Trade Shocks and Firms: Neglected Margins of Adjustment

Beata Javorcik
Oxford and CEPR

October 2018

How do firms adjust to trade shocks?

- The literature has mainly focused on
  - exit of the least productive firms and reallocation of market shares towards more productive ones (Pavcnik 2002, Melitz 2003)
  - dropping the least performing products and expanding the best performing ones (Bernard, Redding, and Schott (2010 and 2011, Eckel and Neary 2010, Mayer, Melitz, and Ottaviano 2014)

- This talk will focus on other margin of adjustment:
  - provision of trade credit
  - evasion of border taxes
  - changes to the domestic supplier base

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  - **provision of trade credit**
  - **evasion of border taxes**
  - **changes to the domestic supplier base**

Don't Throw in the Towel, Throw in Trade Credit

Banu Demir and Beata Javorcik
Journal of International Economics (2018)

Trade credit as a margin of adjustment

- In response to an exogenous increase in competition in export markets
  - exporters extend **trade credit** and drop prices
  - provision of **trade credit** generates a dampening effect on the price response

Anecdotal evidence

Advice given to exporters by the US Department of Commerce:

- *"Insisting on cash-in-advance could, ultimately, cause exporters to lose customers to competitors who are willing to offer more favorable payment terms to foreign buyers"*
- *"Open account terms (i.e., **providing trade credit**) may help win customers in competitive markets"*

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End of the Multi-Fibre Agreement: Shock for Turkish Exporters

- The MFA, a system of bilateral quotas governing the global trade in textiles and clothing since 1974, was dismantled in 2005. The decision was taken during the Uruguay Round which finished in 1994
- Turkish exports have not been subject to any quota restrictions since 1996 (when Turkey formed a customs union with the EU)
- Chinese exports were subject to MFA quotas which were abolished (with some exceptions) on **1 January 2005**
- Quota fill rates varied from below 10% to 100% in 2004, higher rates indicating greater constraint on Chinese exporters $\Longrightarrow$ a greater increase in competitive pressures after the quota removal

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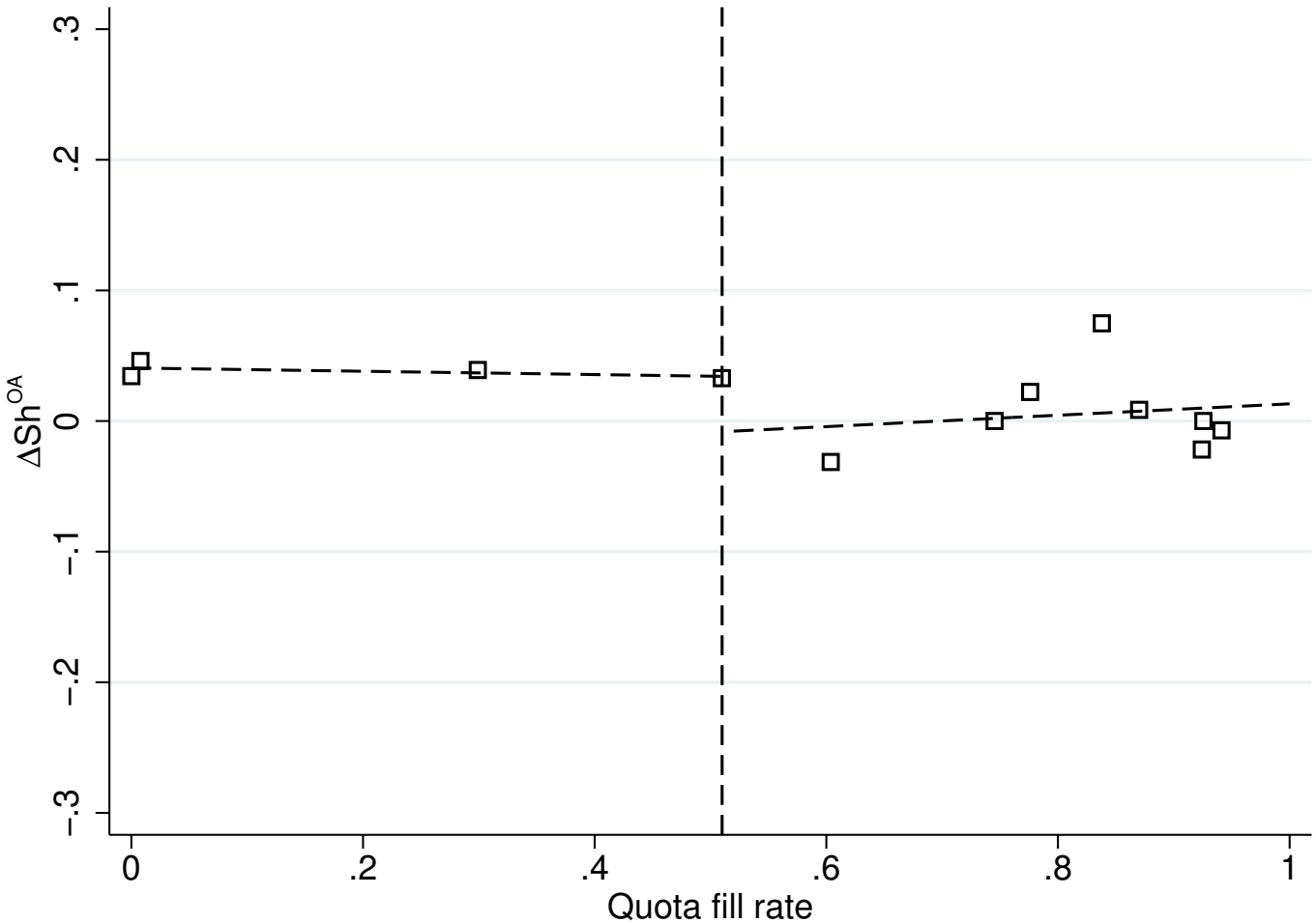
Data

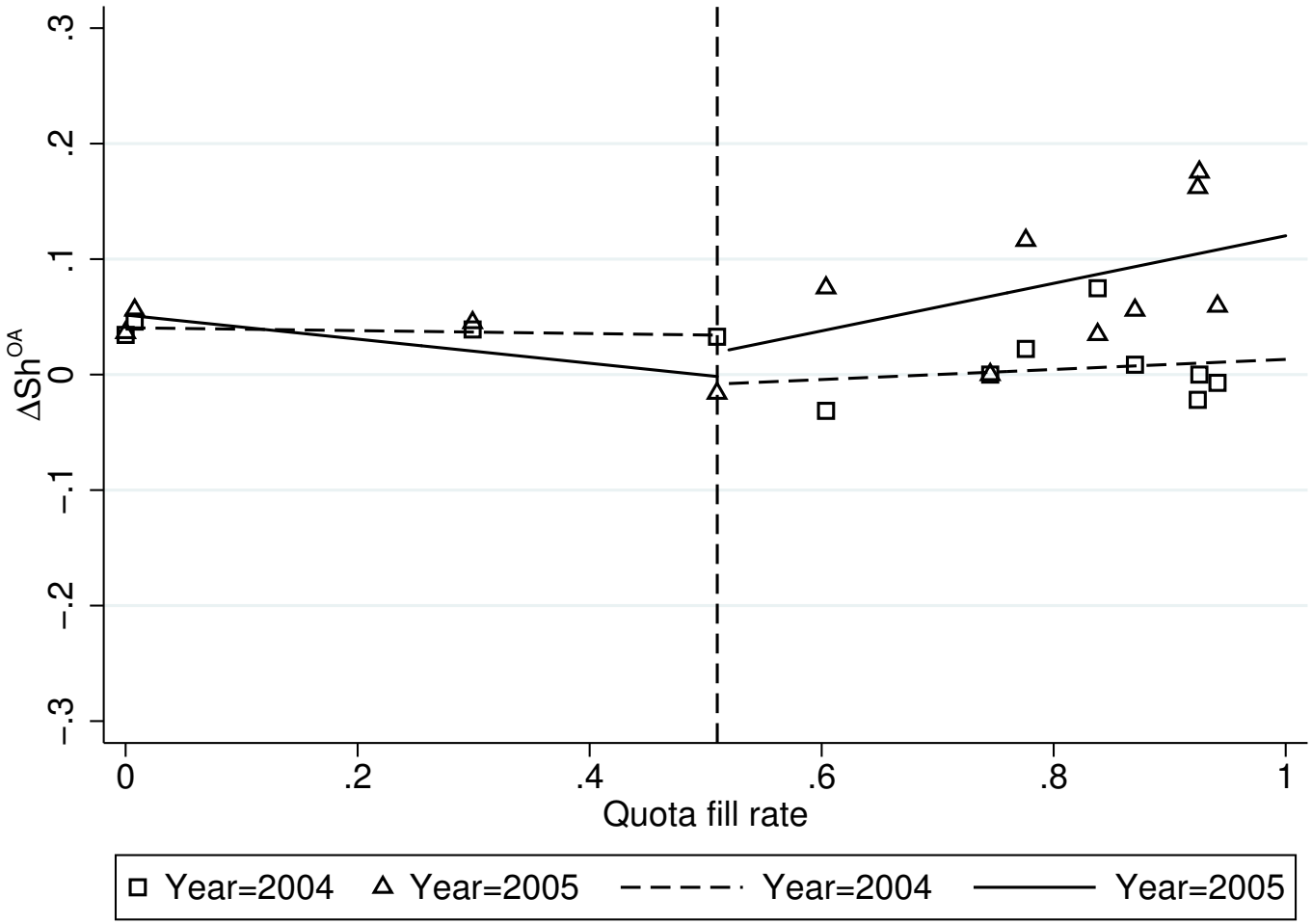
- Universe of Turkey's exports of T&C to EU15 for 2003-2005
- Data disaggregated by firm, product (6-digit HS product code), destination country and year
  - value (free-on-board)
  - quantity (measured in specified units, e.g. number, pair, etc.)
  - **financing terms**: cash in advance, **open account**, letter of credit, and documentary collection
- Data on quota fill rates from *Système Intégré de Gestion de Licenses*

Change in share of exports with trade credit before the end of the MFA ($t = 2004$)



Notes: ΔSh^{OA} denotes annual change in the share of exports on OA terms. A marker represents average ΔSh^{OA} over firms, products and destination countries for a given quota-fill rate and year. Lines represent fitted values of (unconditional) linear predictions. The vertical line represents the quota fill rate of 0.5 as of 2004.

Change in share of exports with trade credit before and after the end of the MFA



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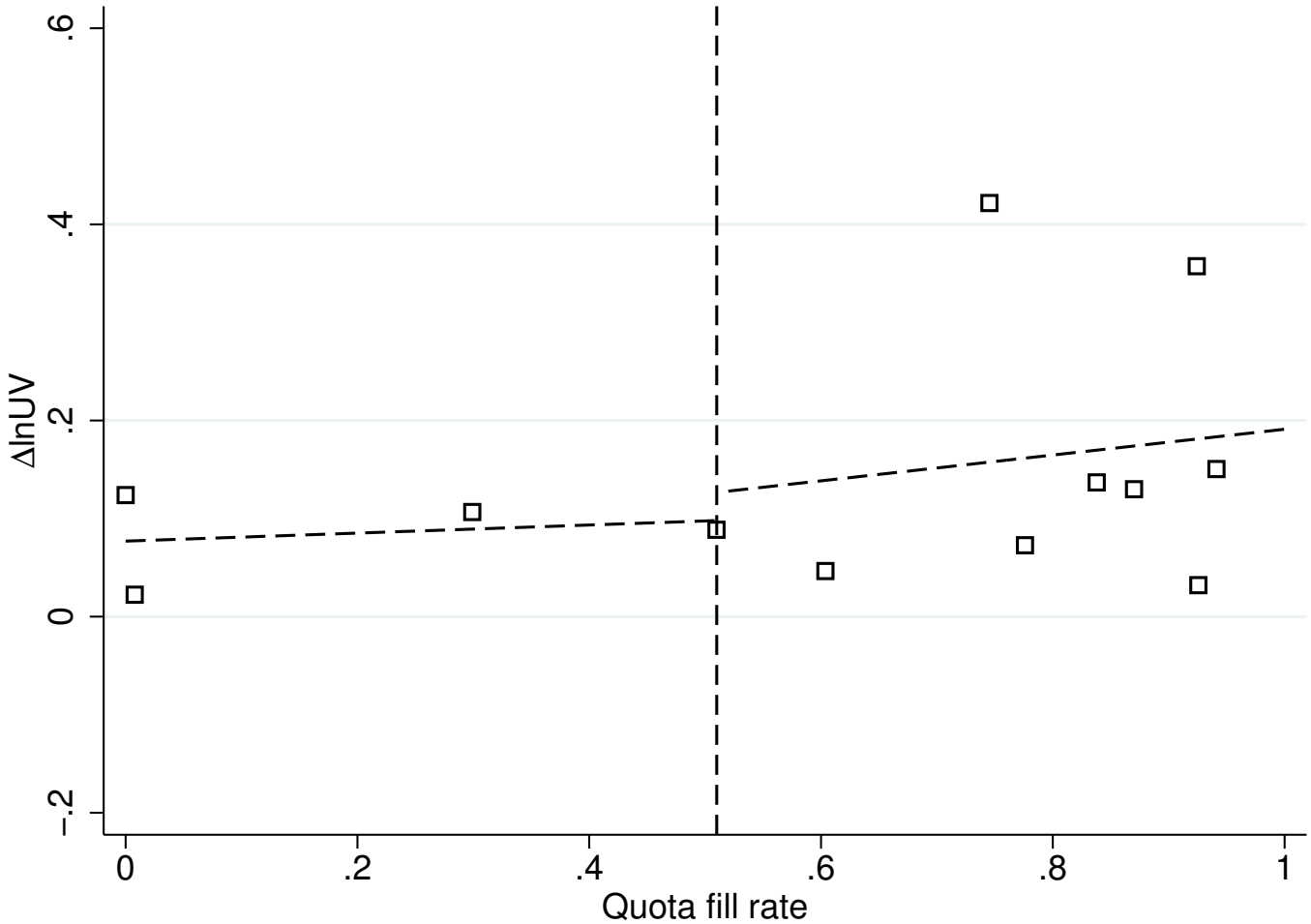
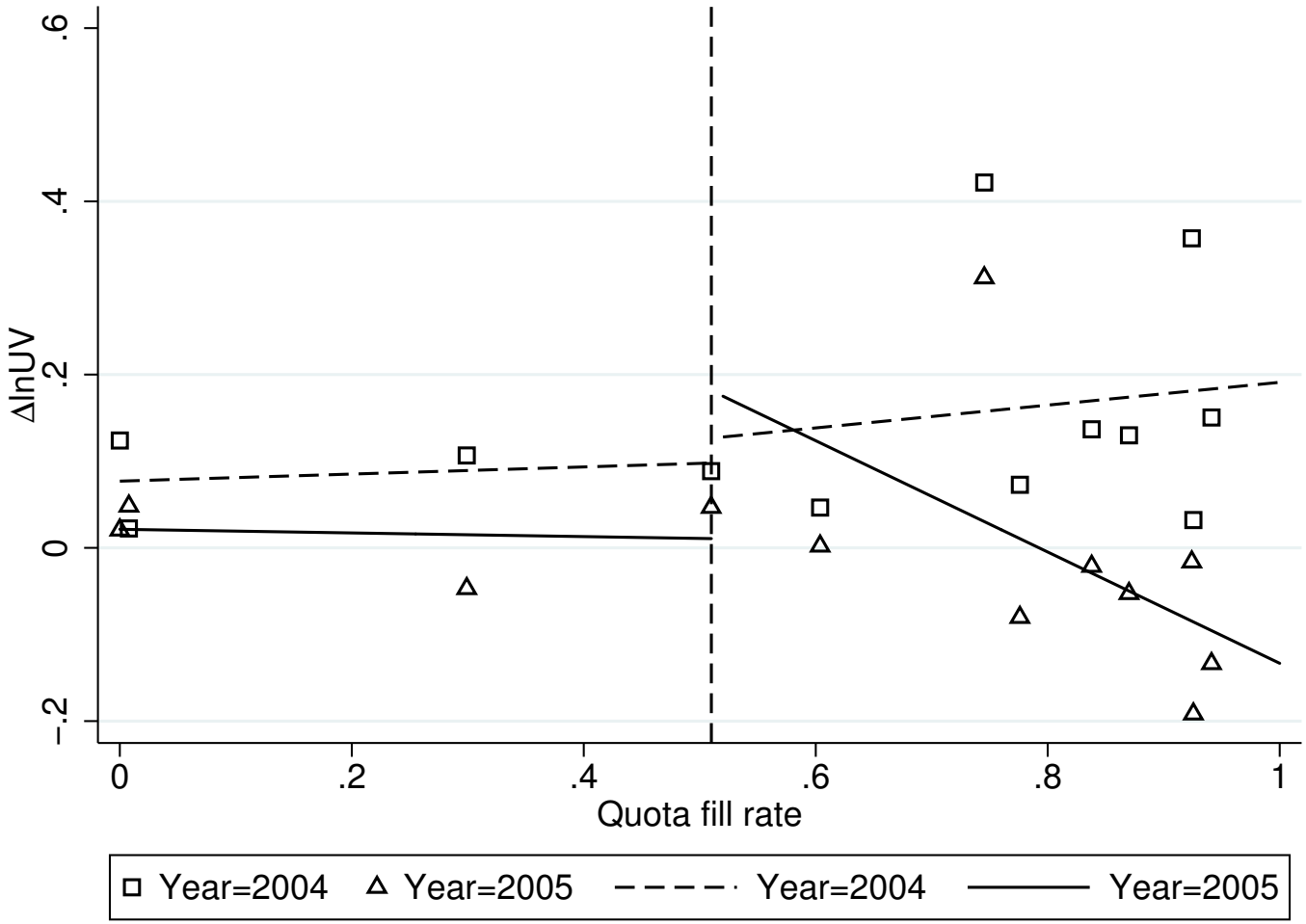
Change in average prices before the end of the MFA ($t = 2004$)



Notes: $\Delta \ln UV$ denotes annual change in the logarithm of unit values. A marker represents average $\Delta \ln UV$ over firms, products and destination countries for a given quota-fill rate and year. Lines represent fitted values of (unconditional) linear predictions. The vertical line represents the quota fill rate of 0.5 as of 2004.

Change in average prices before and after the end of the MFA



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Difference-in-differences approach

- Baseline equation for $t = \{2004, 2005\}$

$$\Delta X_{ijdt} = \beta_0 + \beta_1 Post_t * Treat_j + \alpha_{dt} + \alpha_j + \alpha_{it} + \epsilon_{ijdt}$$

- ΔX_{ijdt} denotes change in outcome variable X at the firm-product-destination level at time t
  - share of exports with trade credit (Sh^{OA})
  - unit value ($\ln UV$)
- $Post_t$ is a binary variable that is equal to one for $t = 2005$, and zero otherwise
- $Treat_j$ is an indicator for quota-constrained products
- We expect $\beta_1 > 0$ for $X = Sh^{OA}$, and $\beta_1 < 0$ for $X = \ln UV$
- Standard errors clustered at the product level

Defining treatment

1. Binary treatment:

$$\begin{aligned} Treat_j &= 1 \text{ , if Quota fill rate}_{j,t=2004} > 0.5 \\ Treat_j &= 0 \text{ , Otherwise} \end{aligned}$$

2. Product-specific quota fill rate in 2004: Quota fill rate$_{j,t=2004}$

Baseline results: Trade credit

$$\Delta Sh_{ijdt}^{OA} = \beta_0 + \beta_1 Post_t * Treat_j + \alpha_{dt} + \alpha_j + \alpha_{it} + \epsilon_{ijdt}$$

	(1)	(2)	(3)	(4)
$Post_t * Treat_j$	**0.0489*****	**0.0375***		
	(0.0149)	(0.0195)		
$Post_t *$ Quota fill rate$_{j,t=2004}$			**0.0631*****	**0.0467***
			(0.0174)	(0.0239)
N	17852	17852	17852	17852
R^2	0.0258	0.234	0.0259	0.234
Country-year FE	+	+	+	+
Product FE	+	+	+	+
Firm-year FE		+		+

Baseline results: Prices

$$\Delta \ln UV_{ijdt} = \beta_0 + \beta_1 Post_t * Treat_j + \alpha_{dt} + \alpha_j + \alpha_{it} + \epsilon_{ijdt}$$

	(1)	(2)	(3)	(4)
$Post_t * Treat_j$	**-0.0669*****	**-0.0745*****		
	(0.0236)	(0.0284)		
$Post_t *$ Quota fill rate$_{j,t=2004}$			**-0.0985*****	**-0.0839****
			(0.0279)	(0.0370)
N	17852	17852	17852	17852
R^2	0.0511	0.271	0.0513	0.271
Country-year FE	+	+	+	+
Product FE	+	+	+	+
Firm-year FE		+		+

High initial share of sales on credit $\Longrightarrow$ less room for adjusting financing

- Test whether flows with a high initial share of sales on trade credit experienced a larger fall in prices

$$\begin{aligned}\Delta \ln UV_{ijdt} &= \phi_0 + \phi_1 ShQ^{OA}_{ijd,t=0} * Post_t * Treat_j \\ &+ \phi_2 Post_t * Treat_j + \phi_3 ShQ^{OA}_{ijd,t=0} * Post_t \\ &+ \phi_4 ShQ^{OA}_{ijd,t=0} * Treat_j + \phi_5 ShQ^{OA}_{ijd,t=0} + \alpha_{dt} + \alpha_j \\ &+ \alpha_{it} + e_{ijdt},\end{aligned}$$

- $ShQ^{OA}_{ijd,t=0}$ average share of OA exports for a flow ijd over 2002-2003

Dependent variable:	$\Delta \ln UV_{ijdt}$	$\Delta \ln UV_{ijdt}$
$ShQ^{OA}_{ijd,t=0} * Post_t * Treat_j$	**-0.111***	**-0.122***
	(0.0589)	(0.0730)
$Post_t * Treat_j$	0.00275	-0.0301
	(0.0470)	(0.0518)
$ShQ^{OA}_{ijd,t=0} * Post_t$	0.0458	0.00157
	(0.0325)	(0.0436)
$ShQ^{OA}_{ijd,t=0} * Treat_t$	0.0205	-0.00206
	(0.0328)	(0.0438)
$ShQ^{OA}_{ijd,t=0}$	0.00848	0.0226
	(0.0178)	(0.0253)
N	13790	13790
R^2	0.0538	0.276
Country-year FE	+	+
Product FE	+	+
Firm-year FE		+

Take aways

- Provision of trade credit is a margin of adjustment that can give firms a competitive edge
- Price response to shocks can be affected by provision of trade credit
- Ignoring the trade credit channel can lead to mismeasurement of price responses

Forensics, Elasticities and Benford's Law

Banu Demir and Beata Javorcik (2018)

Evasion as another margin of adjustment

- Evidence consistent with an increase in evasion after an unexpected increase in import taxes in Turkey

- Three methods for detecting evasion
  - "missing trade" approach of Fisman and Wei (2004)
  - Benford's Law
  - comparing price and trade cost elasticities

Exogenous shock

- Resource Utilization Support Fund (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
- 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**

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Measuring exposure to the shock

- Construct *Exposure* using monthly 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.).

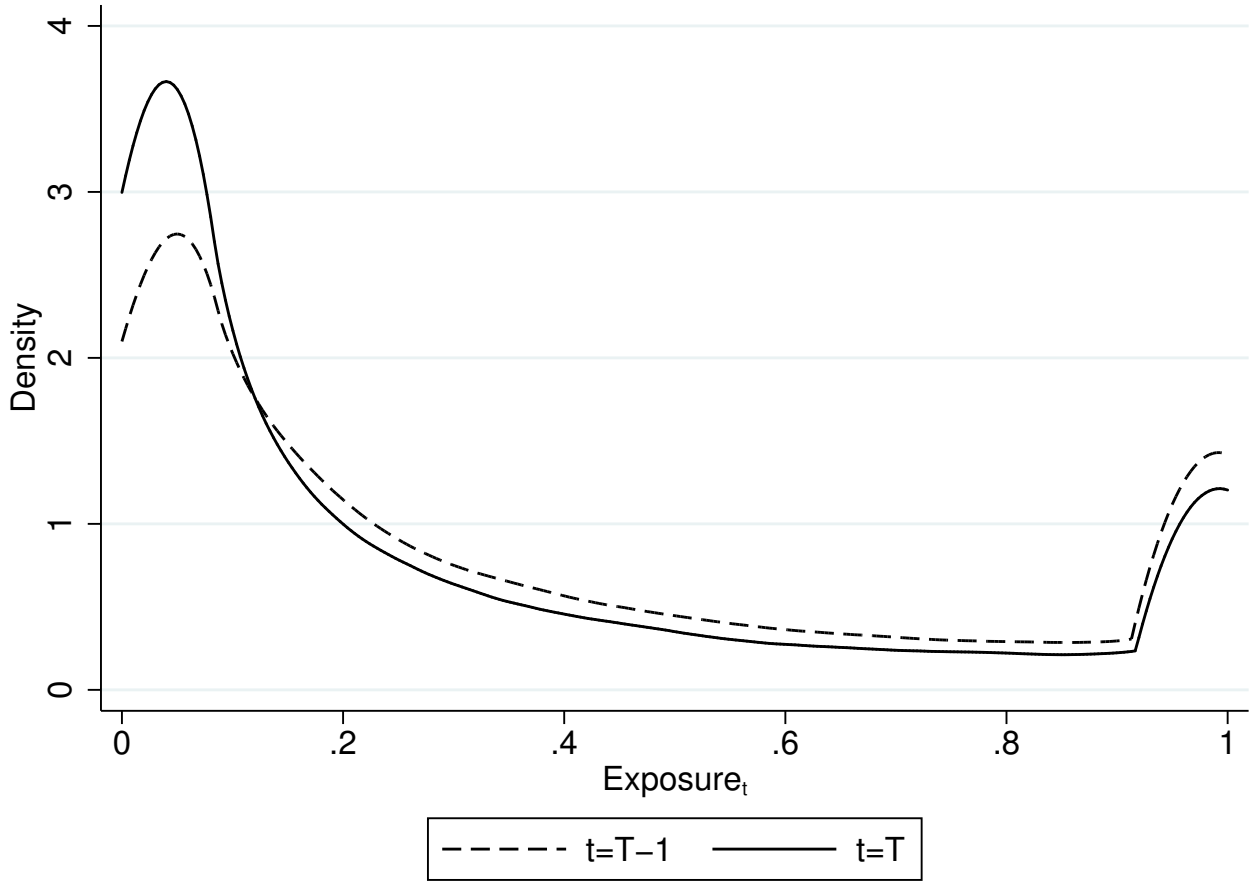
- Define the share of annualized imports of product h from country c coming with external financing at time $t = \{T-2, T-1, T\}$.

$$Exposure_{hct} = \frac{\sum_{m \in \{OA,AC,DLC\}} M_{hcmt}}{\sum_{m} M_{hcmt}}$$

- *Exposure* constructed for about
  - 150 source countries (all of them members of WTO),
  - 4,700 6-digit HS product codes,
  - 75,000 country-product pairs.

Share of ordinary imports with external financing (hc level)

$\overline{Exposure}_{hc,t=T-1} = 0.195$; $\overline{Exposure}_{hc,t=T} = 0.137$



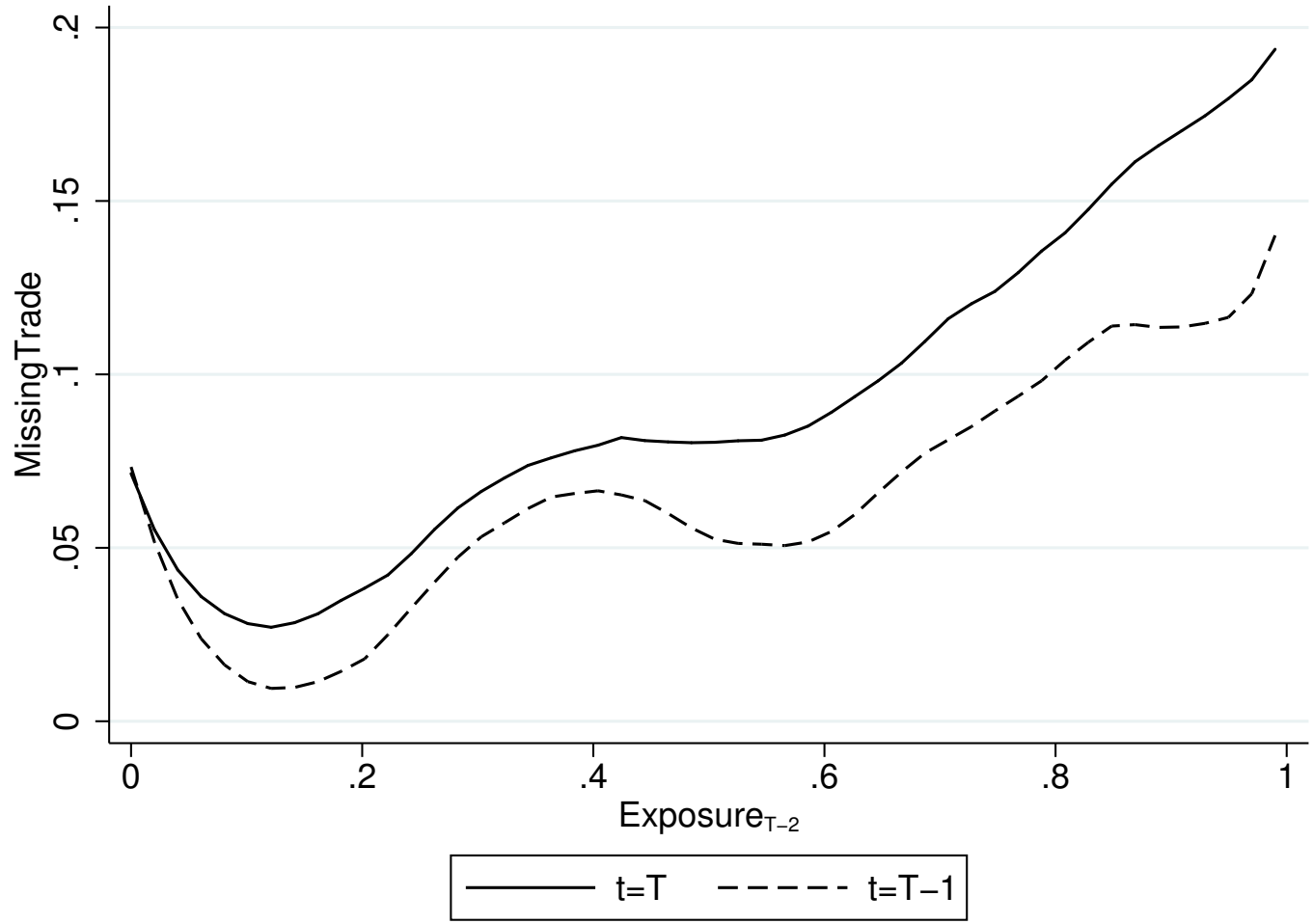
"Missing trade" approach (Fisman and Wei, 2004

- Consider Turkey's imports of product h from country c at time t

$$MissingTrade_{hct} = \ln X^{c}_{hct} - \ln M^{TUR}_{hct}$$

- $\ln X^{c}_{hct}$ is logarithm of country c's exports of product h to Turkey as reported by c.
- $\ln M^{TUR}_{hct}$ is the logarithm of imports of h from c as reported by Turkey.
- COMTRADE data on imports of 4,295 products from 98 countries

Missing trade and exposure



Notes: Figure shows $MissingTrade$ at time T and $T-1$ as a function of $Exposure$ constructed for $T-2$ at the country-product level. The figure is obtained from local polynomial regressions with Epanechnikov kernel.

Estimating equation

- Estimate:

$$\begin{aligned} MissingTrade_{hct} &= \gamma_0 + \gamma_1 1\{t = T\} * Exposure_{hc,T-2} \\ &+ \alpha_{ht} + \alpha_{ct} + \alpha_{hc} + \varepsilon_{hct} \end{aligned}$$

- Include three periods: $t = \{T-2, T-1, T\}$
- $Exposure_{hc,t=T-2}$ is share of imports of product p from country c coming with external financing at time $t = T-2$
- $\gamma_1 > 0$ consistent with an increase in tax evasion after the hike in the RUSF tax rate in October 2011

Evidence consistent with evasion

	(1)	(2)	(3)
Missing Trade in	Value	Quantity	Price
$1\{t = T\} * Exposure_{hc,T-2}$	**0.062****	0.022	**0.040***
	(0.028)	(0.035)	(0.020)
N	70089	70089	70089
R^2	0.812	0.787	0.711
	Placebo:	**Processing**	**trade**
Missing Trade in	Value	Quantity	Price
$1\{t = T\} * Exposure_{hc,T-2}$	0.028	0.000	0.027
	(0.030)	(0.037)	(0.020)
N	23913	23913	23913
R^2	0.858	0.838	0.761
Fixed effects	hxt,cxt,hxc	hxt,cxt,hxc	hxt,cxt,hxc

Notes: *, **, *** represent significance at the 10, 5, and 1 percent levels, respectively. Robust standard errors are clustered at the country and 4-digit HS product level.

Benford's law

- Benford's law describes the distribution of first digits in economic or accounting data
- It naturally arises when data are generated by an exponential process or independent processes are pooled together.
- Why do we expect it to hold in our data?
  - "Second-generation" distributions, i.e. combinations of other distributions, conform with Benford's law, e.g. quantity x price (Hill 1995)
    - Distributions where mean is greater than median, and skew is positive (Durtschi et al. 2004)
      - A χ^2 test can't reject that the law holds in our data prior to the shock and post-shock for the flows not subject to the tax

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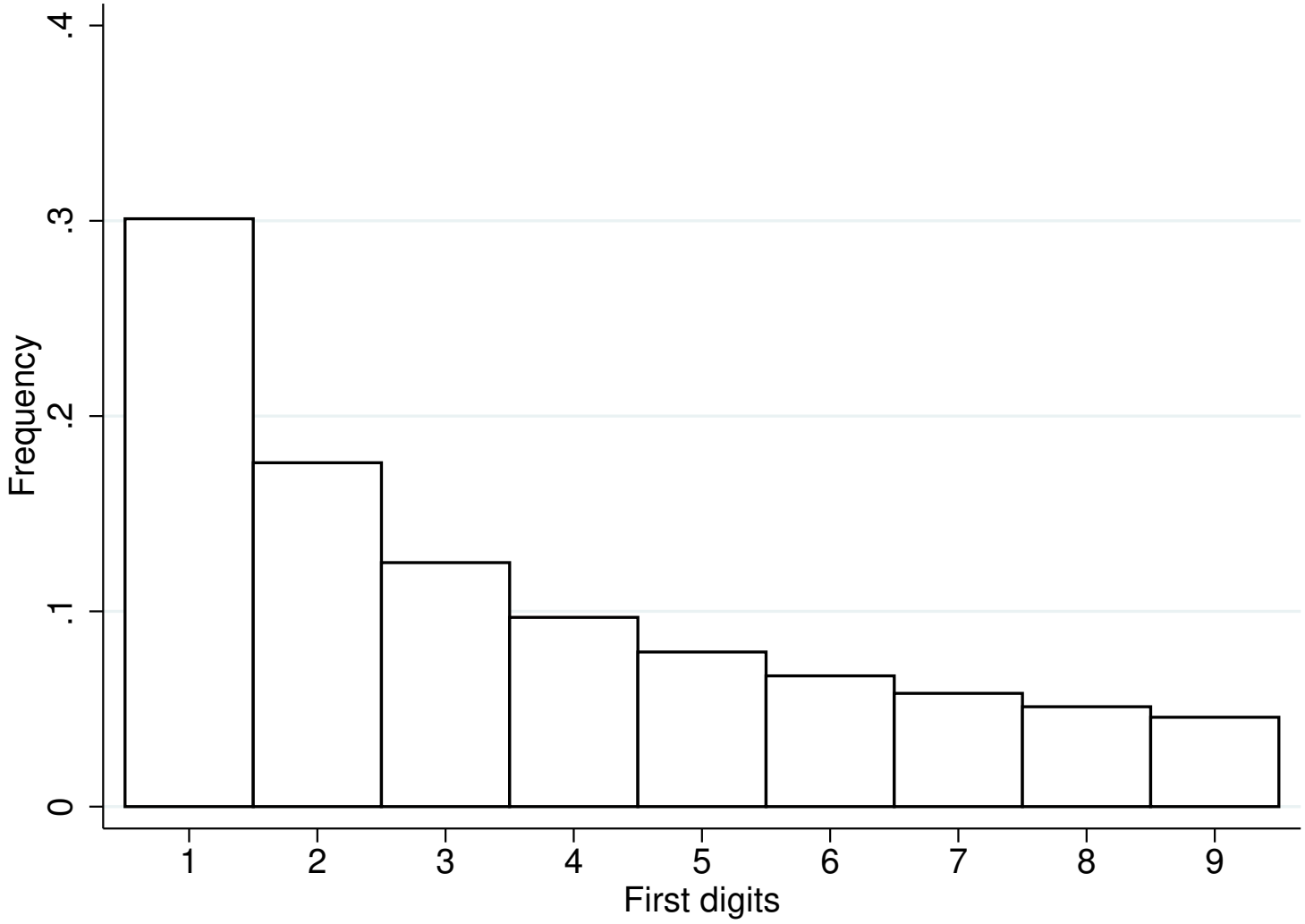
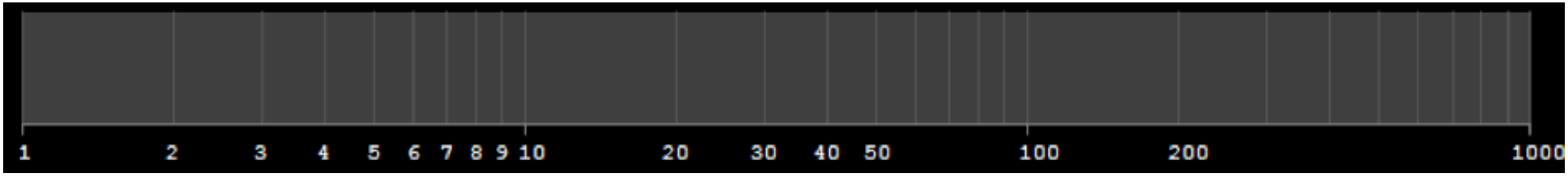
Benford's distribution of first digits

$$P(\text{First digit is d}) = log_{10}(1 + 1/d)$$



Why does it work?



Measuring deviations from Benford's law

- Define

$$D = \sum_{d=1}^{9} (f_d - \hat{f}_d)^2$$

  - $\hat{f}_d$: observed fraction of digit d in the data
  - f_d: fraction predicted by Benford law

- Trade values generated by a standard Armington-type trade model comply with Benfords law in the absence of tax evasion.

Measuring deviations from Benford's law in the data

- Remember

$$D = \sum_{d=1}^{9} (f_d - \hat{f}_d)^2$$

  - $\hat{f}_d$: observed fraction of digit d in the data
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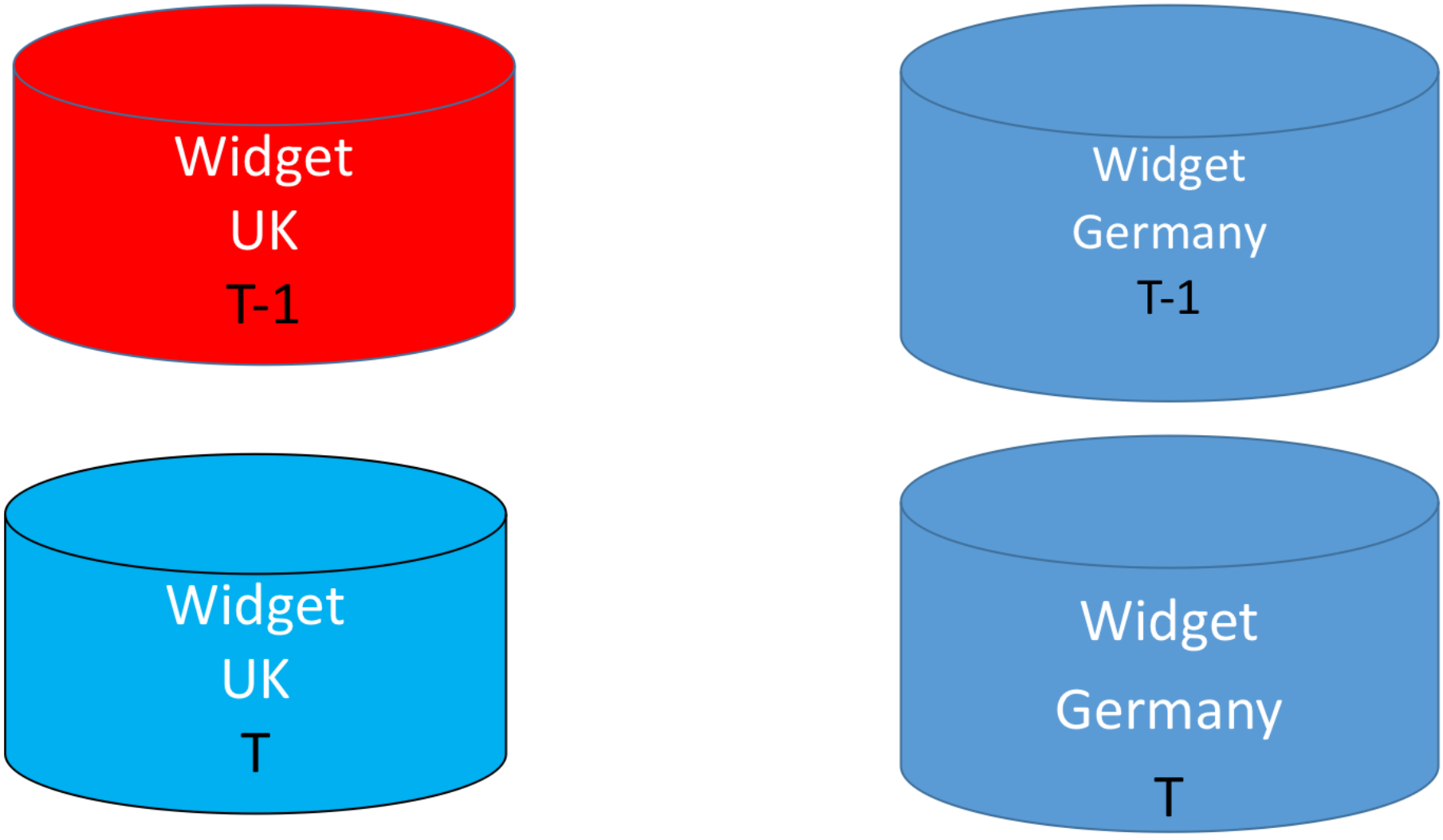
- Use monthly firm-product-country-payment method level Turkish import data
- Calculate D for each hct

Constructing bins

Sort observations into bins (hct)



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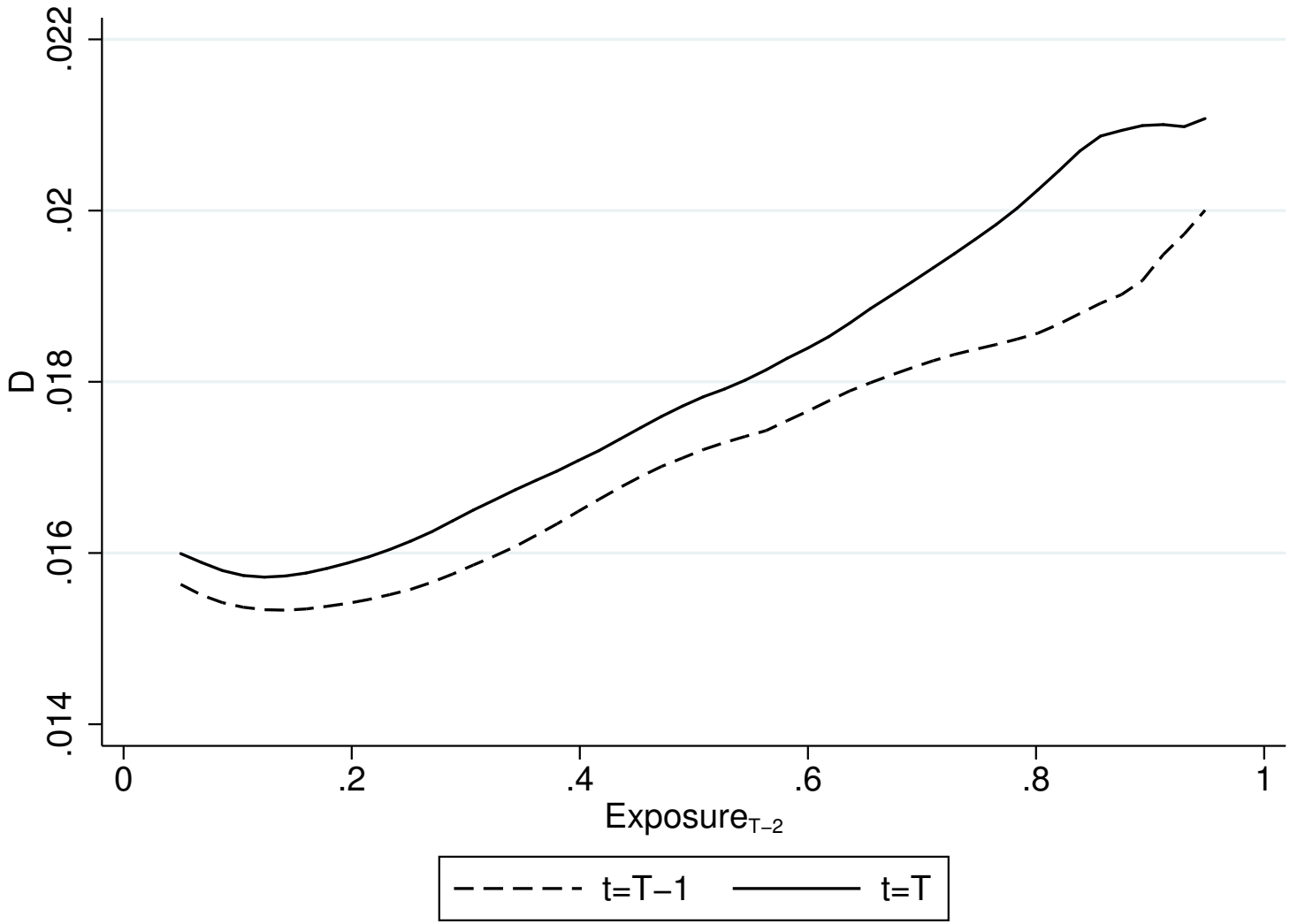
- Use monthly firm-product-country-payment method level Turkish import data
- Calculate D for each hct
- Keep only hc pairs with $n > 30$

Deviations from Benford's law and exposure



Notes: Figure is obtained from local polynomial regression with Epanechnikov kernel of D.

Estimating equation

- Construct D_{hct} and estimate:

$$\begin{aligned} D_{hct} &= \theta_0 + \theta_1 1\{t = T\} * Exposure_{hc,T-2} \\ &+ \alpha_{ht} + \alpha_{ct} + \alpha_{hc} + e_{hct} \end{aligned}$$

- $\theta_1 > 0$ consistent with an increase in tax evasion after the hike in the RUSF tax rate in October 2011

	Baseline	Processing
$1\{t = T\} * Exposure_{hc,T-2}$	**0.00286*****	0.0000811
	(0.00107)	(0.000719)
N	26369	12468
R^2	0.645	0.798
Fixed effects	hxt,cxt,hxc	hxt,cxt,hxc
Cluster	cxHS4	cxHS4

Notes: *, **, *** represent significance at the 10, 5, and 1 percent levels, respectively. Robust standard errors are clustered at the country and 4-digit HS product level.

A thought experiment

- Consider a random sample with characteristics similar to an average bin in our sample before the shock. e.g. $D = 0.0172$.
- Add "faked" observations: each digit occurring with equal probability.
- What is the fraction of "faked" observations required to generate the estimated increase in D due to an increase in $Exposure$ from zero to one?
- **About 40%!**

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- Add "faked" observations: each digit occurring with equal probability.
- What is the fraction of "faked" observations required to generate the estimated increase in D due to an increase in $Exposure$ from zero to one?
- **About 40%!**

Robustness check: second-digit test

	Baseline	Processing	**First two digits**
$1\{t = T\} * Exposure_{hc,T-2}$	**0.00286*****	0.0000811	**0.00069***
	(0.00107)	(0.000719)	(0.00037)
N	26369	12468	26369
R^2	0.645	0.798	0.882
Fixed effects	hxt,cxt,hxc	hxt,cxt,hxc	hxt,cxt,hxc
Cluster	cxHS4	cxHS4	cxHS4

Notes: *, **, *** represent significance at the 10, 5, and 1 percent levels, respectively. Robust standard errors are clustered at the country and 4-digit HS product level.

Take aways

- Evasion is another margin of adjustment
- Ignoring evasion will lead to underestimating the effects of policy shocks
- Evasion induces a bias in the estimation of trade cost elasticity of import demand, leading to miscalculation of gains from trade

Financial Constraints and Propagation of Shocks in Production Networks

Banu Demir, Beata Javorcik, Tomasz Michalski and Evren Ors (2018)

RUSF shock and the domestic supplier base

- Data covering quasi-totality of supplier-customer links
- Considers both direct and indirect effects
- Shows that even a small cost-push shock can have a substantial impact on local sourcing relationships

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:

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

- $\omega_{fj,T-2}$ 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

Estimation strategy: Direct effect

- Estimating equation:

$$\Delta_{2011-l} \ln Y_{fsr} \quad = \quad \beta_0 + \beta_l Exposure_{fsr,T-2} + \alpha_{sr} + e_{fsr}$$

- 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=$\{$2012, 2013, 2014$\}$.

- Standard errors clustered at the sector-region level

Impact of the shock on firm sales

Dep vrb:$\Delta_{2011-l} \ln Sales_{fsr}$	(1)	(2)	(3)
	$l = 2012$	$l = 2013$	$l = 2014$
$Exposure_{fsr,T-2}$	**-0.235*****	**-0.264*****	0.159
	(0.0830)	(0.0943)	(0.152)
R^2	0.0370	0.0433	0.0398
N	28270	28270	28270
Fixed effects	sr	sr	sr

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

Impact on input sourcing

	(1)	(2)	(3)
Dep vrb:	$\Delta_{2011-l}\left(\frac{M}{Sales}\right)_{fsr}$	$\Delta_{2011-l}\left(\frac{DomPurch}{Sales}\right)_{fsr}$	$NewDomSupp_{fsr,l}$
		$l = 2012$	
$Exposure_{fsr,T-2}$	**-0.327***	**0.356*****	**10.99*****
	(0.188)	(0.0742)	(2.549)
R^2	0.0473	0.0397	0.0400
		$l = 2013$	
$Exposure_{fsr,T-2}$	**-0.718*****	**0.477*****	**23.20*****
	(0.208)	(0.111)	(3.920)
R^2	0.0530	0.0444	0.0440
		$l = 2014$	
$Exposure_{fsr,T-2}$	**-0.971*****	**0.665*****	**50.39*****
	(0.246)	(0.105)	(5.544)
R^2	0.0490	0.0457	0.0556
N	28270	28270	28270
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.

Network effects

Dep vrb:$\Delta_{2011-l} \ln Sales_{fsr}$	(1)	(2)	(3)
	$l = 2012$	$l = 2013$	$l = 2014$
$Exposure_{fsr,T-2}$	**-0.247*****	**-0.226*****	-0.129
	(0.0683)	(0.0837)	(0.145)
$Exposure^{Suppliers}_{fsr,T-2}$	**-0.318*****	**-0.250****	**-0.355****
	(0.105)	(0.105)	(0.161)
$Exposure^{Buyers}_{fsr,T-2}$	-0.0448	0.0408	0.0009
	(0.0214)	(0.0482)	(0.0590)
R^2	0.0452	0.0505	0.0521
N	28270	28270	28270
Fixed effects	sr	sr	sr

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

Financing Constraints as a Propagation Channel

Dep vrb:$\Delta_{2011-l} \ln Sales_{fsr}$	(1)	(2)	(3)
	$l = 2012$	$l = 2013$	$l = 2014$
$Exposure_{fsr,T-2}$	**-0.233*****	**-0.231*****	0.188
	(0.0690)	(0.0836)	(0.329)
$HighLiq_{fsr,T-2} * Exposure_{fsr,T-2}$	**0.207****	**0.231***	0.382
	(0.100)	(0.134)	(0.370)
$HighLiq_{fsr,T-2}$	-0.0170***	-0.0224***	-0.0573***
	(0.00319)	(0.00645)	(0.0158)
R^2	0.0399	0.0472	0.0404
N	28270	28270	28270
Fixed effects	sr	sr	sr

Notes: Ease of access to liquidity measured with the quick ratio, defined as the ratio of the sum of cash, marketable securities and accounts receivable to current liabilities. *, **, *** represent significance at the 10, 5, and 1 percent levels, respectively.

Network Effects with Financing Constraints

Dep vrb:$\Delta_{2011-l} \ln Sales_{fsr}$	(1)	(2)	(3)
	$l = 2012$	$l = 2013$	$l = 2014$
$Exposure_{fsr,T-2}$	**-0.216*****	**-0.232*****	-0.0408
	(0.0600)	(0.0886)	(0.117)
$Exposure^{Suppliers,LowLiq}_{fsr,T-2}$	**-0.335*****	**-0.341****	**-0.411*****
	(0.106)	(0.136)	(0.151)
$Exposure^{Suppliers,HighLiq}_{fsr,T-2}$	-0.143	-0.122	-0.077
	(0.0925)	(0.149)	(0.150)
$Exposure^{Buyers,LowLiq}_{fsr,T-2}$	-0.0114	-0.0398	0.0174
	(0.0146)	(0.0438)	(0.0115)
$Exposure^{Buyers,HighLiq}_{fsr,T-2}$	0.0337	0.0131	0.0122
	(0.0389)	(0.0117)	(0.0305)
R^2	0.0427	0.0497	0.0492
N	28270	28270	28270
Fixed effects	sr	sr	sr

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

Take aways

- Even a small cost-push shock can have substantial consequences for local sourcing relationships
- The shock is propagated downstream by firms facing financial constraints

Conclusions

- Firms adjust to globalization-induced shocks through a variety of margins
  - **provision of trade credit**
  - **evasion of border taxes**
  - **changes to the domestic supplier base**
- Ignoring these margins gives a distorted picture of adjustment and in some cases affects calculation of welfare effects of trade policies