The Impact of Contract Enforcement Costs on Outsourcing and Aggregate Productivity

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Sciences Po

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Introduction

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  - Enforcement takes a few months in Iceland, several years in India
- Enforcement frictions constitute transaction costs; transaction costs shape firm boundaries

  ▸ ZeeTV in India
- How important are these distortions for aggregate outcomes?

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- I show why and how this constitutes a transaction cost
- I show that this transaction cost leads to distortions on a macroeconomic scale
  - Model, reduced-form evidence, structural estimation

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- Aggregate, and study effects of enforcement costs on external input use

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Theory prediction:

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- Construct new measure of enforcement-intensity by sector-pairs from microdata on US case law
- Identification:
  - Variation by: country $\times$ upstream sector $\times$ downstream sector
  - Control for upstream sector $\times$ country FE (productivity, external financing, etc.)

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Quantiative evaluation

Through the lens of the model:

How important are enforcement costs for aggregate productivity and welfare?

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  $\Rightarrow$ Contracting institutions and the boundaries of the firm are issues of macroeconomic importance!

Related Literature

- Legal Institutions and Macro Outcomes:
  La Porta et al. (1997), Rajan and Zingales (1998), Djankov et al. (2003), Acemoglu and Johnson (2005), Acemoglu, Antràs, and Helpman (2007), Levchenko (2007), Nunn (2007)
- International Boundaries of the Firm:
  Antràs (2003), Antràs and Helpman (2004), Garetto (2013), Irarrazabal et al. (2013), Ramondo and Rodriguez-Clare (2013)
- I-O linkages:
  Jones (2011), Acemoglu, Carvalho, et al. (2013), Oberfield (2013), Bartelme and Gorodnichenko (2014)
- Quantitative Trade Models:
  Eaton and Kortum (2003), Costinot, Donaldson and Komunjer (2012), Caliendo and Parro (2012), Arkolakis, Costinot and Rodriguez-Clare (2012)
- Country-specific papers on impact of legal institutions or TC

Macro-model

Macro-model

N sectors, continuum of perfectly competitive firms in each sector. Sector n firms have production function

$$y_n = \prod_{i=1}^{N} \left(\int_0^1 q_{ni}(j)^{(\sigma_n - 1)/\sigma_n} dj \right)^{\frac{\sigma_n}{\sigma_n - 1} \gamma_{ni}}, \quad n = 1, \ldots, N.$$

with $\sum_{i=1}^{N} \gamma_{ni} = 1$.

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with $\sum_{i=1}^{N} \gamma_{ni} = 1$. Each of the varieties (n, i, j) may be either

- produced by the firm itself, using labor (frictionless), or
- outsourced to sector i (produced using y_i). This is subject to contracting frictions!

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Discrete choice as in McFadden/Eaton-Kortum. Contracting friction enters like an iceberg trade cost.

Expenditure share on intermediate inputs

$$\frac{X_{ni}}{X_n} = \gamma_{ni}\alpha_n^{1-\rho}p_n^{\rho-1}\frac{T_i\left(d_{ni}p_i\right)^{-\theta}}{\left(S_n w^{-\theta} + T_i\left(d_{ni}p_i\right)^{-\theta}\right)^{1+\frac{1}{\theta}(1-\rho)}}$$

- Increasing in upstream sector productivity T_i
- Decreasing in contracting frictions term d_{ni}
- Later, use this equation to estimate parameters

▸ Parallels to Eaton-Kortum ▸ What determines d_{ni}? Medium Version ▸ What determines d_{ni}? Long Version

What determines contracting frictions d_{ni}?

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$$d_{ni}^{c} = \min\left(\frac{1}{1-0.5\delta^{c}}, 2-\omega_{ni}\right)$$

Macro-prediction

$$\frac{X_{ni}^c}{X_n^c} = \gamma_{ni}\alpha_n^{1-\rho}\left(p_n^c\right)^{\rho-1}\frac{T_i^c\left(d_{ni}^c p_i^c\right)^{-\theta}}{\left(S_n^c w^{-\theta} + T_i^c\left(d_{ni}^c p_i^c\right)^{-\theta}\right)^{1+\frac{1}{\theta}(1-\rho)}}$$

where

$$d_{ni}^c = \min\left(\frac{1}{1-0.5\delta^c}, 2-\omega_{ni}\right)$$

- In countries with high enforcement costs δ^c, expenditure share on intermediate inputs is low when dependence on enforcement (because of relationship-specificity, or other reasons) $1-\omega_{ni}$ is high.

Reduced-form evidence

$$\frac{X_{ni}^c}{X_n^c} = \alpha_{ni} + \alpha_i^c + \alpha_n^c + \beta\delta^c(1-\omega_{ni}) + \gamma(\text{controls})_{ni}^c + \varepsilon_{ni}^c$$

- Expenditure shares (LHS) from GTAP I-O tables: 109 countries, 35 sectors

▸ Dispersion ▸ IO as measure of outsourcing

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- Enforcement costs δ^c from World Bank Doing Business: *cost of enforcing a standarized supplier contract, as a fraction of the value of the claim*

$$\delta^c = (\text{monetary cost, as pct})_c + 0.03\,(\text{time until enforcement, years})$$

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- Dependence on enforcement: construct a new measure based on the relative prevalence of litigation between two sectors in the US

Dependence on contract enforcement $1 - \omega_{ni}$

- Data: LexisLibrary from LexisNexis: all reported US court cases related to contract law, since 1990

- Match firms to Orbis firms (sector classifications)

$$z_{ni}^{(1)} = \frac{\left(\text{\# cases between sector i and n}\right)}{\left(\text{\# sector n firms}\right)}$$

$$z_{ni}^{(2)} = \frac{\left(\text{\# cases between sector i and n}\right)}{\sqrt{\text{\# (sector n firms)(\# sector i firms)}}}$$

STRUCTURAL METALS, INC., Plaintiff, v. S&C ELECTRIC COMPANY, Defendant.

Civil Action No. SA-09-CV-984-XR

UNITED STATES DISTRICT COURT FOR THE WESTERN DISTRICT OF TEXAS, SAN ANTONIO DIVISION

2012 U.S. Dist. LEXIS 151396

October 22, 2012, Decided
October 22, 2012, Filed

SUBSEQUENT HISTORY: Motion granted by, Motion denied by, Judgment entered by **Structural Metals,** Inc. v. S&C Elec. Co., 2013 U.S. Dist. LEXIS 31226 (W.D. Tex., Mar. 7, 2013)

PRIOR HISTORY: **Structural Metals,** Inc. v. S&C Elec. Co., 2012 U.S. Dist. LEXIS 36785 (W.D. Tex., Mar. 19, 2012)

CORE TERMS: buyer's, breach of warranty, summary judgment, breach-of-contract, revocation, breach of contract, delivery, non-conforming, non-conformity, notice, seller, warranty, revoke, breach-of-warranty, nonconformity, revoked, theory of recovery, commissioning, overheating, case law, failure to perform, warranty claim, reconsideration, commissioned, pretrial, deliver, installed, nonconforming, recovering, discovery

Table : Average enforcement-intensity of upstream sectors, $z_{ni}^{(2)}$ measure

Upstream sector	$\overline{z_i^{(2)}} \cdot 10^4$	Upstream sector	$\overline{z_i^{(2)}} \cdot 10^4$
Insurance	1.099	Transport nec	0.163
Business services nec	0.785	Gas manufacture, distribution	0.118
Financial services nec	0.548	Transport equipment nec	0.116
Electricity	0.443	Food products and beverages	0.114
Trade	0.388	Recreation and other services	0.112
Chemical,rubber,plastic prods	0.357	Mineral products nec	0.109
Paper products, publishing	0.354	Electronic equipment	0.108
PubAdmin/Defence/Health/Educat	0.351	Oil and Gas	0.104
Agriculture, Forestry, Fishing	0.286	Wearing apparel	0.0727
Metal products	0.233	Motor vehicles and parts	0.0685
Communication	0.221	Water	0.0438
Ferrous metals	0.22	Minerals nec	0.0396
Metals nec	0.211	Petroleum, coal products	0.0359
Machinery and equipment nec	0.199	Coal	0.0349
Construction	0.198	Textiles	0.0322
Air transport	0.194	Wood products	0.0282
Manufactures nec	0.194	Leather products	0.0188
Sea transport	0.176		

The Results in a Nutshell

- In countries with costly enforcement ('dev countries') input shares are lower for sector-pairs where there is a lot of litigation in the US.
- Control for upstream sector $\times$ country FE to take out anything that varies at the sector-country level (e.g. productivity, access to external financing, etc).
- In line with model predictions.

Table : The Determinants of Expenditure Shares on Intermediates: Benchmark Results

	Dependent variable: X_{ni}^c / X_n^c					
	(1)	(2)	(3)	(4)	(5)	(6)
$\delta^c \frac{\#\text{Cases}_{ni}}{\sqrt{\#\text{Firms}_n \#\text{Firms}_i}}$	-71.78***		-101.0***		-120.3***	
	(15.39)		(24.07)		(28.53)	
$\delta^c \frac{\#\text{Cases}_{ni}}{\#\text{Firms}_n}$		-9.246		-14.42***		-15.35***
		(4.829)		(3.987)		(4.176)
Upstr × Downstr FE	Yes	Yes	Yes	Yes	Yes	Yes
Upstr × Country FE			Yes	Yes	Yes	Yes
Downstr × Country FE					Yes	Yes
N	133525	133525	133525	133525	133525	133525
R^2	0.447	0.447	0.531	0.531	0.537	0.537

Standard errors in parentheses, clustered at the country level
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table : Expenditure Shares on Intermediates: Robustness

	Dependent variable: X_{ni}^c / X_n^c					
	(1)	(2)	(3)	(4)	(5)	(6)
$\delta^c \frac{\#\text{Cases}_{ni}}{\sqrt{\#\text{Firms}_n \#\text{Firms}_i}}$	-90.24***		-72.24**		-123.6***	
	(25.01)		(23.29)		(30.24)	
$\delta^c \frac{\#\text{Cases}_{ni}}{\#\text{Firms}_n}$		-7.871*		-12.65**		-15.71***
		(3.796)		(3.191)		(4.635)
$\text{trust}^c \frac{\#\text{Cases}_{ni}}{\sqrt{\#\text{Firms}_n \#\text{Firms}_i}}$			29.99		4.808	
			(43.62)		(54.78)	
$\text{trust}^c \frac{\#\text{Cases}_{ni}}{\#\text{Firms}_n}$				0.692		-7.113
				(5.996)		(8.099)
$\delta^c I_{ni}^{US}$					-0.0082	-0.011*
					(0.004)	(0.0048)
$\text{trust}^c I_{ni}^{US}$					-0.0007	-0.0006
					(0.005)	(0.005)
Upstream × Downstream FE	Yes	Yes	Yes	Yes	Yes	Yes
Upstream × Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Downstream × Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Sample	Up services	Up services	Full	Full	Full	Full
N	53410	53410	106575	106575	106575	106575
R^2	0.459	0.459	0.482	0.481	0.566	0.566

Standard errors in parentheses, clustered at the country level
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Normalized by Upstream | Informal Sector

Table : The Determinants of Expenditure Shares on Intermediates: Domestic Inputs Only

	Dependent variable: $X^c_{ni,\text{dom}} / X^c_n$					
	(1)	(2)	(3)	(4)	(5)	(6)
$\delta^c \frac{\#\text{Cases}_{ni}}{\sqrt{\#\text{Firms}_n \#\text{Firms}_i}}$	-45.14**		-63.46***		-72.11***	
	(13.37)		(17.58)		(21.68)	
$\delta^c \frac{\#\text{Cases}_{ni}}{\#\text{Firms}_n}$		-7.713		-10.75***		-10.80***
		(4.531)		(2.882)		(2.971)
Upstr × Downstr FE	Yes	Yes	Yes	Yes	Yes	Yes
Upstr × Country FE			Yes	Yes	Yes	Yes
Downstr × Country FE					Yes	Yes
N	133525	133525	133525	133525	133525	133525
R^2	0.315	0.315	0.453	0.453	0.465	0.464

Standard errors in parentheses, clustered at the country level
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

What's the importance of enforcement costs δ^c for aggregate productivity?

Back to the model.

$$d \log p_n = \sum_i \frac{X_{ni}}{X_n} \left(d \log p_i + d \log d_{ni} \right) \tag{1}$$

hence

$$d \log p = (I - \Xi)^{-1} \operatorname{diag} \left(\Xi \left(d \log d_{ni} \right)'_{n,i} \right) \tag{2}$$

- Price level depends on transaction cost; get amplified through I-O linkages (Leontief inverse)

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- Expenditure shares also adjust, as governed by elasticity θ

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- Price level depends on transaction cost; get amplified through I-O linkages (Leontief inverse)
- Expenditure shares also adjust, as governed by elasticity θ
- If we know d_{ni}, we can get a first-order estimate of Δp

Mapping litigation data into ω_{ni}

- Idea: litigation can only occur when contract is formal (and this is when enf. costs matter)
- Hence, higher ω_{ni} should be associated with less litigation
- Set

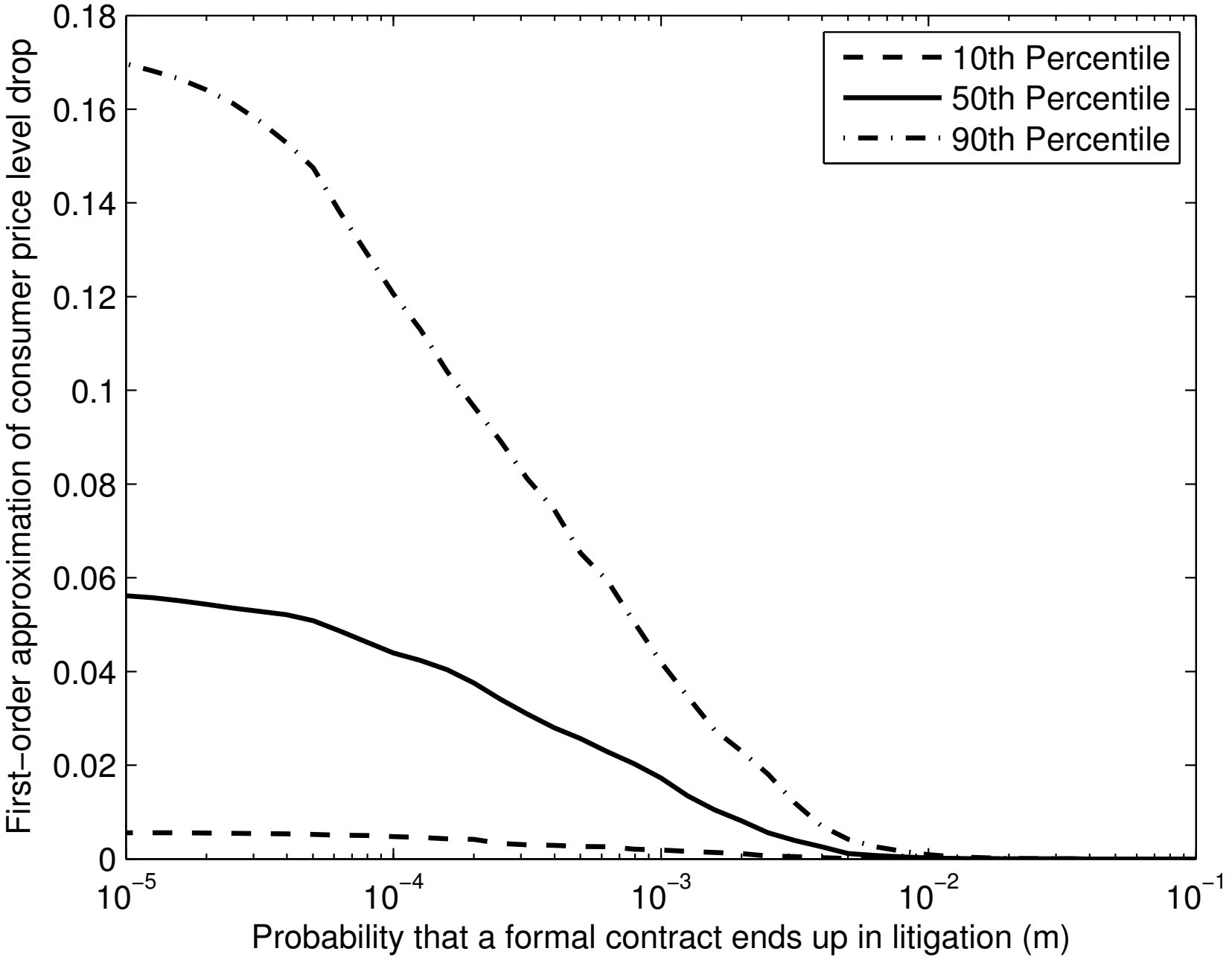
$$\omega_{ni} = 1 - \frac{1}{m} z_{ni}$$

  and estimate m.
- Motivation: assume that a measure zero set of firms draw a stochastic δ (ex-ante, known to everyone), so that

$$\frac{1}{1 - \frac{1}{2}\delta} \sim \mathsf{U}[1, 2]$$

- If they decide to use a formal contract: with probability m they cannot settle, go to court.
- Then z_{ni} is the probability that they end up in court.

Aggregate price level drop as a function of m



Structural estimation

Structural equation for input share, plus error term

$$\frac{X_{ni}^c}{X_n^c} = \gamma_{ni} \frac{T_i^c \left(\mu_n p_i^c d_{ni}^c\right)^{-\theta}}{S_n^c + T_i^c \left(\mu_n p_i^c d_{ni}^c\right)^{-\theta}} + \varepsilon_{ni}^c$$

with mapping $\alpha_n^c = \log(S_n^c / \mu_n^{-\theta})$ and $\alpha_i^c = \log\left(T_i^c (p_i^c)^{-\theta}\right)$,

$$\frac{X_{ni}^c}{X_n^c} = \gamma_{ni} \frac{1}{1 + \exp(\alpha_n^c - \alpha_i^c + \theta \log d_{ni}^c)} + \varepsilon_{ni}^c$$

- If we calibrate markups μ, all other parameters can be identified
- Choose $\sigma = 3.5$, which implies $\mu = 1.4$.

Structural estimation

$$\frac{X_{ni}^c}{X_n^c} = \gamma_{ni} \frac{1}{1 + \exp(\alpha_n^c - \alpha_i^c + \theta \log d_{ni}^c)} + \varepsilon_{ni}^c$$

- Estimation problem similar to gravity equations
- NLS in levels problematic because of nonconvexities
- NLS in logs problematic because of observations that are very close to zero
- PPML is good compromise
  - Consistent if conditional mean is as given by the model

PPML estimates

	$d_{ni}^{(1)}$	$d_{ni}^{(2)}$
$\log_{10} m$	-3.55**	-3.62**
	(0.03)	(0.02)
θ	2.81**	3.06**
	(0.99)	(1.17)
N	133525	133525

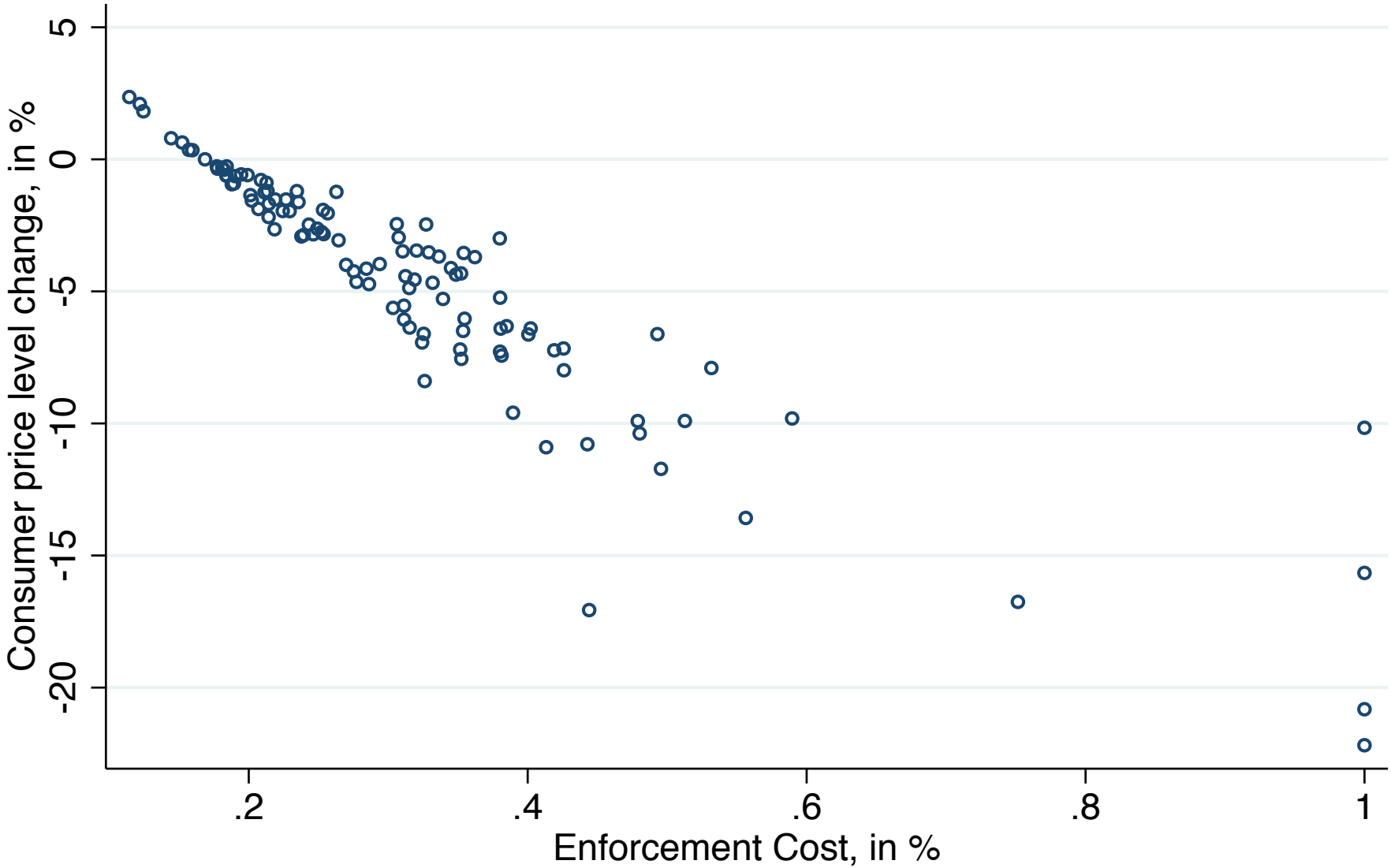
* $p < 0.05$, ** $p < 0.01$

- θ lower than in structural gravity estimations

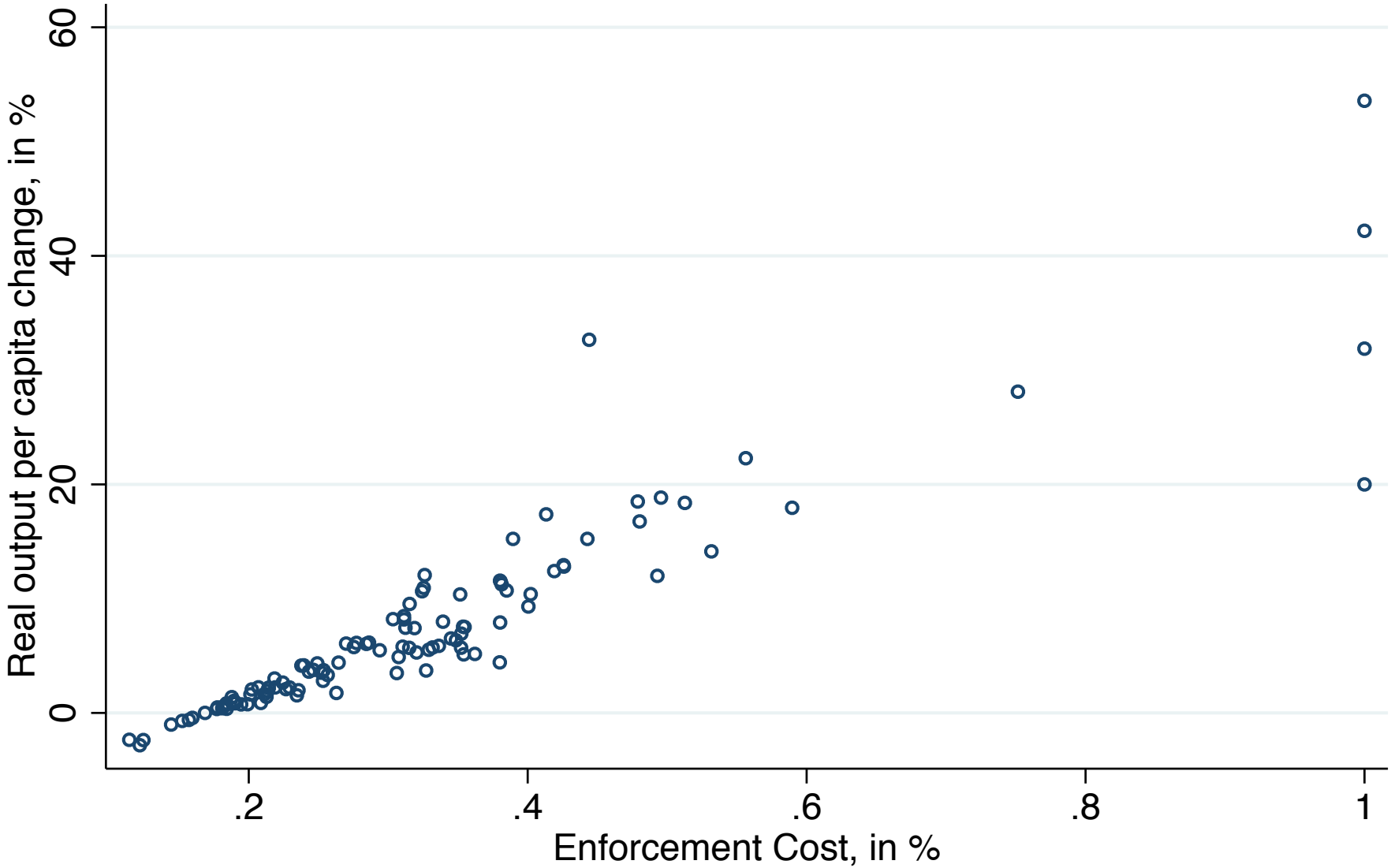
▸ No I-O linkages

Counterfactual aggregate productivity gains

Counterfactual sets enforcement costs to US levels



Counterfactual welfare increase



Summary: what do we learn?

- Enforcement costs (and, more generally, transaction costs and the boundaries of the firm) are important on a macro scale
- Litigation data is useful for thinking about dependence on judicial institutions and transaction costs
- I-O tables differ systematically and significantly across countries
  - Cross-country differences correlated with enforcement frictions
  - Fraction of I-O differences explained by enforcement frictions suggest large welfare implications

Additional slides

Existence and Uniqueness

Theorem

Let Ξ be the matrix with elements $\Xi_{ni} = (\alpha_n \mu_n)^{-\theta} \gamma_{ni}^{\theta/(\rho-1)} T_i$ for all $n, i = 1, \ldots, N$. Assume that

1. *the spectral radius of Ξ is strictly less than one, and*
2. $0 < \theta/(\rho - 1) < 1$.

Then, for all $(d_{ni})_{n,i}$ with $d_{ni} \geq 1$ for all n, i, an equilibrium price vector $(p_n(w))_{n=1,\ldots,N}$ exists and is unique. Furthermore, $p_n(w)$ is homogenous of degree one in w.

Back

The model from a trade perspective

- Discrete choice between Outsourcing and In-house production is like discrete choice between countries in Eaton-Kortum.
- Contracting friction d_{ni}^{c} enter like iceberg trade costs
- Welfare counterfactuals: reducing enforcement costs to zero is similar to studying the gains from trade in Ricardian models

Back

Table : Enforcement cost by country

Country	δ
Luxembourg	0.114
South Korea	0.122
Norway	0.124
China	0.144
Finland	0.152
Russian Federation	0.157
Austria	0.160
United States	0.169
⋮	⋮
Colombia	0.590
Bangladesh	0.752
Cambodia	1.060
Indonesia	1.274
Malawi	1.460
Mozambique	1.508

Identifiability

System of equations that determines equilibrium:

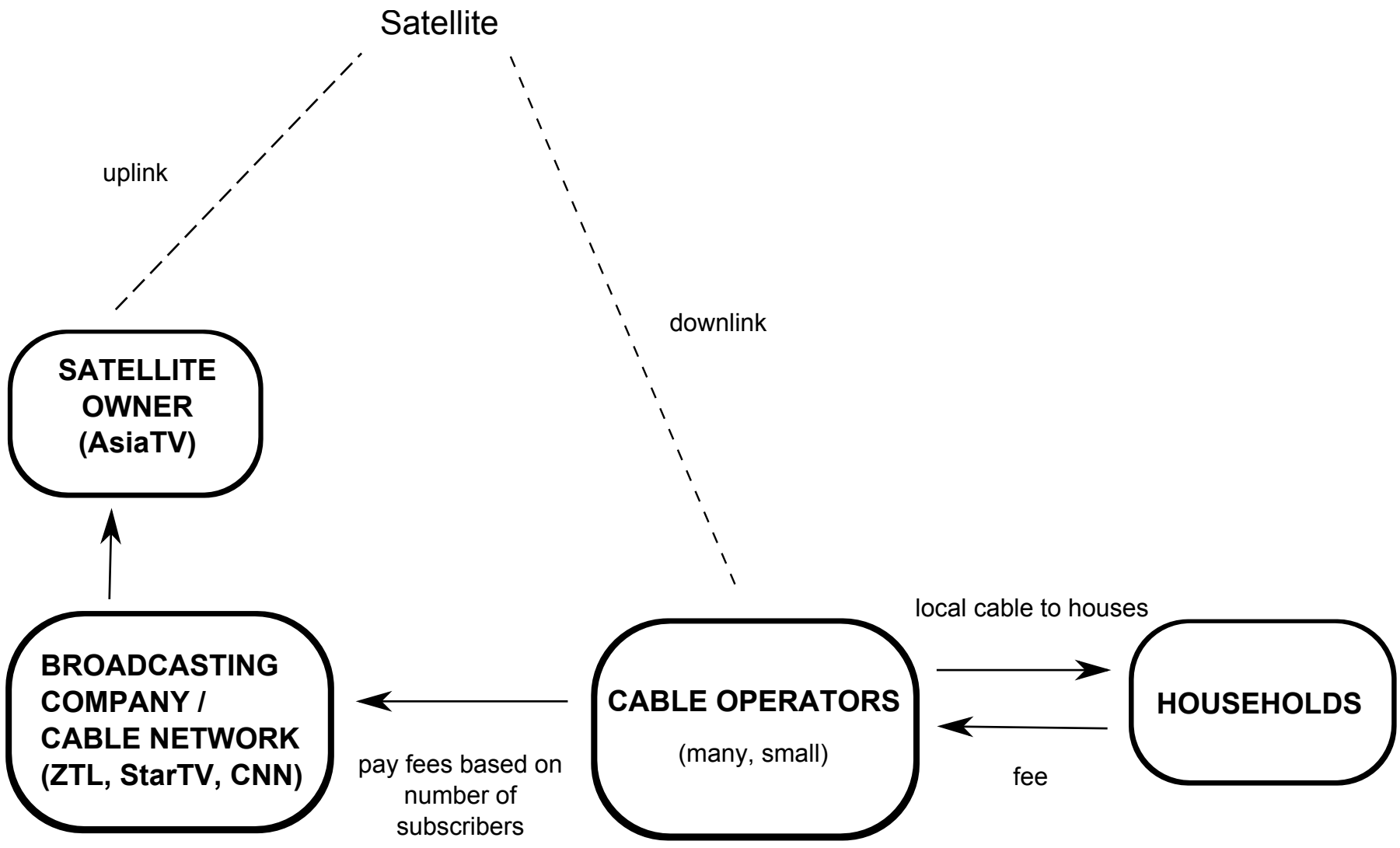
$$(p_n^c)^{1-\rho} = \sum_{i=1}^{N} \left(\left[\gamma_{ni}^{\frac{\theta}{\rho-1}} \alpha_n^{-\theta} S_n^c \right] + \left[\gamma_{ni}^{\frac{\theta}{\rho-1}} \alpha_n^{-\theta} T_i^c \mu_n^{-\theta} \right] \left(p_i^c d_{ni}^c \right)^{-\theta} \right)^{\frac{\rho-1}{\theta}}$$

$$\frac{X_{ni}^c}{X_n^c} = (p_n^c)^{1-\rho} \frac{\left[\gamma_{ni}^{\frac{\theta}{\rho-1}} \alpha_n^{-\theta} T_i^c \mu_n^{-\theta} \right] \left(p_i^c d_{ni}^c \right)^{-\theta}}{\left(\left[\gamma_{ni}^{\frac{\theta}{\rho-1}} \alpha_n^{-\theta} S_n^c \right] + \left[\gamma_{ni}^{\frac{\theta}{\rho-1}} \alpha_n^{-\theta} T_i^c \mu_n^{-\theta} \right] \left(p_i^c d_{ni}^c \right)^{-\theta} \right)^{1+\frac{1-\rho}{\theta}}}$$

Parameters m, θ, ρ, and terms in square brackets are identified

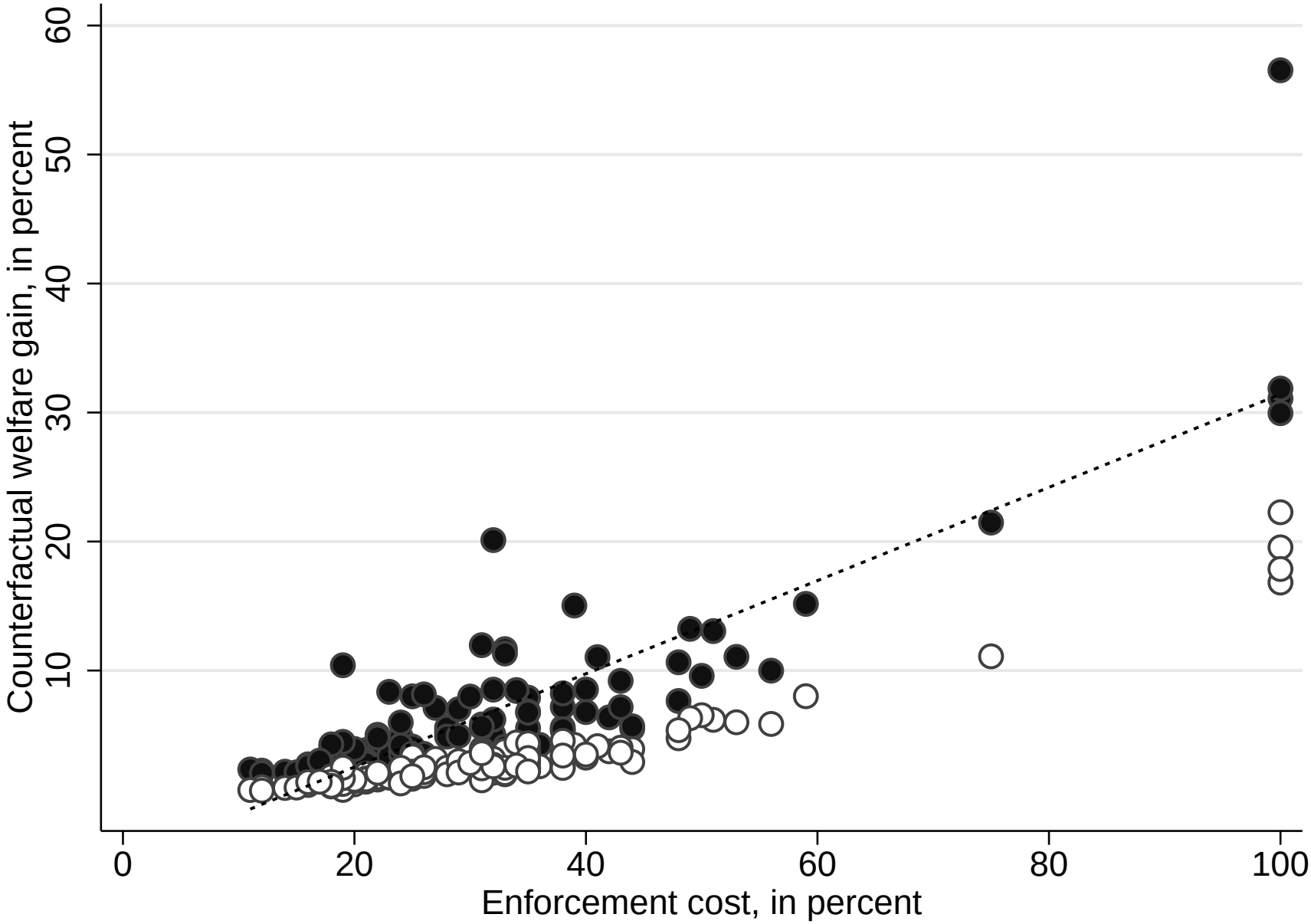
Back


ZEE TV


Satellite
uplink
downlink
SATELLITE OWNER (AsiaTV)
BROADCASTING COMPANY / CABLE NETWORK (ZTL, StarTV, CNN)
pay fees based on number of subscribers
CABLE OPERATORS
(many, small)
local cable to houses
fee
HOUSEHOLDS

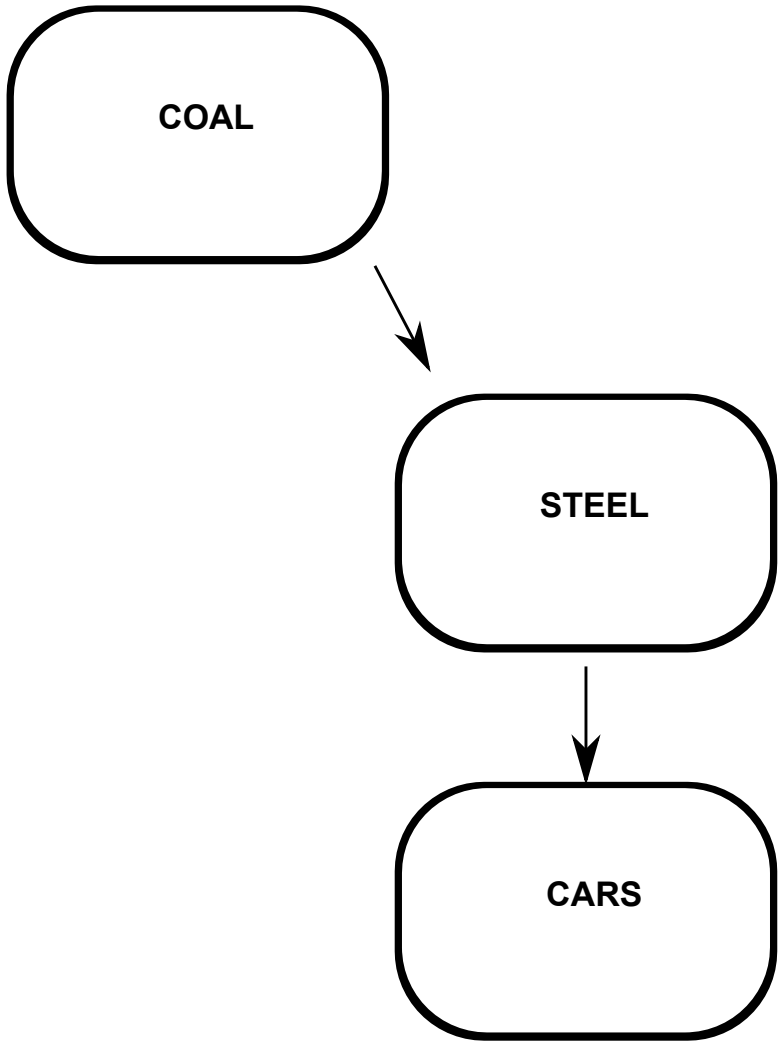
Back

No I-O linkages: welfare impact still big



Back

Input-Output linkages



Back Welfare effects without linkages

Table : Enforcement-intensity: #cases/#upstream sector firms

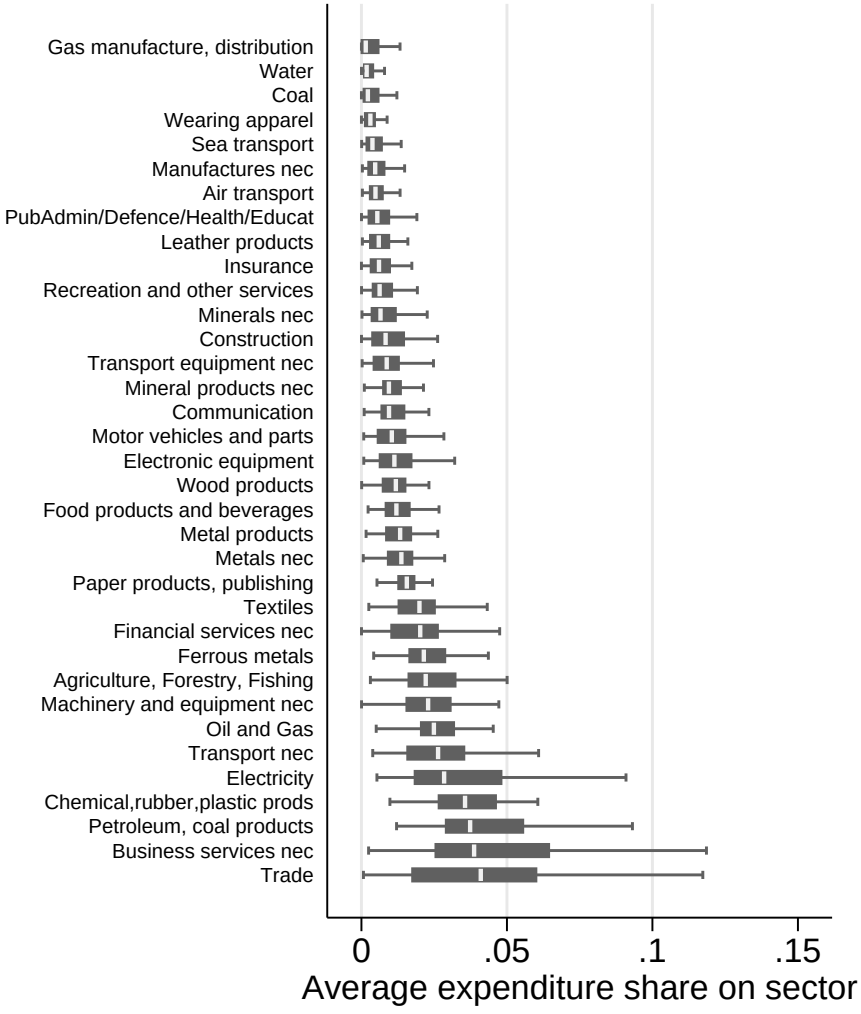
	Dependent variable: X^c_{ni}/X^c_n				$X^c_{ni,dom}/X^c_n$
	(1)	(2)	(3)	(4)	(5)
$\delta^c \frac{\#\text{Cases}_{ni}}{\#\text{Firms}_i}$	-13.91***	-15.38***	-15.24***	-28.43***	-7.832**
	(3.097)	(3.614)	(3.573)	(5.668)	(2.418)
$\text{trust}^c \frac{\#\text{Cases}_{ni}}{\#\text{Firms}_i}$		0.271	0.274	-3.780	1.928
		(6.110)	(6.066)	(13.84)	(4.638)
$\delta^c I^{US}_{ni}$			-0.0110*	-0.000245	-0.00129
			(0.00483)	(0.00238)	(0.00486)
$\text{trust}^c I^{US}_{ni}$			-0.000721	-0.00125	0.00645
			(0.00517)	(0.00244)	(0.00531)
Upstr × Downstr FE	Yes	Yes	Yes	Yes	Yes
Upstr × Country FE	Yes	Yes	Yes	Yes	Yes
Downstr × Country FE	Yes	Yes	Yes	Yes	Yes
Sample	Full	Full	Full	Up services	Full
N	133525	106575	106575	42630	106575
R^2	0.537	0.566	0.566	0.467	0.481

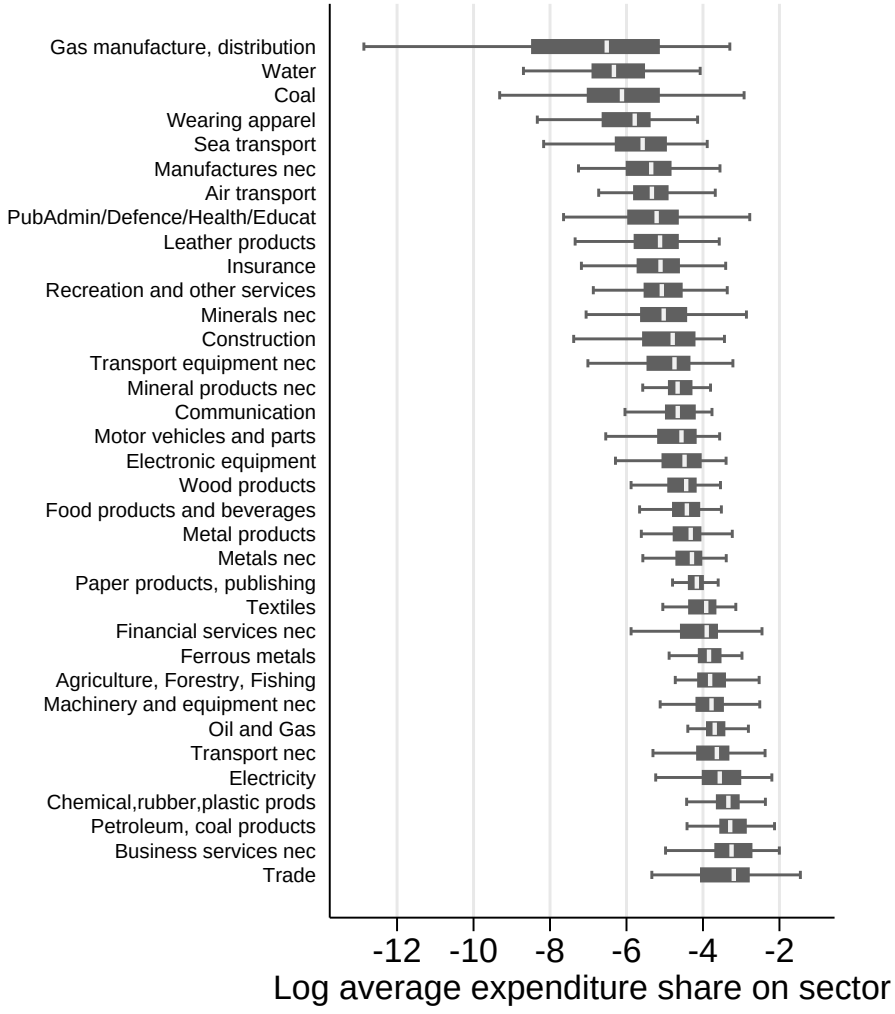
Standard errors in parentheses, clustered at the country level
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Back

Cross-country distribution of input shares by upstream sector

Unweighted averages across downstream sectors





Source: Author's calculations from GTAP 8 data. Excludes outliers.

Back

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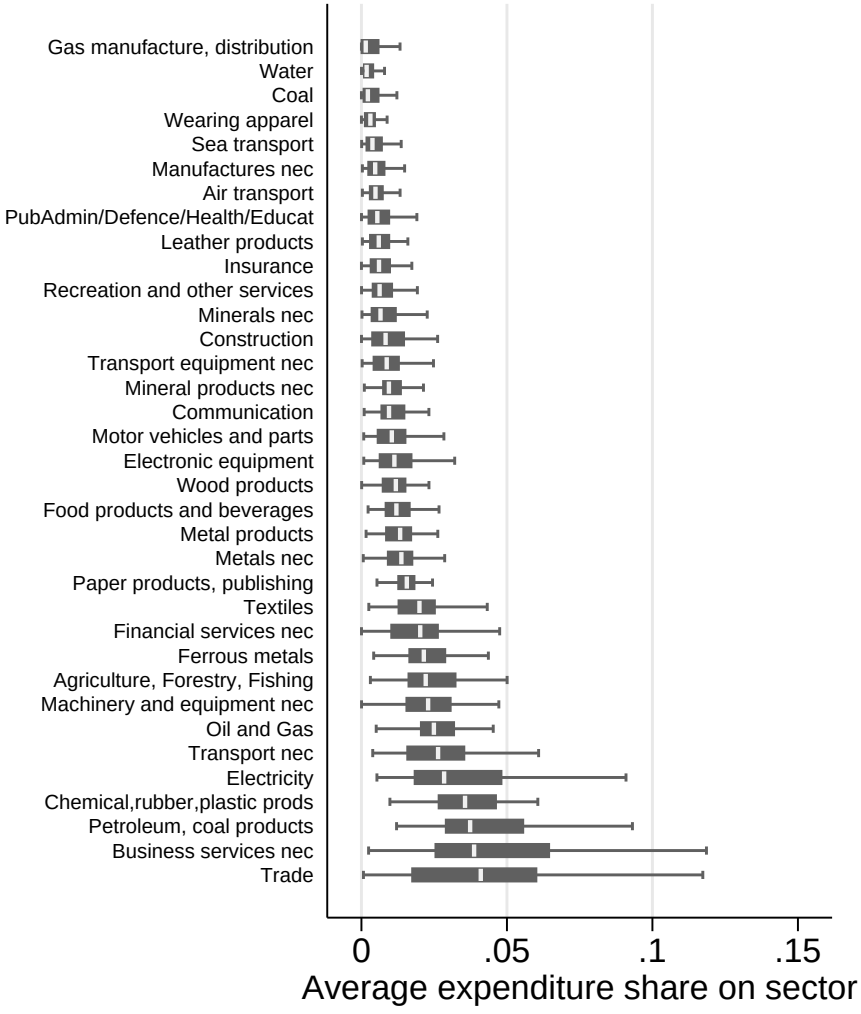

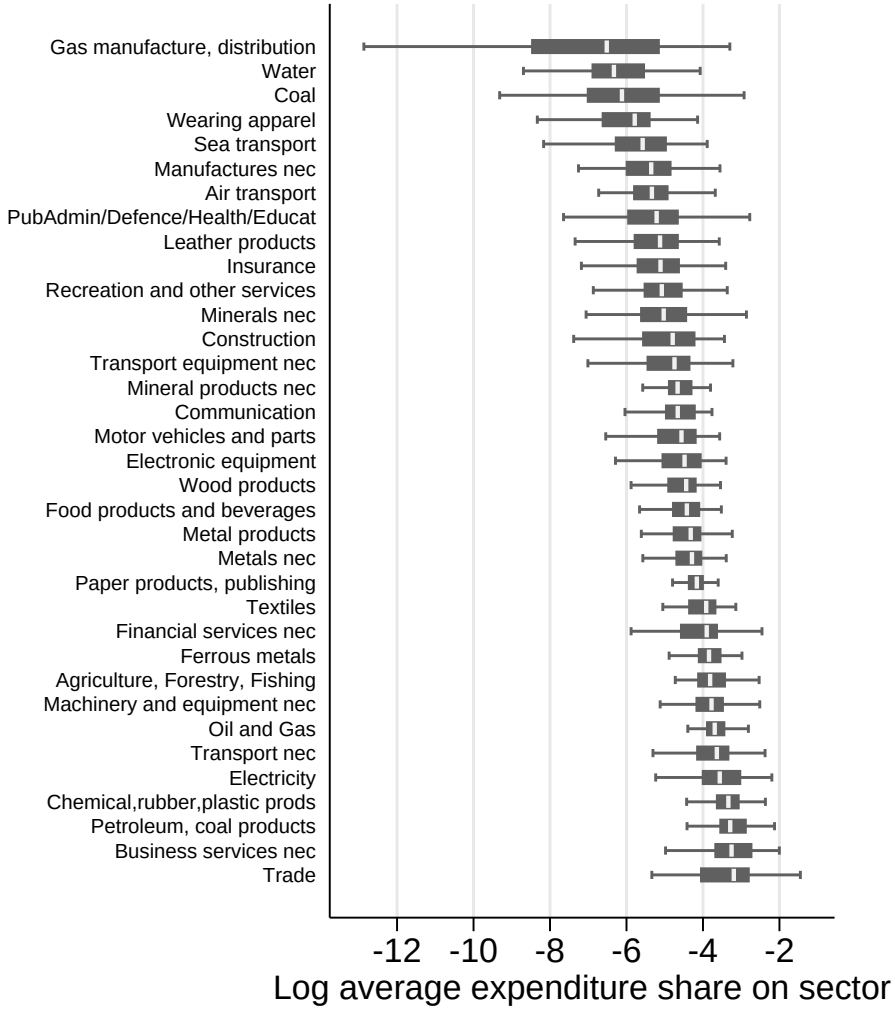

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Back

Informal Sector

- Positive correlation between firm size (employment) and vertical integration (VA/sales)
- Informal sector: left-censoring the firm size distribution.
  - If uniform across inputs: should be picked up by α_n^c.
  - According to India's ASI: small positive correlation between employment and services inputs expenditure share
    $\Rightarrow$ works against what I observe

Back

IO expenditure shares as measure of outsourcing

- $VA/Sales$: Adleman (1955), and widely used since (Levy, 1985, Holmes, 1999,...)
  Cross-country: Macchiavello (2009) (cf. Acemoglu et al., 2009)

- Main drawback: if constructed from plant data, transactions may be intra-firm

  - Atalay et al. (2013) Intra-firm input flows between integrated plants are surprisingly small

  - Intra-firm services flows would not show up $\Rightarrow$ use for robustness check!

Back

What determines contracting frictions d_{ni}?

- Contracting game between the intermediary ('buyer') and a sector i firm ('seller')
- Production one-sided, constant marginal cost c
- Contract specifies quantity q^* and payoff schedule $M(q)$
- Buyer's valuation is $R(q)$

Key assumptions

- Relationship-specificity of the produced goods:

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Brief sketch of outcome

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  - Underproduction because of relationship-specificity (Klein, Crawford, Alchian, 1979)

What do we learn from this?

- Breach is more likely if goods are very relationship-specific

Back to macromodel

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$$d_{ni} = \min\left(\frac{1}{1 - 0.5\delta}, 2 - \omega_{ni}\right)$$

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- Contracting game between the intermediary ('buyer') and a sector i firm ('seller')
- Production one-sided, constant marginal cost c
- Contract is pair $(q^*, M(q))$
  - q^* is quantity to be produced
  - $M(q)$ is a state-contingent payment from the buyer to the seller
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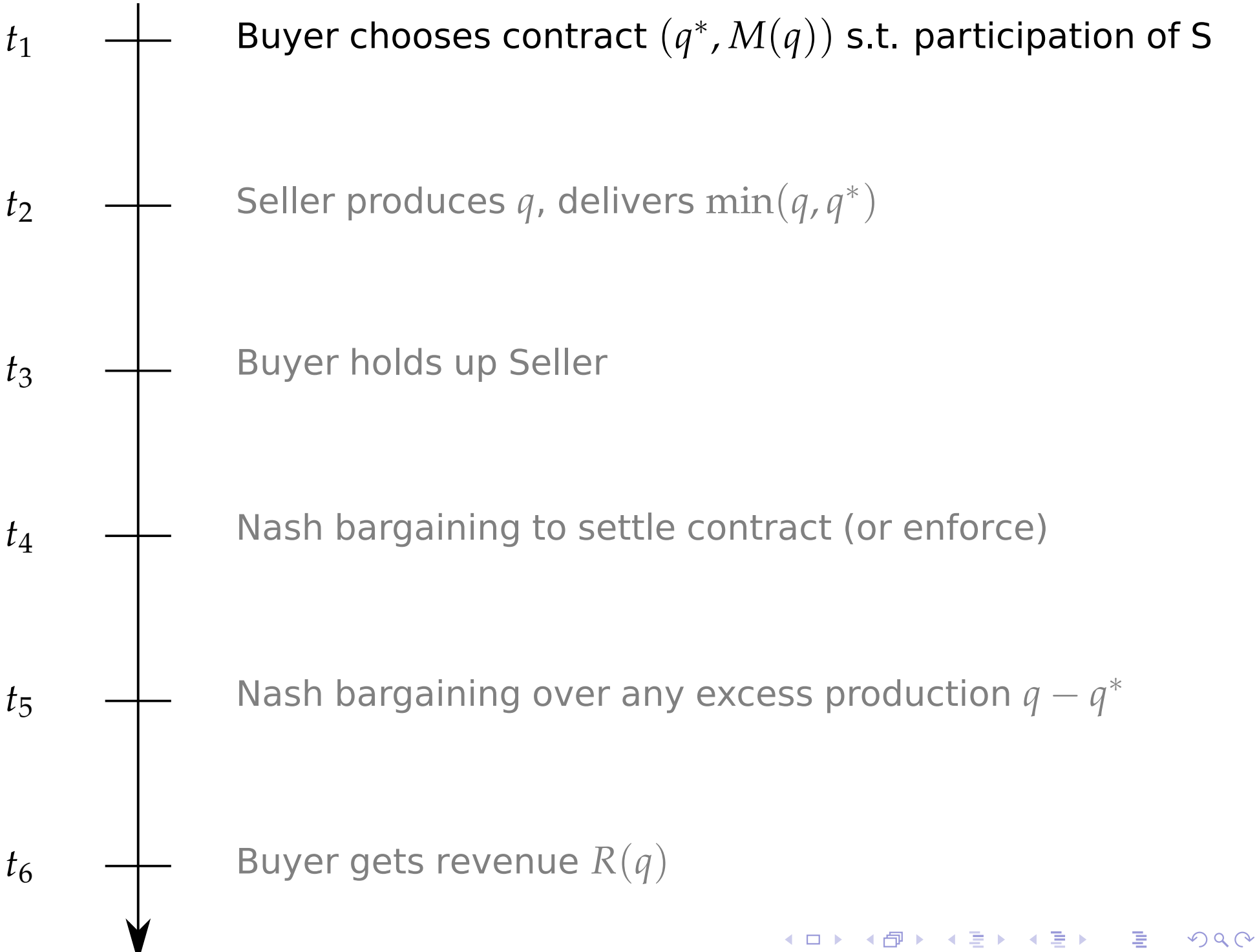
t_1
Buyer chooses contract $(q^*, M(q))$ s.t. participation of S
t_2
Seller produces q, delivers $\min(q, q^*)$
t_3
Buyer holds up Seller
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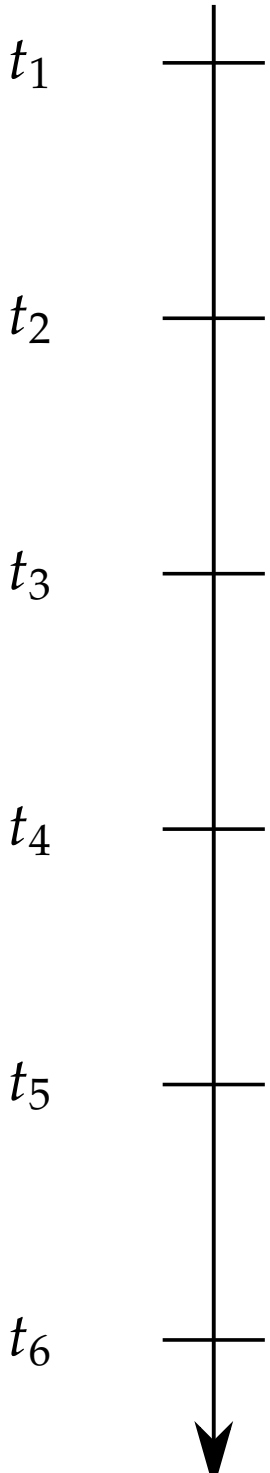
Nash bargaining to settle contract (or enforce)
t_5
Nash bargaining over any excess production $q - q^*$
t_6
Buyer gets revenue $R(q)$



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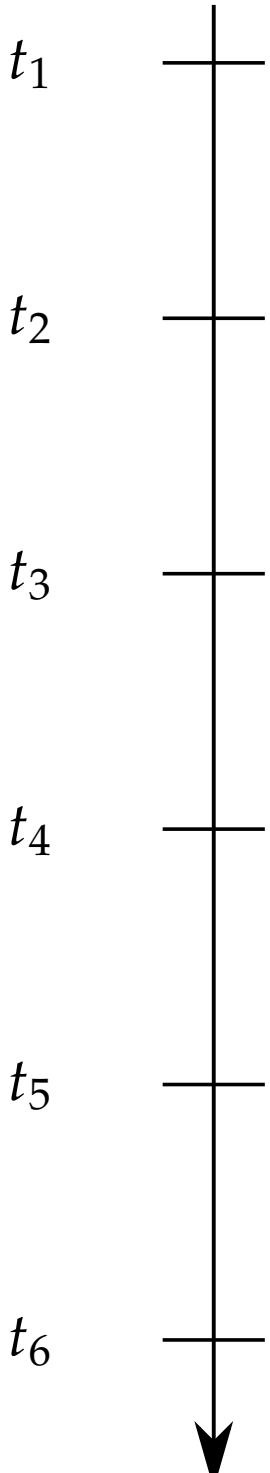

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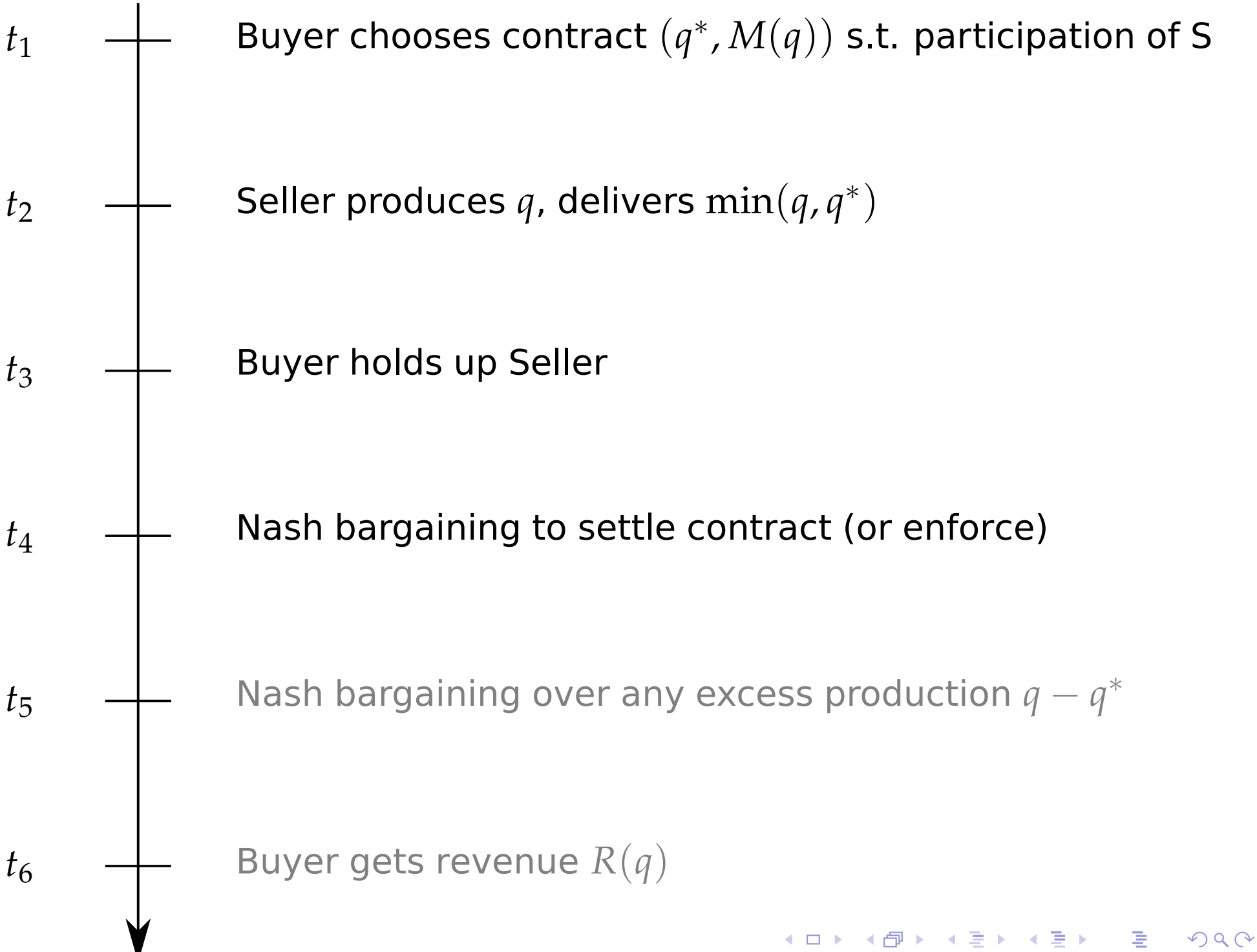
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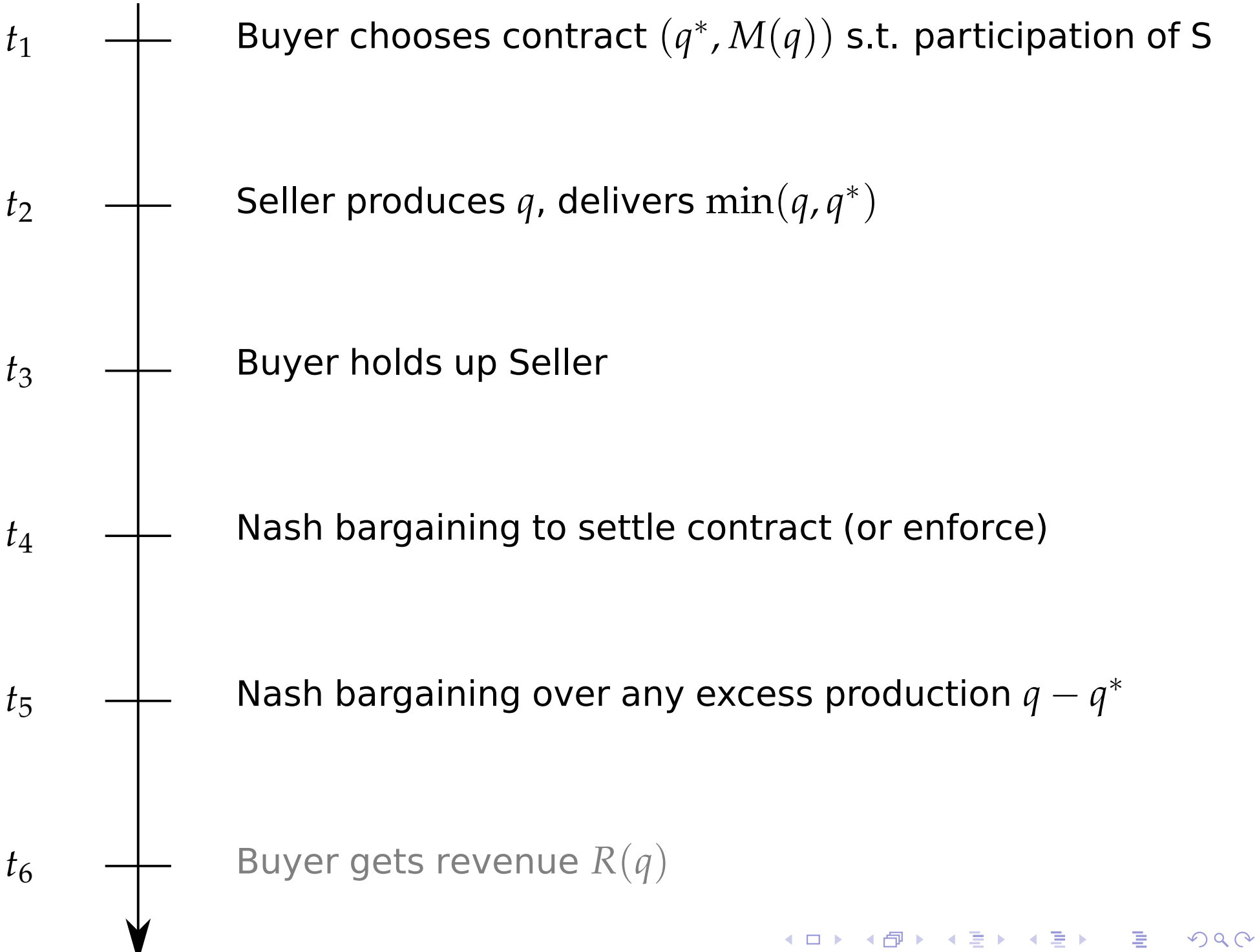
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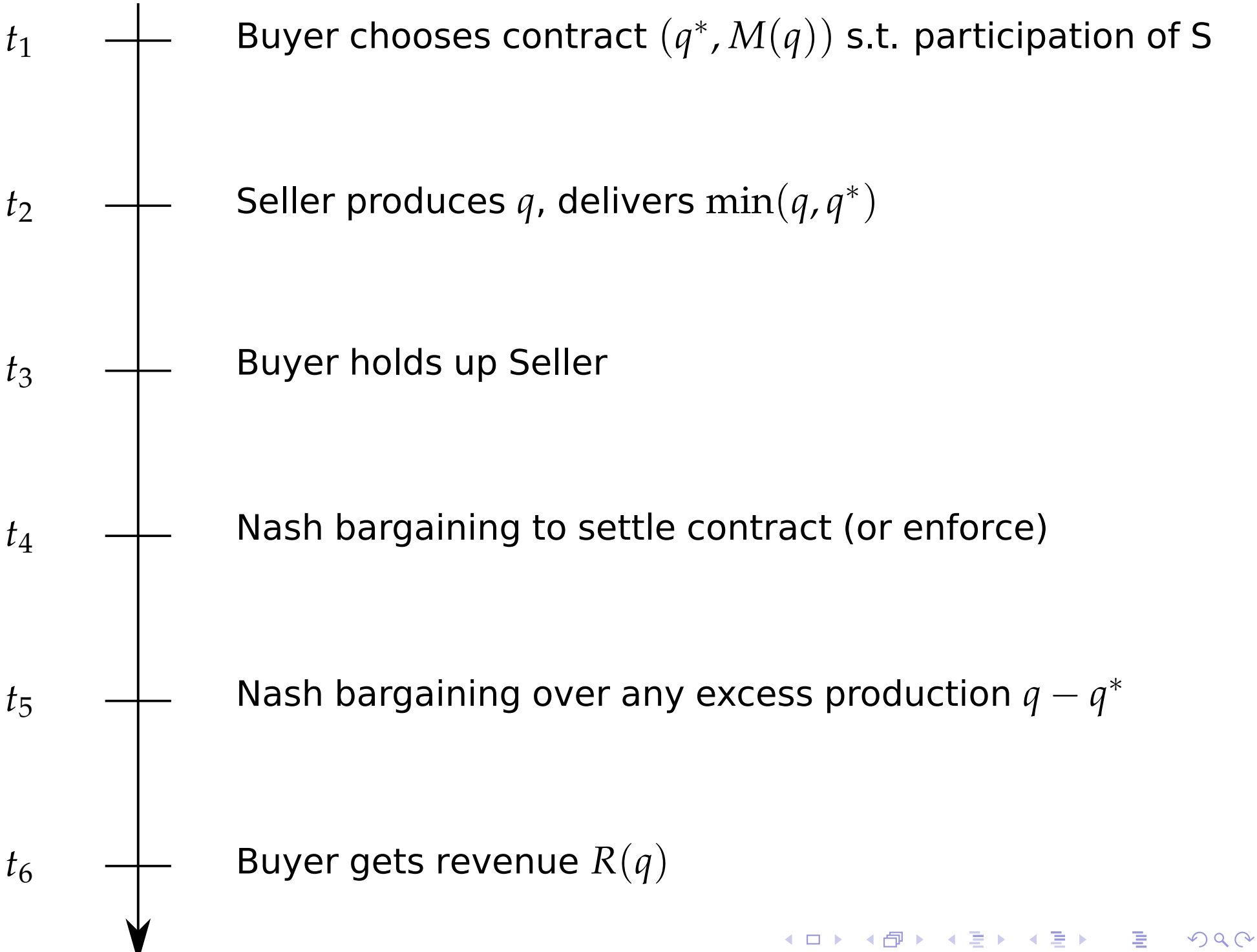
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Case 1: Seller breaches the contract, $q < q^*$

- Seller's payoff under enforcement

$$\pi_s(q) = (1-\delta)\,(\underbrace{M(q)}_{\text{Fee}} - \underbrace{D(q,q^*)}_{\text{Damages}}) - (\text{prod. cost})$$

where $D(q,q^*) = R(q^*) - M(q^*) - (R(q) - M(q))$

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- Damages related to buyer's payoff $\Rightarrow$ seller internalizes buyer's payoff (Shavell, 1980)
- Proportional enforcement cost $\delta \Rightarrow$ Seller can only recover a smaller fraction of fees net of damages $\Rightarrow$ ex-ante efficiency loss!

Case 2: Seller fulfills the contract, $q \geq q^*$

- Hold-up and settlement as before
- Excess production left? Bargain over the surplus from the remaining goods $q - q^*$
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Think: informal contracts (Klein, Crawford, Alchian, 1979)

Optimal contract

- Both cases lead to inefficiency:
  - Breach: enforcement cost δ means that seller can only recover a fraction of his fee net of damages (relationship-specificity does not matter)
  - Fulfillment/Informal contract: δ does not matter, but relationship-specificity does
- Optimal contract implements the case with the smaller distortion:

$$d_{ni}^{c} = \min\left(\frac{1}{1-0.5\delta^{c}}, 2-\omega_{ni}\right)$$

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