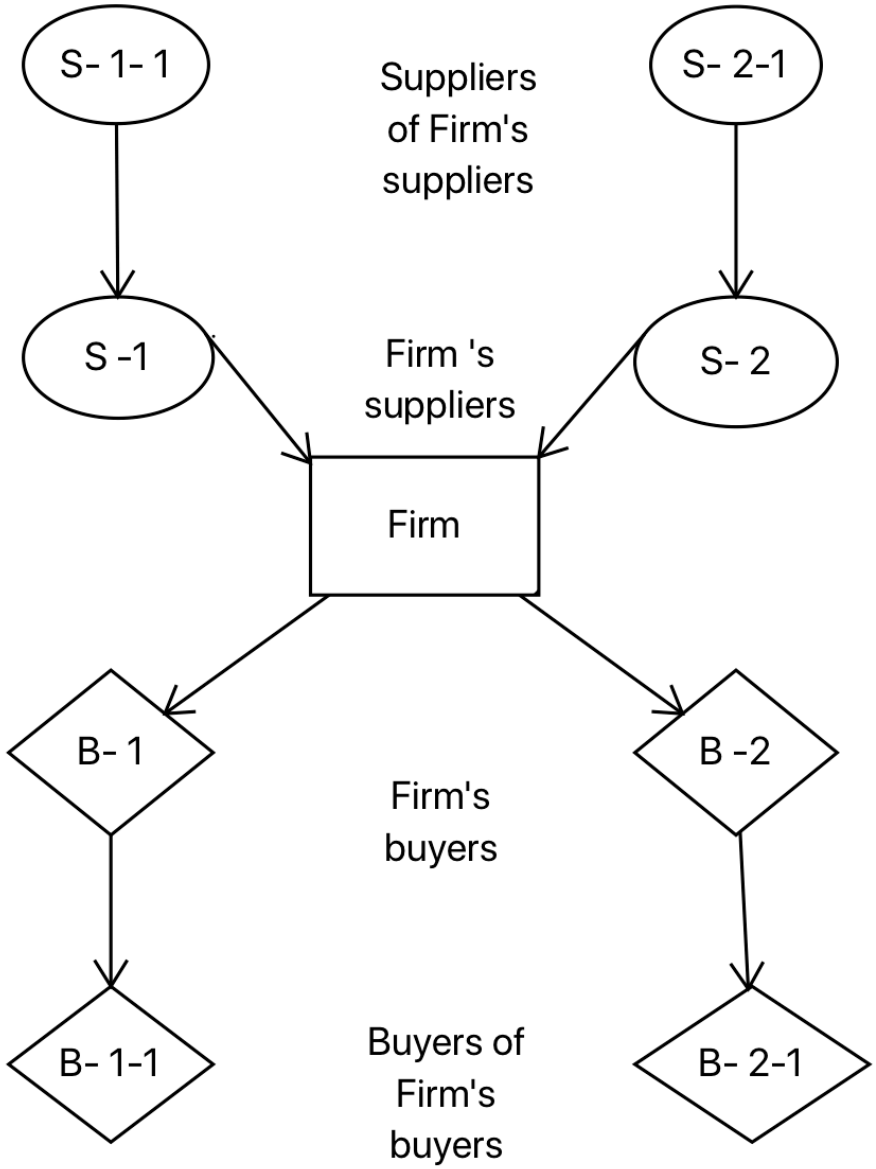
▸ Correlations

First-degree indirect exposure





Network structure: Second-degree linkages



Second-degree supplier/buyer exposure

- Construct exposure variables for second-degree vertical linkages as:

$$Exposure_{f,T-2}^{Suppliers-of-Suppliers} = \sum_{s} \omega_{fs,T-2} \times Exposure_{s,T-2}^{Suppliers}$$

$$Exposure_{f,T-2}^{Buyers-of-Buyers} = \sum_{b} \omega_{fb,T-2} \times Exposure_{b,T-2}^{Buyers}$$

- We will consider the sum of first- and second-degree exposures, e.g. $Exposure_{f,T-2}^{Suppliers} + Exposure_{f,T-2}^{Suppliers-of-Suppliers}$

Summary statistics

	Variable		
	$Exposure$	$Exposure^{Suppliers}$	$Exposure^{Buyers}$
		Importers	
Mean	0.007	0.003	0.002
25th pctile	0.0003	0.0006	0.0002
Median	0.003	0.002	0.001
75th pctile	0.009	0.004	0.002
90th pctile	0.019	0.006	0.005
Std dev	0.012	0.004	0.007
Number of obs.	14,473	14,473	14,473
		Non-importers	
Mean	0	0.002	0.001
25th pctile	0	0	0
Median	0	0.003	0.001
75th pctile	0	0.004	0.002
90th pctile	0	0.006	0.005
Std dev	0	0.004	0.007
Number of obs.	54,820	54,820	54,820

Propagation of the shock

Estimation strategy: Direct effect

- Estimating equation:

$$\Delta_{2011-l} Y_{fsr} = \beta_0 + \beta_l Exposure_{fsr,2010} + \alpha_{sr} + e_{fsr}$$

- Y is an outcome variable for firm f operating in one of the 22 two-digit manufacturing NACE industries (s), and located in one of the 81 regions (r), with $l = \{2012, 2013, 2014\}$.

- Main outcome variable is gross sales, where

$$\Delta_{2011-l} Sales_{fsr} = \frac{Sales_{fsr,l} - Sales_{fsr,2011}}{Sales_{fsr,2011}}$$

- Standard errors clustered at the sector-region level (sector level as a robustness check).

Impact of the shock on firm sales

Dep var:$\Delta_{2011-l} Sales_{fsr}$	(1)	(2)	(3)
	2012	2013	2014
$Exposure_{fsr,2010}$	**-0.364*****	-0.128	0.054
	(0.079)	(0.109)	(0.146)
R^2	0.0193	0.0260	0.0291
N	73,519	73,519	73,519
Fixed effects	sr	sr	sr

Notes: *, **, *** represent significance at the 10, 5, and 1 percent levels, respectively.

Economic significance

- Construct an effective tax rate at the firm level as: $\tau_f = 1 + Exposure_f * \tau$
- Modified estimating equation:

$$\Delta_{2011-l} Y_{fsr} = \epsilon_l^{\tau} \ln \left(\frac{1 + Exposure_{fsr,2010} \tau_T}{1 + Exposure_{fsr,2010} \tau_{T-1}} \right) + \alpha_{sr} + e_{fsr}$$

- ϵ^{τ} is tax elasticity of sales and composed of two parts:
  - Elasticity of price wrt tax: $\frac{\partial \ln p_f}{\partial \tau_f}$
  - Price elasticity of sales: e.g. under CES demand $1 - \sigma$

Economic significance

Dep var:$\Delta_{2011-l} Sales_{fsr}$	(1)	(2)	(3)
	2012	2013	2014
$\ln\left(\frac{1+Exposure_{fsr,2010}\tau_T}{1+Exposure_{fsr,2010}\tau_{T-1}}\right)$	**-11.73*****	-4.421	4.649
	(2.474)	(3.230)	(7.103)
R^2	0.0191	0.0248	0.0245
N	73,519	73,519	73,519
Fixed effects	sr	sr	sr

Notes: *, **, *** represent significance at the 10, 5, and 1 percent levels, respectively.

- Estimated short-run elasticity $\epsilon^{\tau}_{2012} = -11.7$
- Assume $\sigma \approx 4$ (Broda and Weinstein (2006, QJE); Melitz and Redding (2015, ARE))
- Implied value of $\frac{\partial \ln p_f}{\partial \tau_f} \approx 3.9$

Placebo tests

- Assign a placebo date to the shock: October 2010 instead of October 2011.
- Use a placebo sample: processing imports, which have not been subject to RUSF.

Placebo tests

	Placebo date	Processing
	$\Delta_{2010-2011} Sales_{fsr}$	$\Delta_{2011-2012} Sales_{fsr}$
$Exposure_{fsr,2009}$	0.003	
	(0.039)	
$Exposure_{fsr,2010}$		0.039
		(0.043)
R^2	0.027	0.025
N	55,245	48,535
Fixed effects	sr	sr

Notes: *, **, *** represent significance at the 10, 5, and 1 percent levels, respectively.

Robustness checks

- Add initial firm size (as of 2010) measured in terms of employment as an additional control to the baseline specification.
- Add the initial ratio of total imports to sales $(M/Sales)_{fsr,2010}$ to check whether other import-related shocks (e.g., exchange rate movements) affect the baseline estimates.
- Add a dummy indicating highly leveraged firms, i.e., firms with the ratio of total debt to assets exceeding the industry mean as of 2010.
- Add a dummy variable indicating firms that rely more on bank financing, i.e., the ratio of bank loans to assets exceeding the industry mean as of 2010.
- Add all controls together.

▸ Table

Impact on firm-level input purchases

	(1)	(2)	(3)
l =	2012	2013	2014
		$\boldsymbol{\Delta_{2011-l}\left(\frac{M}{Sales}\right)_{fsr}}$	
$Exposure_{fsr,2010}$	**-1.299*****	**-1.112*****	**-0.949*****
	(0.085)	(0.208)	(0.211)
R^2	0.0149	0.0374	0.0437
		$\boldsymbol{\Delta_{2011-l}\left(\frac{DomPurch}{Sales}\right)_{fsr}}$	
$Exposure_{fsr,2010}$	**0.676*****	**0.938*****	**1.022*****
	(0.093)	(0.130)	(0.069)
R^2	0.0242	0.0323	0.0566
		$\mathbf{NewDomSupp_{fsr,l}}$	
$Exposure_{fsr,2010}$	**2.015*****	**5.411*****	**12.50*****
	(0.366)	(0.902)	(1.725)
R^2	0.0183	0.0231	0.0297
N	73,519	73,519	73,519
Fixed effects	sr	sr	sr

Notes: *DomPurch* denotes the total value of total domestic purchases, and *NewDomSupp* denotes the number of new domestic supplier links established. *, **, *** represent significance at the 10, 5, and 1 percent levels, respectively.

▸ Placebo tests

Exploring network effects

Dep var:$\Delta_{2011-l} Sales_{fsr}$	(1)	(2)	(3)
	2012	2013	2014
$Exposure_{fsr,2010}$	**-0.374*****	-0.139	0.0454
	(0.0794)	(0.111)	(0.148)
$Exposure^{Suppliers}_{fsr,2010}$	**-0.472*****	**-0.465*****	-0.112
	(0.0866)	(0.147)	(0.181)
$Exposure^{Buyers}_{fsr,2010}$	0.153	0.138	0.201
	(0.111)	(0.157)	(0.149)
R^2	0.0196	0.0262	0.0291
N	73,519	73,519	73,519
Fixed effects	sr	sr	sr

Notes: *, **, *** represent significance at the 10, 5, and 1 percent levels, respectively.

Economic significance

- Own-tax elasticity of sales $\approx 12 \implies \frac{\partial \ln p_f}{\partial \tau_f} \approx 4$
- Supplier-tax elasticity of sales $\approx 14 \implies \frac{\partial \ln p_f}{\partial \tau_f^S} \approx 4.7$

Exploring network effects: sum of first- and second-degree exposures

Dep var:$\Delta_{2011-l}Sales_{fsr}$	(1)	(2)	(3)
	2012	2013	2014
$Exposure_{fsr,2010}$	**-0.379*****	-0.145	0.0471
	(0.0795)	(0.110)	(0.147)
$Exposure^{S}_{fsr,2010}$	**-0.421*****	**-0.424*****	-0.170
	(0.0758)	(0.129)	(0.145)
$Exposure^{B}_{fsr,2010}$	-0.0006	-0.0012	0.0001
	(0.0011)	(0.0015)	(0.0015)
R^2	0.0196	0.0262	0.0291
N	73,519	73,519	73,519
Fixed effects	sr	sr	sr

Notes: *, **, *** represent significance at the 10, 5, and 1 percent levels, respectively.

▸ Buyer size

Role of financial constraints

Financing Constraints as a Propagation Channel:Conceptual framework

- A simple partial equilibrium model where firms combine capital, labor, and a CES-composite of materials in Cobb-Douglas form.
- Firms import some of their intermediate inputs.
- Firms can pay for imports immediately or delay payment by using external financing.
  - When firm f pays immediately, it incurs a liquidity cost $r_f > 1$ but saves on the tax $\tau_0 > 1$
- Two types of firm heterogeneity:
  - in terms of liquidity costs r_f,
  - in terms of initial reliance on external financing (as of $t = T - 2$): the set of intermediates on which firm f initially pays the tax by N_f.

▸ Details

Predictions

- The negative direct effect of an increase in τ on sales goes up with firm's reliance on external financing ($\beta_{Exposure} < 0$).
- For a given level of reliance on external financing, firms with high liquidity costs experience a larger fall in sales ($\beta_{LowLiq*Exposure} < 0$).
- The effect of an increase in τ on firm's sales through suppliers is negative ($\beta_{Exposure^{Suppliers}} < 0$), and it is increasing in
  - domestic input share,
  - imported input share of the firm's domestic suppliers, and
  - number of domestic suppliers that face high liquidity costs.

Financing Constraints as a Propagation Channel

- Easy access to liquidity can dampen the effect of the tax increase.
- "Ease of access" to liquidity measured with the quick ratio as of $T-2$:

$$QuickRatio = \frac{Cash + MarketableSecurities + AccRec}{CurrentLiabilities}$$

  - Low quick ratio $\implies$ insufficient liquidity to meet short-term liabilities.
  - Define
    - **Liquidity constrained firms** ($LowLiq$): $QuickRatio <$ industry median
    - **Liquidity unconstrained firms** ($HighLiq$): $QuickRatio >$ industry median

▸ Liquidity vs Exposure

Role of Financing Constraints

Dep var:$\Delta_{2011-2012} Sales_{fsr}$	(1)	(2)	(3)
$Exposure_{fsr,2010}$	**-0.227****	**-0.238****	**-0.234****
	(0.100)	(0.101)	(0.101)
$LowLiq_{fsr,2010} * Exposure_{fsr,2010}$	**-0.336*****	**-0.336*****	**-0.349*****
	(0.128)	(0.128)	(0.128)
$Exposure^{Suppliers}_{fsr,2010}$		**-0.512*****	**-0.525*****
		(0.0851)	(0.111)
$Exposure^{Buyers}_{fsr,2010}$		0.160	0.0762
		(0.109)	(0.101)
$LowLiq_{fsr,2010} * Exposure^{Suppliers}_{fsr,2010}$			0.0190
			(0.149)
$LowLiq_{fsr,2010} * Exposure^{Buyers}_{fsr,2010}$			0.0331
			(0.190)
$LowLiq_{fsr,2010}$	0.0606***	0.0615***	0.0595***
	(0.0052)	(0.0052)	(0.0061)
R^2	0.0210	0.0214	0.0214
N	73,519	73,519	73,519
Fixed effects	sr	sr	sr

Notes: *, **, *** represent significance at the 10, 5, and 1 percent levels, respectively.

▸ Robustness

Network effects with financing constraints

- Are liquidity constrained suppliers more likely to propagate the shock?
- Split suppliers (and buyers) into two groups: those with easy access to external liquidity ($HighLiq$) and others ($LowLiq$).
- Construct separate exposure measures for each group: $Exposure_{fsr,T-2}^{Suppliers,HighLiq}$, $Exposure_{fsr,T-2}^{Suppliers,LowLiq}$, $Exposure_{fsr,T-2}^{Buyers,HighLiq}$, $Exposure_{fsr,T-2}^{Buyers,LowLiq}$

Liquidity Constrained Suppliers have a larger impact

Dep vrb: $\Delta_{2011-2012} Sales_{fsr}$	(1)	(2)
	High Own liquidity	Low Own liquidity
$Exposure_{fsr,2010}$	**-0.245****	**-0.602*****
	(0.0991)	(0.103)
$\mathbf{Exposure}^{\mathbf{Suppliers,LowLiq}}_{\mathbf{fsr,2010}}$	**-0.487*****	**-0.766*****
	(0.188)	(0.162)
$\mathbf{Exposure}^{\mathbf{Suppliers,HighLiq}}_{\mathbf{fsr,2010}}$	**-0.254***	**-0.338****
	(0.142)	(0.163)
$Exposure^{Buyers,LowLiq}_{fsr,2010}$	-0.00463	0.0842
	(0.0915)	(0.158)
$Exposure^{Buyers,HighLiq}_{fsr,2010}$	0.00931	-0.0236
	(0.0383)	(0.313)
$\beta^{Suppliers,LowLiq} = \beta^{Suppliers,HighLiq}$	1.016	**3.147***
R^2	0.0279	0.0381
N	40,640	32,879
Fixed effects	sr	sr

▸ Combined sample

Is it about liquidity or size?

- Conduct a similar exercise splitting suppliers (and buyers) based on their gross sales relative to the industry median at time $T-2$: *Large* vs *Small*.

- We do not find a statistically significant difference between the two groups.

▸ Split by size

Estimating Elasticity

Setup

- A simple partial equilibrium model.
- A fixed number of firms, indexed by f, combine labor, capital, and intermediate inputs to produce a final good according to:

$$Q_f = A_f K_f^{\alpha} L_f^{\beta} \Pi_{j=1}^{N} X_{fj}^{\gamma_j}.$$

- X_{fj} is the quantity of the composite input j used by firm f:

$$X_{fj} = \left(b^{\frac{1}{\varepsilon_X}} \left(X_{fj}^F\right)^{\frac{\varepsilon_X - 1}{\varepsilon_X}} + (1-b)^{\frac{1}{\varepsilon_X}} \left(X_{fj}^H\right)^{\frac{\varepsilon_X - 1}{\varepsilon_X}} \right)^{\frac{\varepsilon_X}{\varepsilon_X - 1}}$$

- Each foreign and domestic variety is composed of sub-varieties:

$$X_{fj}^F = \left(\sum_s^{N^F} \left(a_{fjs}^F\right)^{\frac{1}{\varepsilon_A}} \left(x_{fjs}^F\right)^{\frac{\varepsilon_A - 1}{\varepsilon_A}} \right)^{\frac{\varepsilon_A}{\varepsilon_A - 1}}$$

$$X_{fj}^H = \left(\sum_k^{N^H} \left(a_{fjk}^H\right)^{\frac{1}{\varepsilon_D}} \left(x_{fjk}^H\right)^{\frac{\varepsilon_D - 1}{\varepsilon_D}} \right)^{\frac{\varepsilon_D}{\varepsilon_D - 1}}$$

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$$X_{fj}^H = \left(\sum_k^{N^H} \left(a_{fjk}^H\right)^{\frac{1}{\varepsilon_D}} \left(x_{fjk}^H\right)^{\frac{\varepsilon_D - 1}{\varepsilon_D}} \right)^{\frac{\varepsilon_D}{\varepsilon_D - 1}}$$

Estimation strategy

- The setup yields the following estimating equation for the elasticity between domestic and foreign materials for importing firms:

$$\Delta \ln \left(\frac{X^F}{X^H} \right)_{fsr} = (\epsilon_X - 1) \Delta \ln \left(\frac{P^H}{P^F} \right)_{fsr}$$

- Construct P^F as a weighted average of the sum of firm's import unit (cif) values and variety-level RUSF charges, where weights reflect share of each variety in firm's total imports at time t.
- Construct P^H as a weighted average of sectoral domestic PPI, where weights reflect the share of each 4-digit industry in firm's total domestic purchases at time t.
- We instrument for $\Delta \ln \left(\frac{P^H}{P^F} \right)_{fsr}$ using the shock: $\ln \left(\frac{1+Exposure^{Suppliers} * \tau_{T-1}}{1+Exposure * \tau_{T-1}} \right)$

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- Construct P^F as a weighted average of the sum of firm's import unit (cif) values and variety-level RUSF charges, where weights reflect share of each variety in firm's total imports at time t.
- Construct P^H as a weighted average of sectoral domestic PPI, where weights reflect the share of each 4-digit industry in firm's total domestic purchases at time t.
- We instrument for $\Delta \ln \left(\frac{P^H}{P^F} \right)_{fsr}$ using the shock: $\ln \left(\frac{1+Exposure^{Suppliers} * \tau_{T-1}}{1+Exposure * \tau_{T-1}} \right)$

Estimation strategy

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OLS Estimates

Dep var: $\Delta_{2011-l} \ln\left(\frac{X^F}{X^H}\right)_{fsr}$	(1)	(2)	(3)
	2012	2013	2014
$\Delta \ln\left(\frac{P^H}{P^F}\right)_{fsr}$	**-0.104*****	**-0.104*****	**-0.106*****
	(0.00926)	(0.00942)	(0.00974)
R^2	0.0489	0.0670	0.0908
N	8496	8496	8496
Fixed effects	sr	sr	sr
ϵ_X	**0.896**	**0.896**	**0.894**

Notes: *, **, *** represent significance at the 10, 5, and 1 percent levels, respectively.

IV Estimates

Dep var: $\Delta_{2011-l} \ln\left(\frac{X^F}{X^H}\right)_{fsr}$	(1)	(2)	(3)
	2012	2013	2014
$\Delta \ln\left(\frac{P^H}{P^F}\right)_{fsr}$	**0.887*****	**0.738*****	**0.736*****
	(0.165)	(0.250)	(0.252)
N	8496	8496	8496
Fixed effects	sr	sr	sr
First stage F-stat	9.050	8.050	9.516
ϵ_X	**1.887**	**1.738**	**1.736**

Notes: *, **, *** represent significance at the 10, 5, and 1 percent levels, respectively.

▸ First-stage results

Interpretation

- Our estimate of $\epsilon \approx 2$ falls within the range of values typically used in the literature.
- This elasticity is a crucial ingredient in IRBC models and determines how well they match the key patterns of the data.
- Researchers assume a wide range of values (as wide as (0.5, 10)!) to determine the model's success.
- Based on structural assumptions, Halpern et al. (2015, *AER*) estimate the elasticity of substitution between domestic and foreign inputs at 4.
- Using a temporary shock (the 2011 Tohoku earthquake), Boehm et al. (forthcoming, *ReStat*) estimate a near-zero elasticity (≈ 0.2).

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Conclusions

- We examine the propagation of an *unexpected policy shock* using data on the universe of supplier-customer links in Turkey.
- The shock has significant direct and downstream consequences
- Financially constrained firms, i.e., those with low access to external liquidity, are primarily responsible for propagating and amplifying shock transmission.

Payment methods **NOT** subject to RUSF

- **Cash in advance (CIA)**: importer pre-pays and receives the goods later.
- **Standard letter of credit (LC)**: payment is guaranteed by the importer's bank provided that delivery conditions specified in the contract have been met.
- **Documentary collection (DC)**: involves bank intermediation without payment guarantee.

Payment methods subject to RUSF

- **Open account (OA)**: payment is due after goods are delivered in the destination (usually 30 to 90 days).
- **Acceptance credit (AC)**: a type of LC that is payable in full to a beneficiary at a later time, as specified by the time draft, after the submission of the documents.
- **Deferred-payment letter of credit (DLC)**: a type of LC that delays payment for a specified amount of time after shipment or submission of the documents. Time drafts are not required for this type of letters of credit.

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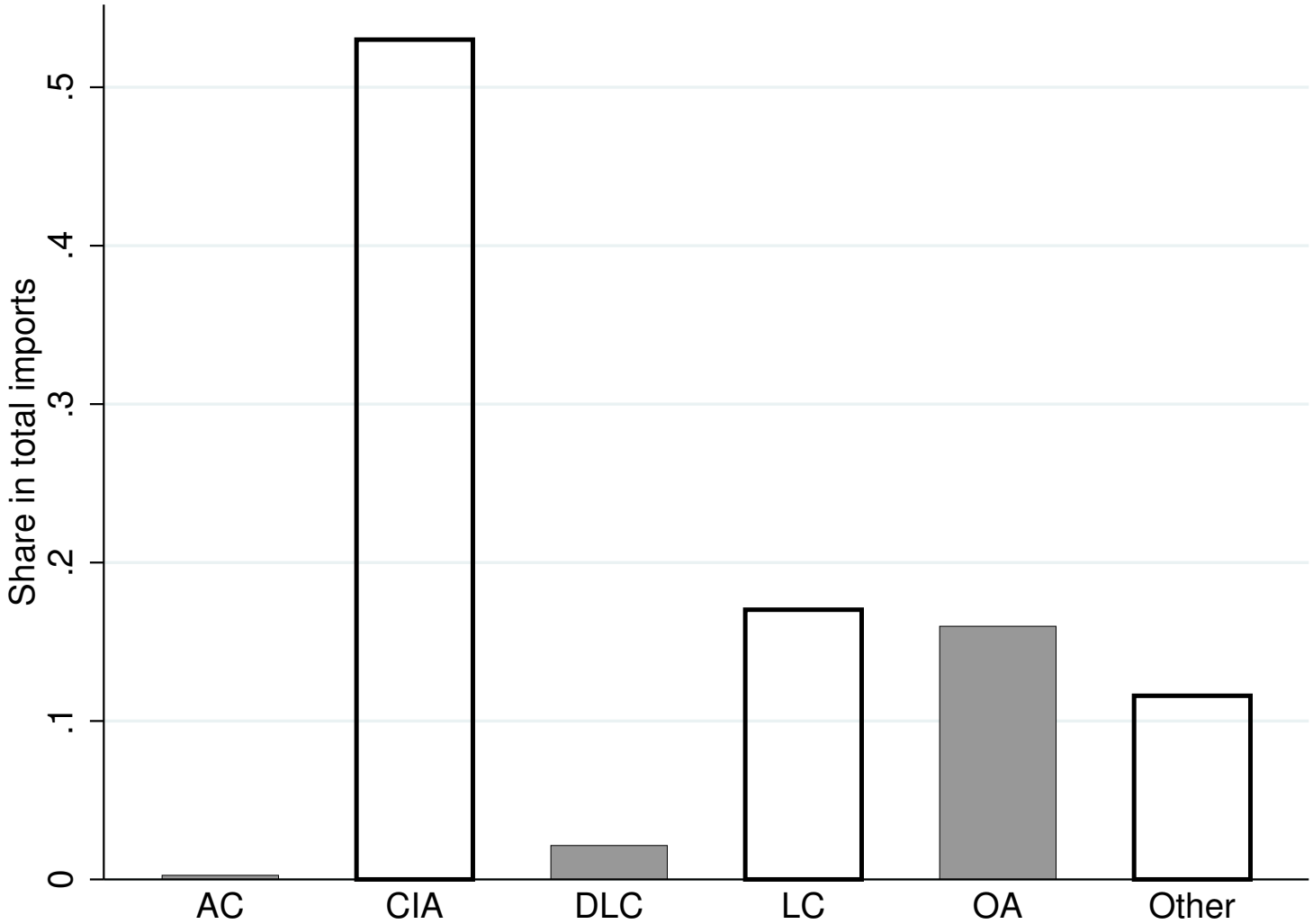
Imports by payment terms in 2011



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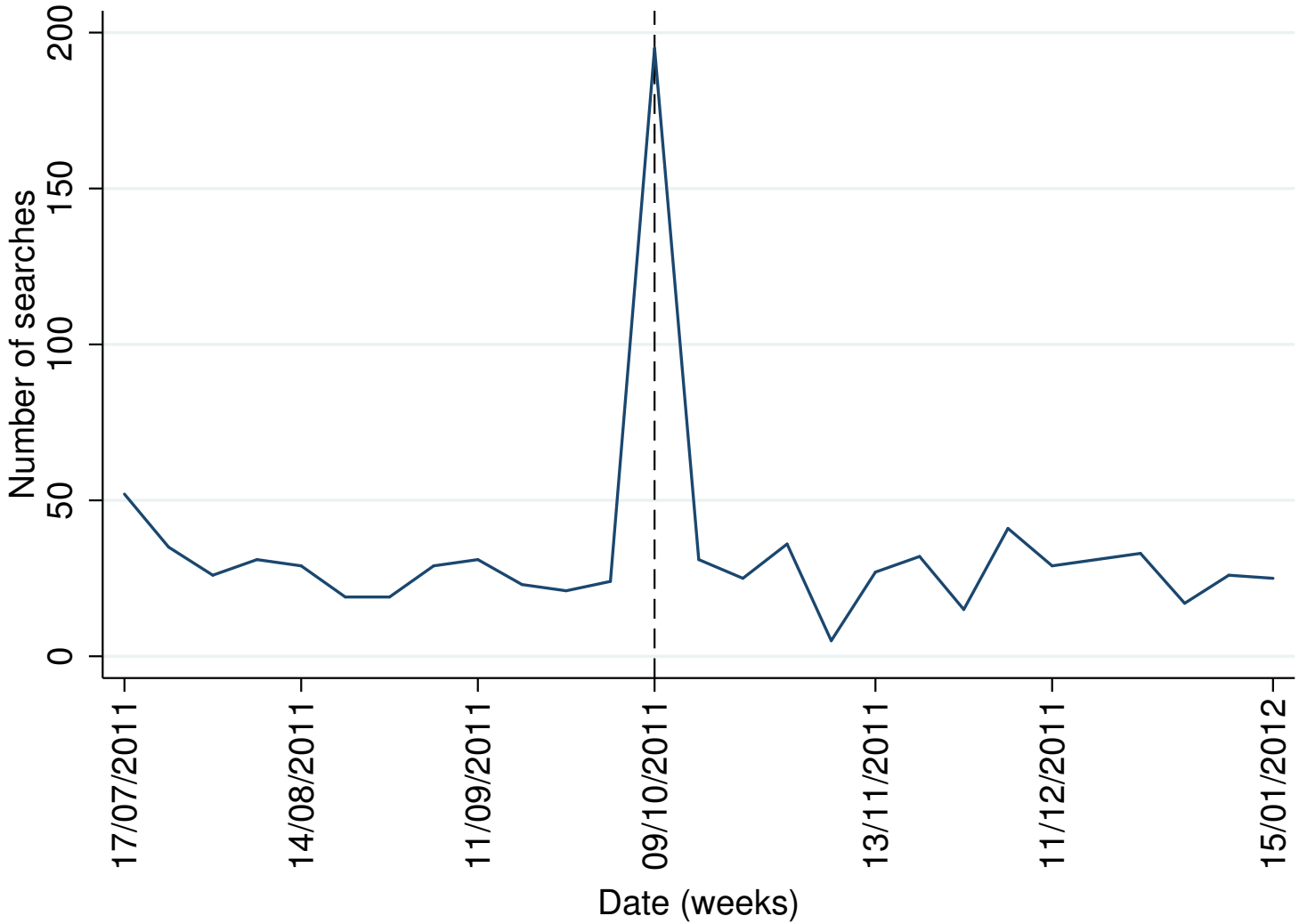
Number of searched for KKDF on Google



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Does RUSF matter?

- RUSF constitutes a significant cost item for importers.
- A report published by the Istanbul Chamber of Industry on the "Manufacture of leather and related products" industry in 2015 argues that
  - RUSF hurts competitiveness as the industry relies heavily on imported inputs and trade credit given firms' capital structure;
  - RUSF must be reduced to 1%;
  - RUSF must be removed for imported inputs that are not available in the domestic market.

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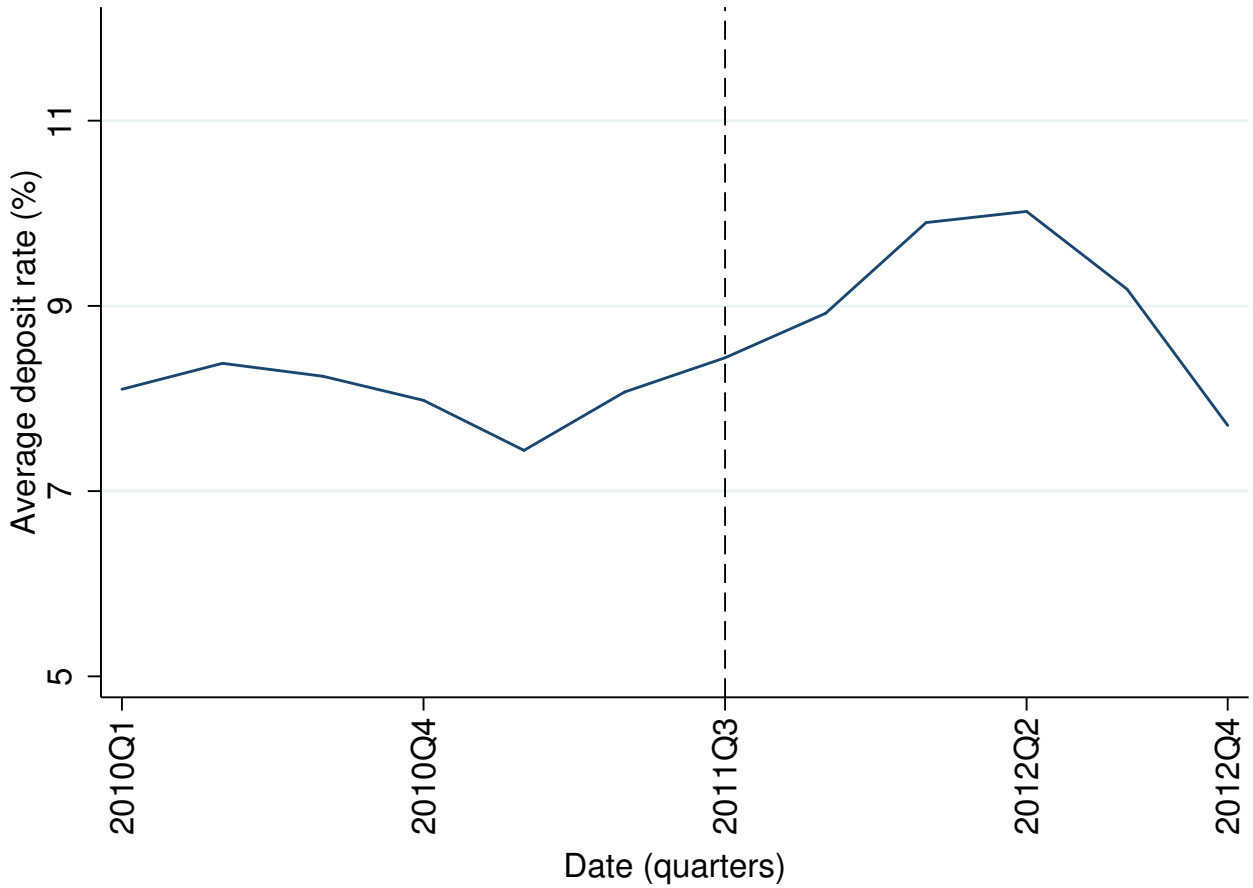
Average deposit rates in Turkey



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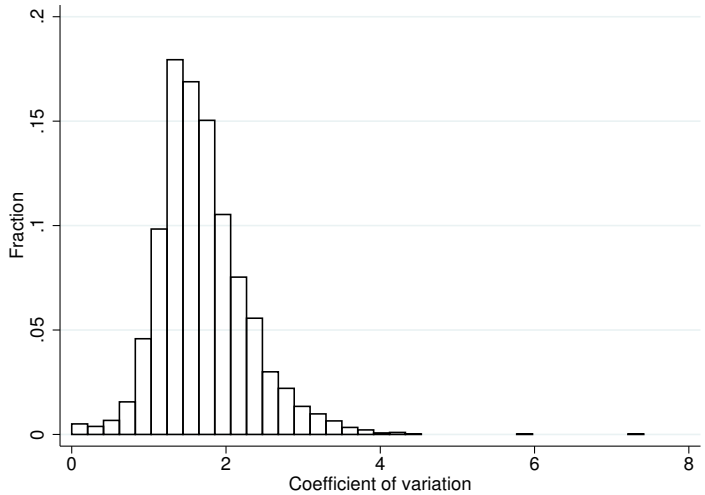
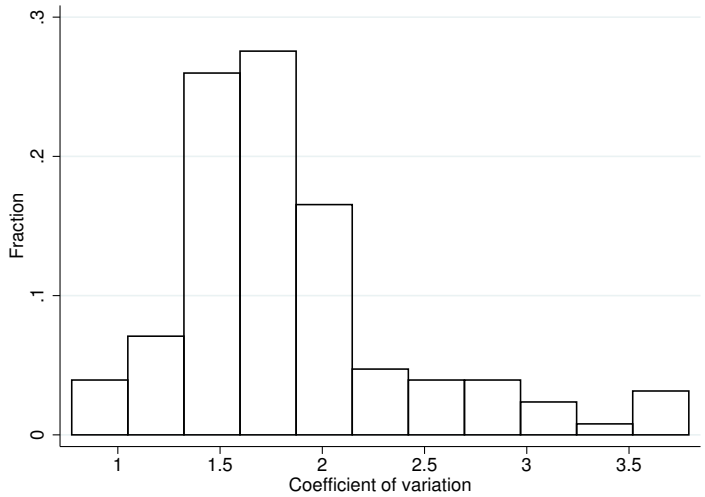
Variation in *Exposure*

Variation within product across countries



Variation within country across products



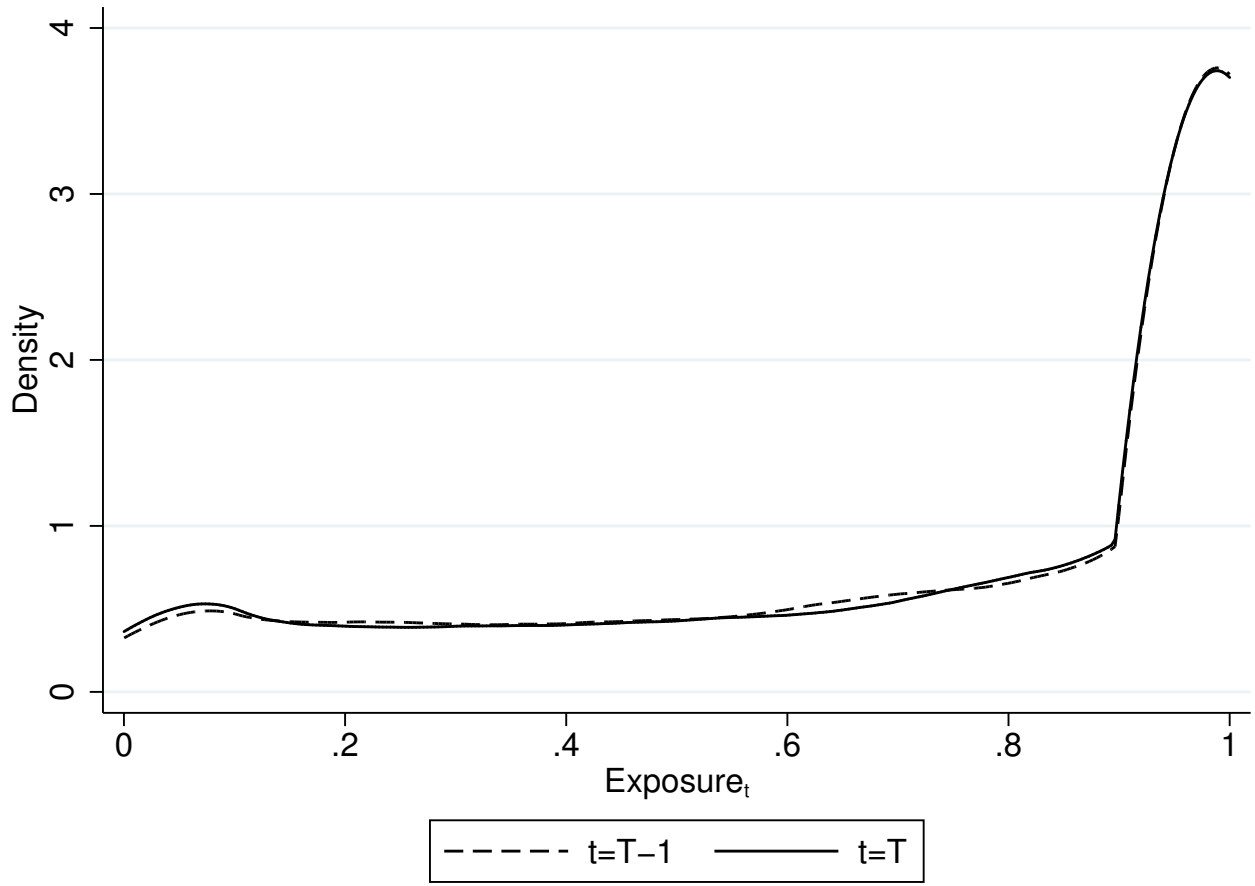
Variation in *Exposure*

Within product			
HS product	Mean	Min (e.g.)	Max (e.g.)
Low-*Exposure* (below mean)			
852329 Magnetic media; other than cards incorporating a magnetic stripe...	0.03	0 (Sweden)	0.53 (Ireland)
843999 Machinery; parts of machinery for making or finishing paper...	0.06	0 (Canada)	0.83 (Belgium)
760820 Aluminium; tubes and pipes, alloys	0.10	0 (Japan)	0.90 (Romania)
560311 Nonwovens; whether or not impregnated, coated...	0.10	0 (South Korea)	0.95 (UK)
720851 Iron or non-alloy steel; (not in coils), flat-rolled...	0.11	0 (Finland)	1 (Poland)
High-*Exposure* (above mean)			
310520 Fertilizers, mineral or chemical; containing the three fertilizing elements...	0.82	0 (UAE)	1 (Romania)
271119 Petroleum gases and other gaseous hydrocarbons...	0.74	0 (Switzerland)	1 (Norway)
310510 Fertilizers, mineral or chemical; in tablets or similar forms...	0.70	0 (Denmark)	1 (Greece)
271019 Petroleum oils and oils from bituminous minerals...	0.59	0 (Hungary)	1 (Czech Rep.)
521031 Fabrics, woven; containing less than 85% by weight of cotton...	0.55	0 (USA)	1 (Japan)

Within source country			
Country	Mean	Min	Max
Low-*Exposure* (below mean)			
Venezuela	0.05	0	1
Bangladesh	0.07	0	1
Macao, SAR China	0.09	0	1
China	0.12	0	1
Estonia	0.15	0	1
High-*Exposure* (above mean)			
Cyprus	0.52	0	1
Greece	0.34	0	1
Kyrgyzstan	0.32	0	1
Peru	0.29	0	1
Bulgaria	0.28	0	1

Placebo: Share of processing imports with external financing (hc level)

$\overline{Exposure}_{hc,t=T-1} = 0.756$; $\overline{Exposure}_{hc,t=T} = 0.755$



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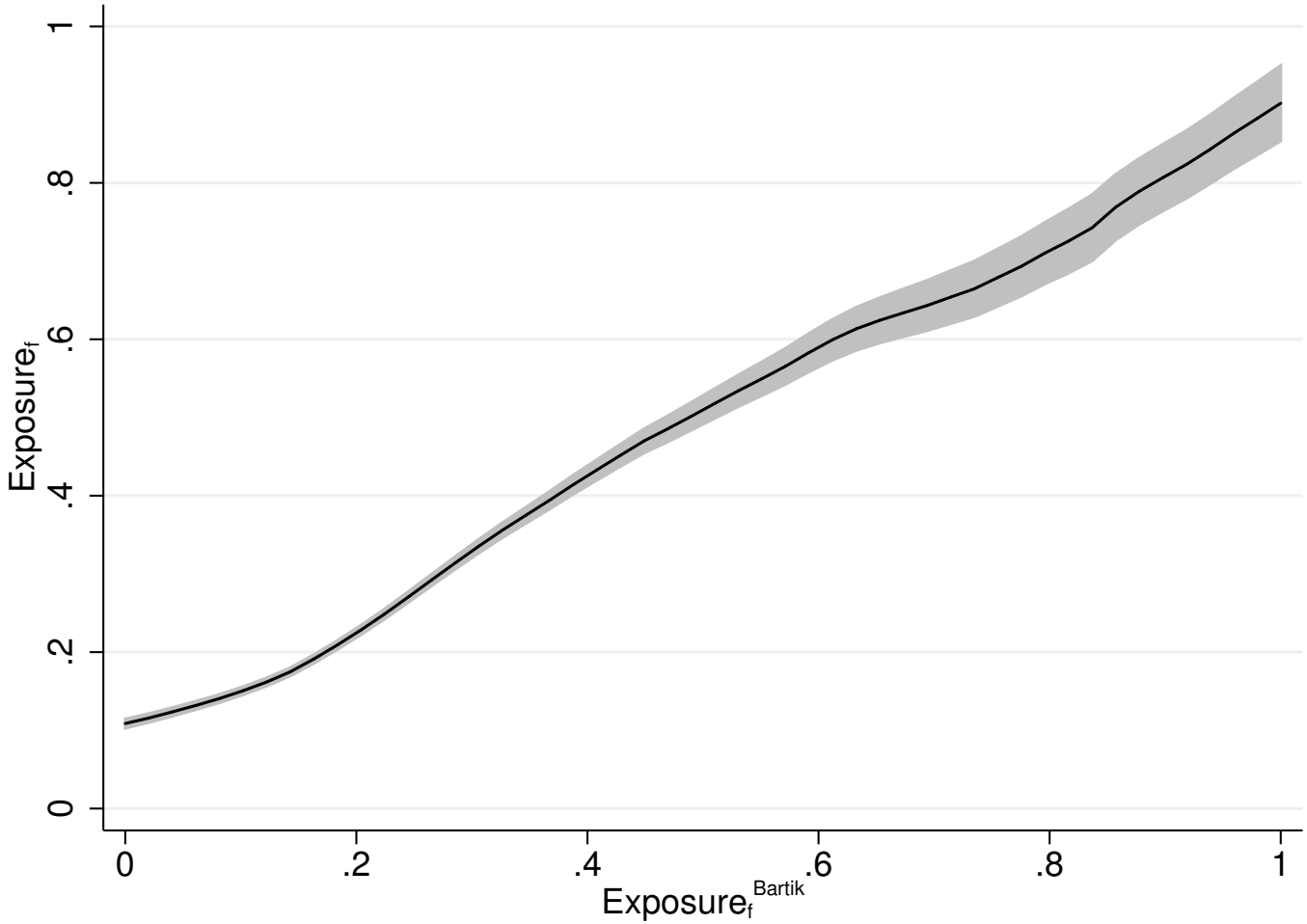
Actual vs. Bartik *Exposure*



- Slope of the linear regression with *sr* fixed effects: 0.9(0.021)

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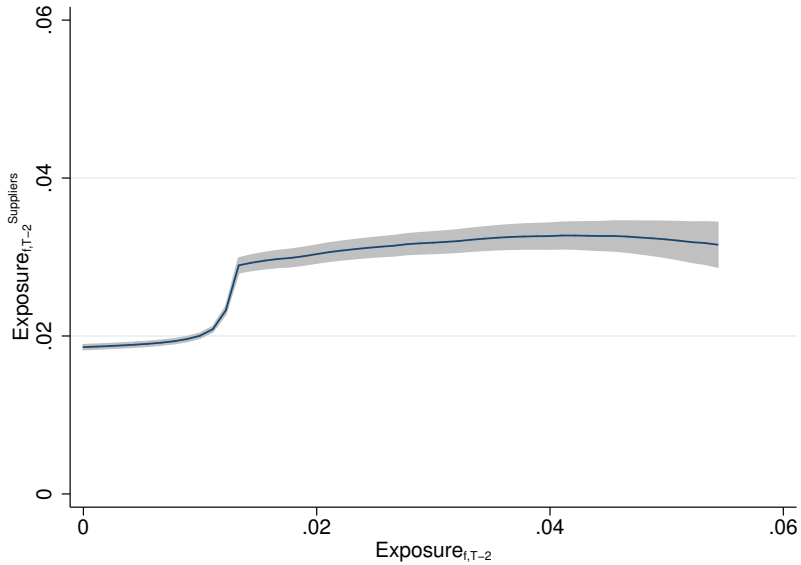
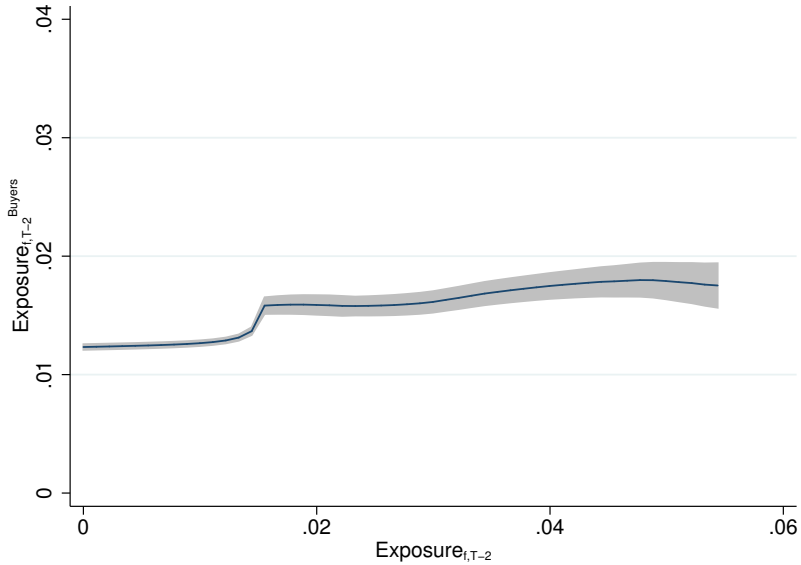
Own exposure and buyer/supplier exposure





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Robustness checks

Dep vrb:$\Delta_{2011-2012}Sales_{fsr}$	(1)	(2)	(3)	(4)	(5)
	Size	Import int.	Leverage	Loans	All
$Exposure_{fsr,2010}$	**-0.319*****	**-0.435*****	**-0.446*****	**-0.322*****	**-0.325*****
	(0.083)	(0.083)	(0.082)	(0.078)	(0.082)
$lnEmp_{fsr,2010}$	-0.019***				-0.018***
	(0.002)				(0.002)
$(M/Sales)_{fsr,2010}$		0.101***			0.009***
		(0.018)			(0.017)
$HighLev_{fsr,2010}$			-0.0269***		-0.0268***
			(0.005)		(0.005)
$HighCredit_{fsr,2010}$				-0.042***	-0.006
				(0.006)	(0.007)
R^2	0.0234	0.0221	0.0225	0.0202	0.0238
N	73,519	73,519	73,519	73,519	73,519
Fixed effects	sr	sr	sr	sr	sr

Notes: *, **, *** represent significance at the 10, 5, and 1 percent levels, respectively.

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Placebo tests

	(1)	(2)	(3)
	$\Delta_{2011-2012}\left(\frac{M}{Sales}\right)_{fsr}$	$\Delta_{2011-2012}\left(\frac{DomPurch}{Sales}\right)_{fsr}$	$NewDomSupp_{fsr,2012}$
		Placebo date	
$Exposure_{fsr,2009}$	0.0456	0.0530	0.668
	(0.0434)	(0.0425)	(0.448)
R^2	0.0128	0.0269	0.0253
N	55,245	55,245	55,245
		Processing	
$Exposure_{fsr,2010}$	-0.0376	0.0190	0.633
	(0.174)	(0.302)	(2.009)
R^2	0.0144	0.0421	0.0244
N	48,535	48,535	48,535
Fixed effects	sr	sr	sr

Notes: *DomPurch* denotes the total value of total domestic purchases, and *NewDomSupp* denotes the number of new domestic supplier links established. *, **, *** represent significance at the 10, 5, and 1 percent levels, respectively.

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Exploring network effects: Effect of buyer size

Dep var:$\Delta_{2011-l} Sales_{fsr}$	(1)	(2)	(3)
	2012	2013	2014
$Exposure_{fsr,2010}$	**-0.382*****	0.106	0.031
	(0.0807)	(0.0687)	(0.154)
$Exposure^{Suppliers}_{fsr,2010}$	**-0.851*****	**-0.728***	0.133
	(0.248)	(0.390)	(0.572)
$Large * Exposure^{Suppliers}_{fsr,2010}$	**0.489***	**0.663***	0.136
	(0.265)	(0.400)	(0.594)
$Exposure^{Buyers}_{fsr,2010}$	0.138	0.243	0.282
	(0.147)	(0.167)	(0.171)
$Large * Exposure^{Buyers}_{fsr,2010}$	-0.102	0.108	-0.039
	(0.198)	(0.304)	(0.285)
$Large$	-0.0740***	-0.0213*	-0.024
	(0.0116)	(0.0116)	(0.0199)
R^2	0.0236	0.0311	0.0375
N	73,519	73,519	73,519
Fixed effects	sr	sr	sr

Notes: *, **, *** represent significance at the 10, 5, and 1 percent levels, respectively.

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Liquidity vs Exposure

- The unconditional correlation between *Exposure* and *QuickRatio* is 0.027.
- For conditional correlations, we run the following regressions:

Dep var:$Exposure_{fsr,2010}$	(1)	(2)
$QuickRatio_{fsr,2010}$	0.0007	0.0004
	(0.0006)	(0.0007)
$\ln Emp_{fsr,2010}$		0.008
		(0.0007)
R^2	0.0390	0.0543
N	47,165	47,165
Fixed effects	sr	sr

Notes: *, **, *** represent significance at the 10, 5, and 1 percent levels, respectively.

- *QuickRatio* measures a firm's access to liquidity.
- Our *Exposure* variable reflects where it is cheaper to find financing.

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N	47,165	47,165
Fixed effects	sr	sr

Notes: *, **, *** represent significance at the 10, 5, and 1 percent levels, respectively.

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Liquidity Constrained Suppliers have a larger impact

Dep vrb: $\Delta_{2011-2012} Sales_{fsr}$	(1)
$Exposure_{fsr,2010}$	**-0.372*****
	(0.0790)
$Exposure_{fsr,2010}^{Suppliers,LowLiq}$	**-0.560*****
	(0.119)
$Exposure_{fsr,2010}^{Suppliers,HighLiq}$	**-0.310*****
	(0.110)
$Exposure_{fsr,2010}^{Buyers,LowLiq}$	0.0223
	(0.136)
$Exposure_{fsr,2010}^{Buyers,HighLiq}$	-0.0398
	(0.0337)
$\beta^{Suppliers,LowLiq} = \beta^{Suppliers,HighLiq}$	**2.792***
R^2	0.0196
N	73,519
Fixed effects	sr

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Role of Financing Constraints: Alternative explanations

Dep var:$\Delta_{2011-2012} Sales_{fsr}$	(1)	(2)
$Exposure_{fsr,2010}$	**-0.457*****	**-0.392*****
	(0.0872)	(0.0770)
$HighLev_{fsr,2010} * Exposure_{fsr,2010}$	0.0964	
	(0.128)	
$Small_{fsr,2010} * Exposure_{fsr,2010}$		0.117
		(0.322)
$Exposure^{Suppliers}_{fsr,2010}$	**-0.505*****	**-0.418*****
	(0.0876)	(0.0809)
$Exposure^{Buyers}_{fsr,2010}$	0.134	0.0982
	(0.111)	(0.113)
$HighLev_{fsr,2010}$	-0.0430***	
	(0.00528)	
$Small_{fsr,2010}$		0.0659***
		(0.0121)
R^2	0.0205	0.0236
N	73,519	73,519
Fixed effects	sr	sr

Notes: *, **, *** represent significance at the 10, 5, and 1 percent levels, respectively. *HighLev* and *Small* are dummy variables indicating firms with the ratio of total debt to assets exceeding the industry median as of $T-2$ and firms with gross sales below the industry median as of $T-2$.

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Is it about liquidity or size?

Dep vrb: $\Delta_{2011-2012} Sales_{fsr}$	(1)
$Exposure_{fsr,T-2}$	**-0.374*****
	(0.0795)
$Exposure_{fsr,2010}^{Suppliers,Small}$	**-0.585***
	(0.317)
$Exposure_{fsr,2010}^{Suppliers,Large}$	**-0.470*****
	(0.0871)
$Exposure_{fsr,2010}^{Buyers,Small}$	0.0116
	(0.234)
$Exposure_{fsr,2010}^{Buyers,Large}$	0.0147
	(0.113)
$\beta^{Suppliers,Small} = \beta^{Suppliers,Large}$	0.007
R^2	0.0196
N	73,519
Fixed effects	sr

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First-stage results

Dep var: $\Delta \ln \left(\frac{P^H}{P^F}\right)_{fsr}$	(1)	(2)	(3)
	2012	2013	2014
$\ln \left(\frac{1+Exposure^{Suppliers}*\tau_{T-1}}{1+Exposure*\tau_{T-1}}\right)$	**0.0000352*****	**0.0000254*****	**0.0000316*****
	(0.0000117)	(0.00000897)	(0.0000102)
R^2	0.0494	0.0577	0.0415
N	8496	8496	8496
Fixed effects	sr	sr	sr

Notes: *, **, *** represent significance at the 10, 5, and 1 percent levels, respectively.

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Setup

- A simple partial equilibrium model.
- A fixed number of firms, indexed by f, combine labor, capital, and intermediate inputs to produce a final good according to:

$$Q_f = A_f K_f^{\alpha} L_f^{\beta} \Pi_{j=1}^{N} X_{fj}^{\gamma_j}.$$

- X_{fj} is the quantity of the composite input j used by firm f:

$$X_{fj} = \left(b^{\frac{1}{\varepsilon_X}} \left(X_{fj}^F\right)^{\frac{\varepsilon_X - 1}{\varepsilon_X}} + (1-b)^{\frac{1}{\varepsilon_X}} \left(X_{fj}^H\right)^{\frac{\varepsilon_X - 1}{\varepsilon_X}} \right)^{\frac{\varepsilon_X}{\varepsilon_X - 1}}$$

- Each foreign and domestic variety is composed of sub-varieties:

$$X_{fj}^F = \left(\sum_s^{N^F} \left(a_{fjs}^F\right)^{\frac{1}{\varepsilon_A}} \left(x_{fjs}^F\right)^{\frac{\varepsilon_A - 1}{\varepsilon_A}} \right)^{\frac{\varepsilon_A}{\varepsilon_A - 1}}$$

$$X_{fj}^H = \left(\sum_k^{N^H} \left(a_{fjk}^H\right)^{\frac{1}{\varepsilon_D}} \left(x_{fjk}^H\right)^{\frac{\varepsilon_D - 1}{\varepsilon_D}} \right)^{\frac{\varepsilon_D}{\varepsilon_D - 1}}$$

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$$X_{fj}^H = \left(\sum_k^{N^H} \left(a_{fjk}^H\right)^{\frac{1}{\varepsilon_D}} \left(x_{fjk}^H\right)^{\frac{\varepsilon_D - 1}{\varepsilon_D}} \right)^{\frac{\varepsilon_D}{\varepsilon_D - 1}}$$

Paying for imports

- Firms can pay immediately or delay payment by using external financing.
- When firm f pays immediately, it incurs a liquidity cost $r_f > 1$ but saves $\tau_0 > 1$.
- Denoting the producer price of the variety by P_j^F, the cost of importing variety j is
  - $r_f P_j^F$ if the firm pays immediately,
  - $\tau_0 P_j^F$ if the firm delays payment by using external financing.
- The choice is exogeneously determined by the interplay between r_f and bargaining with international suppliers before the shock.
- Two types of firm heterogeneity:
  - in terms of liquidity costs r_f,
  - in terms of initial reliance on external financing: the set of intermediates on which firm f initially pays the tax by N_f.

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Firms' costs

- Model implies a constant marginal cost of production:

$$c_f = \frac{R^{\alpha}\Pi_{fj}\left(P_{fj}\right)^{\gamma_j}}{A_f\left(\alpha\right)^{\alpha}\Pi_j\left(\gamma_j\right)^{\gamma_j}},$$

- Price index is defined as

$$P_{fj} = \left(b\left(\widetilde{P}_{fj}^{F}\right)^{\frac{\varepsilon_X-1}{\varepsilon_A-1}} + (1-b)\left(\widetilde{P}_{fj}^{H}\right)^{\frac{\varepsilon_X-1}{\varepsilon_D-1}}\right)^{\frac{1}{1-\varepsilon_X}}$$

where $P_{fj}^{F} = \left(\widetilde{P}_{fj}^{F}\right)^{-\frac{1}{\varepsilon_A-1}}$ and $P_{fj}^{H} = \left(\widetilde{P}_{ij}^{H}\right)^{-\frac{1}{\varepsilon_D-1}}$ are the prices of the bundles X_{fj}^{F} and X_{fj}^{H} respectively and

$$\widetilde{P}_{fj}^{F} = \sum\left(p_{fjk}^{F}\right)^{1-\varepsilon_A} a_{fjk}^{F}$$

$$\widetilde{P}_{fj}^{H} = \sum\left(p_{fjk}^{H}\right)^{1-\varepsilon_D} a_{fjk}^{H}$$

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Effect of an increase in τ

- A firm will react to an increase in τ depending on whether $r_f > \tau_1$ or not: firms with $r_f > \tau_1$ will continue to import $j \in N_f$ on credit, and other firms will switch to pre-payment for $j \in N_f$.

- For $r_f > \tau_1$, the direct effect of a change in τ on the firm's unit costs is:

$$\frac{d \ln c_f}{d\tau} \Delta\tau = \Delta\tau \sum_{j \in N_f} \gamma_j \frac{1}{\tau_0} \eta_{fj}^F$$

  where

  - $\eta_{fj}^F = \dfrac{b\left(\widetilde{P}_{fj}^F\right)^{\frac{1-\varepsilon_X}{1-\varepsilon_A}}}{\left(b\left(\widetilde{P}_{fj}^F\right)^{\frac{1-\varepsilon_X}{1-\varepsilon_A}} + (1-b)\left(\widetilde{P}_{fj}^H\right)^{\frac{1-\varepsilon_X}{1-\varepsilon_D}}\right)}$: share of foreign intermediates in the total usage of intermediates for input j.

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- For $r_f < \tau_1$, it is:

$$(r_f - \tau_0) \frac{\partial \ln c_f}{\partial \tau} = (r_f - \tau_0) \sum_{j \in N_f} \gamma_j \frac{1}{\tau_0} \eta^F_{fj}.$$

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Network effects

- Firms do not change their mark-ups as a response to an exogenous shock, i.e. $\frac{\partial\left(p_{fjk}^{H}\right)}{\partial\tau} = \frac{\partial c_{fjk}}{\partial\tau}$
- Then the indirect change in the cost of firm f is:

$$\sum_{j=1}^{N} \gamma_j \frac{1}{\tau_0} \eta_{fj}^{H} \left\{ \begin{array}{l} \left[(\tau_1 - \tau_0) \sum_{k \notin \Theta_{fj}} \chi_{fjk} \left(\sum_{s \in N_k} \gamma_s \eta_{ks}^{F} \right) \right] \\ + \left[\sum_{l \in \Theta_{fj}} (r_l - \tau_0) \chi_{fjl} \left(\sum_{s \in N_l} \gamma_s \eta_{ls}^{F} \right) \right] \end{array} \right\}$$

where

  - Θ_{fj} denotes the set of suppliers that face low liquidity costs, $r_k < \tau_1$;
  - $\chi_{fjk} = \frac{p_{fjk}^{H} x_{fjk}^{H}}{\sum p_{fjs}^{H} x_{fjs}^{H}}$ is the share of the domestic input k in the total domestic inputs used to produce X_{fj}.

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Firms' sales

- Spending on a particular domestic variety is given by:

$$P_{fj}X_{fj} = \gamma_j p_f Q_f = p^H_{fjs} x^H_{fjs} \left(\eta^H_{fj}\right)^{-1} \chi^{-1}_{fjl},$$

- Demand for a firm's products comes from final demand (with a constant expenditure share ζ_f) and the demand from other firms:

$$Q_f = \frac{\zeta_f Y}{p_f} + \sum_{i=1}^{n} x_{if} = \frac{\zeta_f Y}{p_f} + \sum_{i=1}^{n} \left(1 - \eta_{ij}\right) \chi_{ijf} \frac{\gamma_j}{p_f} p_i Q_i$$

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- Let $(1-\eta_{ij})\,\chi_{ijf}\gamma_j = \xi_{fi}$ and

  $\xi_{ff} = 0, \boldsymbol{\xi}_f = \begin{bmatrix} \xi_{f1} & \xi_{f2} & \cdots & \xi_{fn} \end{bmatrix}, \mathbf{pQ} = \begin{bmatrix} p_1Q_1 \\ p_2Q_2 \\ \cdots \\ p_nQ_n \end{bmatrix}$. Then

$$p_fQ_f = \zeta_f Y + \boldsymbol{\xi}_f \mathbf{pQ}$$

- Stacking for all firms, with $\boldsymbol{\Xi} = \begin{bmatrix} \xi_1 \\ \xi_2 \\ \cdots \\ \xi_n \end{bmatrix}$ and $\boldsymbol{\zeta} = \begin{bmatrix} \zeta_1 \\ \zeta_2 \\ \cdots \\ \zeta_n \end{bmatrix}$, we obtain

$$\mathbf{pQ} = (\mathbf{I} - \boldsymbol{\Xi})^{-1}\,\boldsymbol{\zeta} Y$$

- $\boldsymbol{\Xi}$ is a collection of constants as well as domestic/foreign intermediates shares in the production process, thus it is endogenous.

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Effect of an increase in τ

- RUSF leads to a change in $(1-\eta_{ij})$ and χ_{ijf}.
- Consider only the first-round effects:

$$\frac{\partial p_f Q_f}{\partial \tau} = Y \sum_{i \neq f} \zeta_i \gamma_j \left[\eta_{ij}^H \frac{\partial \chi_{ijf}}{\partial \tau} + \chi_{ijf} \frac{\partial \eta_{ij}^H}{\partial \tau} \right]$$

- The overall effect is ambiguous and depends on the whole network.
- It depends on the changes in the usage by buyers of a particular intermediate among other domestic intermediates ($\frac{\partial \chi_{ijf}}{\partial \tau}$) and the general change in the usage of domestic and foreign intermediates ($\frac{\partial \eta_{ij}^H}{\partial \tau}$).
- Example: suppose firm f is the only one impacted by the RUSF
  - as its variety price increases, it is going to be substituted among other domestic varieties by each buyer ($\frac{\partial \chi_{ijf}}{\partial \tau} < 0$)
  - as the general price level of domestic varieties increases, there is some (small) substitution towards foreign varieties ($\frac{\partial \eta_{ij}^H}{\partial \tau} < 0$)

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Effect of an increase in τ: direct effects

We are interested in how the direct impact of the RUSF changes firm's f sales when it passes on the cost increases into prices.

- If the firm is one of many in the economy producing variety j, then changes in its cost will impact the general change in substitution between domestic and foreign inputs minimally ($\frac{\partial \eta_{ij}^H}{\partial \tau} \approx 0$)
- What will matter more for the direct impact on sales is the change in the share of domestic intermediates used by buyers of variety j:

$$Y \sum_{i \neq f} \zeta_i \gamma_j \left[\eta_{ij}^H \frac{\partial \chi_{ijf}}{\partial \tau} \right]$$

- Since $\frac{\partial \chi_{ijf}}{\partial \tau}$ will change because of price increases caused both by direct and supplier-driven cost increases we need to find $\frac{\partial \chi_{ijf}}{\partial p_f} \frac{\partial p_f}{\partial \tau}$ and decompose it.

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Effect of an increase in τ: direct effects (cont.)

Since

$$\frac{\partial \chi_{ijf}}{\partial p^H_{ijf}} = \frac{(1-\varepsilon_D)}{p^H_{ijf}} \chi_{ijf},$$

for a firm f with high-liquidity cost where the direct cost shock of the RUSF for firm f is $(\tau_1 - \tau_0)\frac{\partial \ln c_f}{\partial \tau} = \Delta\tau \sum_{m \in N_m} \gamma_m \frac{1}{\tau_0} \eta^F_{fm}$.

Then, the direct effect of RUSF on sales of firm f is

$$Y \sum_{i \neq f} \zeta_i \gamma_j \left[(1-\eta_{ij}) \frac{\partial \chi_{ijf}}{\partial p_f} \left[\frac{\partial p_f}{\partial \tau} \right]_{direct} \right]$$

$$= Y \Delta\tau (1-\varepsilon_D) \left(\sum_{m \in N_f} \gamma_m \frac{1}{\tau_0} \eta^F_{fm} \right) \left(\sum_{i \neq f} \zeta_i \gamma_j (1-\eta_{ij}) \chi_{ijf} \right)$$

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