'Need for speed': The role of timeliness in the trade effect of the 2004 EU enlargement

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Motivation and Contribution

Motivation and Contribution

Motivation

- Positive trade effect of EU enlargement + No trade policy change
- Change in "other" trade costs (legal framework, political security, TBT, ...)
- No border controls and customs procedure $\longrightarrow$ improved timeliness
- Aim of paper: use the episode of EU enlargement to infer the cost of time in trade

Contribution

- Increased timeliness significantly contributed to the trade effect of EU enlargement
- The EU effect is larger for trade of a country pair
  - ..with more pre-2004 border crossings and longer waiting time
  - ..with worse customs administration quality

On timeliness

Why is there demand for timeliness in trade?

- not only perishability, but high-value goods, variable demand, internationalization of production

Theory

- Deardorff (2002), Evans-Harrigan (2003), Harrigan-Venables (2004)
- The time cost of trade can hinder the outsourcing of time-sensitive production to more distant and/or less developed locations and reduce international trade.

Empirical evidence is scarce

- Hummels (2001b) compares US trade via air vs ocean shipping: plus 1 day is like a 1% tariff on manufactures
- Doing Business trading time data
  - Djankov-Freund-Pham (2006): plus 1 day reduces trade volume by at least 1%
  - Freund-Rocha (2010) on Africa: plus 1 day in transit, 7% less exports

Empirical strategy

Measuring industry-specific trade barriers

- Industry-specific bilateral trade barrier (in Novy (2008), also known as Head and Ries index)
- ..can be derived from any trade theory that yields a gravity equation
- ..controls for the country-time-specific heterogeneity in the gravity equation ("multilateral trade resistance")

$$\theta_{ij}^{k} = \left(\frac{T_{ij}^{k} T_{ji}^{k}}{T_{ii}^{k} T_{jj}^{k}} \right)^{\frac{1}{2}} = \left(\frac{X_{ii}^{k} X_{jj}^{k}}{X_{ij}^{k} X_{ji}^{k}} \right)^{\frac{1}{2(\sigma^{k}-1)}} \tag{1}$$

where

- T_{ij}^{k}: bilateral trade cost (ad valorem) from i to j for industry k
- T_{ii}^{k}: domestic trade cost (ad valorem) in country i for industry k
- X_{ij}^{k}: export from country i to j in industry k's products
- X_{ii}^{k}: domestic sales in country i in industry k's products
- σ^{k}: industry-specific elasticity of substitution among domestic and foreign goods

Sample and Data

- Eurostat data: trade, output, IO tables year 2000
- 13 old and 8 new members (EU25 less GR, IE, MT, CY)
- 19 non-food, non-energy manufacturing industries (2-digit NACE)
- 7 years (2000-2006)
- Balanced panel with 30,000 observations
- Empirical challenges in calculating θ_{ij}^k:
  - calculating domestic sales (gross output - export + re-export)
  - σ^k estimates from Chen-Novy (2008)

Evolution of barriers around EU enlargement

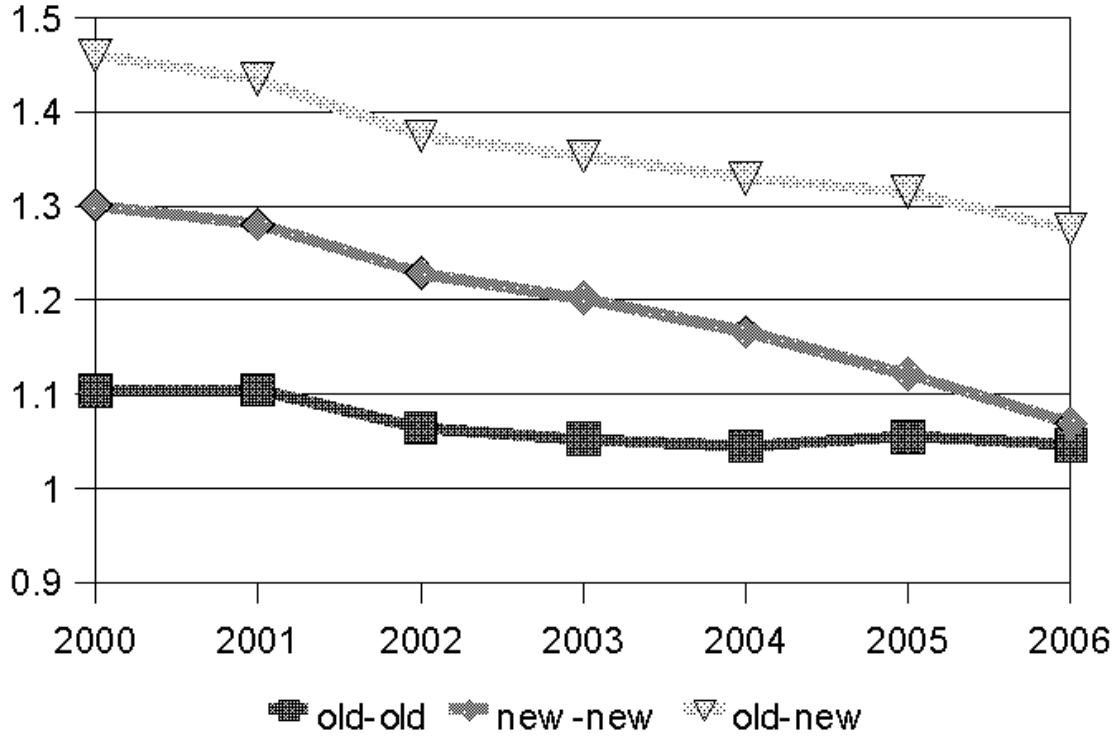
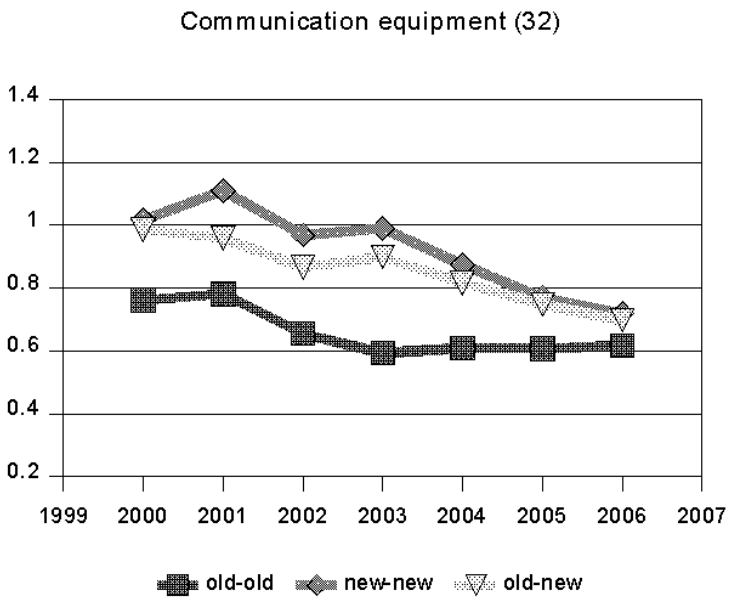
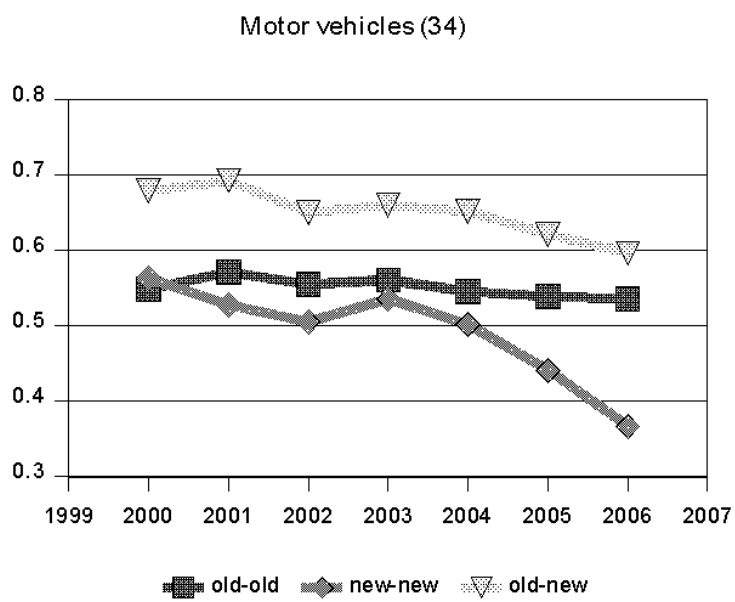


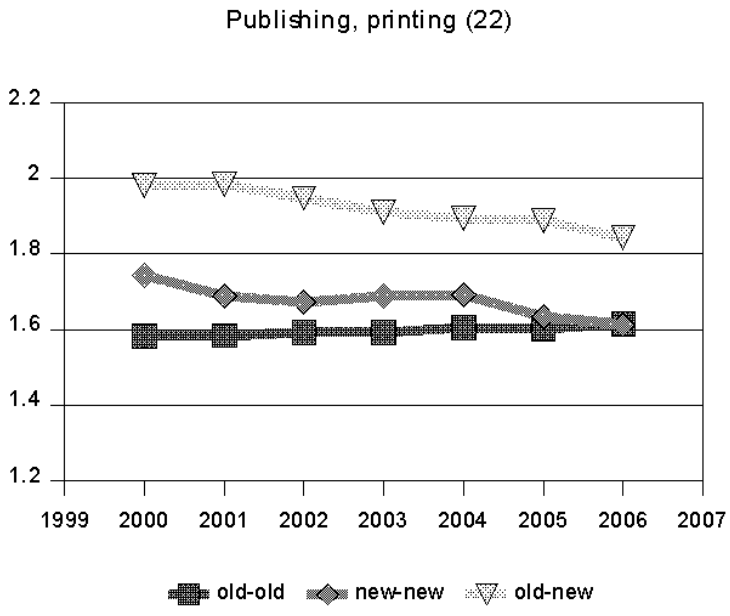
Fig 1: averages of log θ's over industries and country-pairs

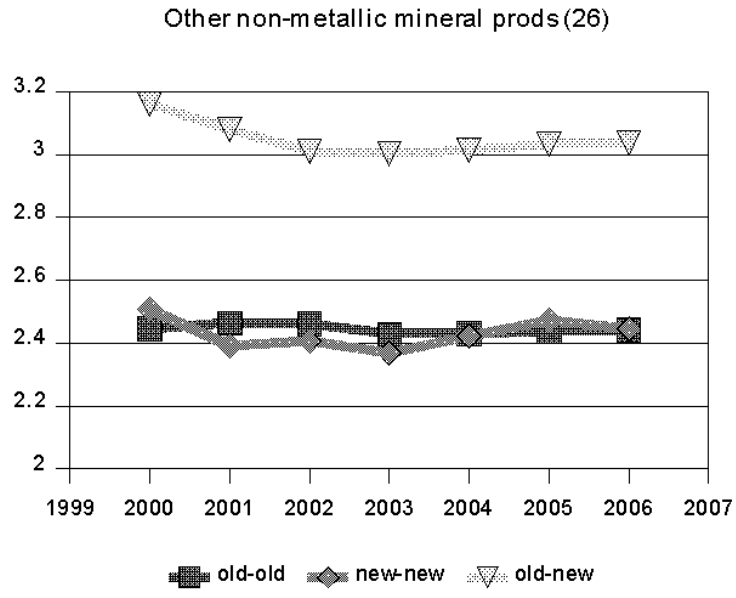
Where enlargement seems to matter - industry examples





Where it does not - industry examples





A Difference-in-Differences strategy

EU enlargement as a quasi natural experiment

- treatment: country pair is becoming an intra-EU country pair in 2004
- treatment group (T) is new-new and old-new, control group (C) is old-old
- the treatment effect is $\left(\theta^{T}_{t>=2004} - \theta^{T}_{t<2004}\right) - \left(\theta^{C}_{t>=2004} - \theta^{C}_{t<2004}\right)$
- time dimension: assume gravity equation holds in each period (comparative statics)
- problem to be addressed: T and C have heterogeneous trends (convergence trends)

Estimating equation (FE)

$$\ln \theta^k_{ij,t} = \beta_1 D_{ij,t} + \beta_2 D_{ij,t} Z^k_{ij} + \beta_3 h^k_{ij,t} + \gamma^k_{ij} + \delta_t + \varepsilon^k_{ij,t} \qquad (2)$$

- the treatment dummy

$$\begin{aligned} D_{ij,t<2004} &= 0 \\ D_{ij,t\geqq 2004} &= \begin{cases} 1 & if\ ij = T \\ 0 & if\ ij = C \end{cases} \end{aligned}$$

- timeliness effect is captured by the interaction of $D_{ij,t}$ and the timeliness variable Z^k_{ij}
- $\hat{\beta}_1$ w/o the interaction term: total EU effect on trade costs
- $\hat{\beta}_2$: contribution of the timeliness variable to the total effect
- $h^k_{ij,t}$ controls for heterogeneous convergence trends across countries
- γ^k_{ij} and δ_t are countrypair-industry FEs and year dummies

Choice of variables

1. Timeliness variables (Z)
   - number of borders to cross
   - waiting hours at borders

Example: from Hungary to Lithuania

Borders to cross	Waiting hours[1]
HU to SK	1.7
SK to PL	3.9
PL to LT	3.4
HU to LT	9.0

[1] *Average of border crossings in 2002-2003.*
Source: International Road Union

   - customs quality: average of 2 scores on efficiency and 2 on bribery (WEF, early 2004 survey)
2. Additional controls, in log (h)
   - country-level: GDP per capita, real effective exchange rate
   - countrypair- and industry-level: horizontal intra-industry trade (Grubel-Lloyd index, differences in capital shares)

Results

Main results

1. Overall treatment effect ($\hat{\beta}_1$) is like a $5\frac{1}{2}\%$ decline in ad valorem trade barriers.
2. One additional border to cross acts like a 2% ad valorem tariff.
3. One hour waiting at the border is like a 0.7% ad valorem tariff.
   (considerably larger than evidence on Doing Business data)
4. The worse the reported customs quality is, the larger the decline in barriers.

Main results

Variable	(1)	(2)	(3)	(4)
D	-0.056***	-0.033***	-0.038***	0.028
	[0.004]	[0.010]	[0.009]	[0.023]
D x border number		-0.021**		
		[0.008]		
D x wait hours			-0.007***	
			[0.002]	
D x customs survey				-0.026***
				[0.007]
REER	-0.183***	-0.182***	-0.191***	-0.187***
	[0.036]	[0.036]	[0.038]	[0.036]
GDP capita	-0.172***	-0.139**	-0.203***	-0.179***
	[0.061]	[0.061]	[0.061]	[0.061]
Grubel-Lloyd index	-0.138***	-0.138***	-0.131***	-0.137***
	[0.009]	[0.009]	[0.009]	[0.009]
Diff in capital share	0.007**	0.007**	0.006**	0.007***
	[0.003]	[0.003]	[0.003]	[0.003]
Constant	2.294***	2.256***	2.355***	2.321***
	[0.172]	[0.172]	[0.176]	[0.172]
Countrypair-industry FEs	yes	yes	yes	yes
Year effects	yes	yes	yes	yes
Observations	31084	31084	25940	31084
Number of groups	4516	4516	3774	4516
Adj. within R^2	0.22	0.22	0.23	0.22

Notes: Robust standard errors (in brackets) are adjusted for clustering at the country-pair and industry level. In (3) without EE, LV, SI. * significant at 10%; ** 5%; *** 1%.

Cross-check 1: Transport mode

- I expect for SEA no role for timeliness, for AIR that only customs quality matters, for INLAND also border and waiting time to be important
- No data. I project likely transport shares from extra-EU data.
  - Cross-section of aver 2002-2003 data, 4-digit industries, 21 EU exporters, 34 non-EU importers
  - Two-step Heckman estimation: 1. trade zero or not (probit), 2. transport share (linear probability model)
  - Second-stage equation, where $s_{ijk}^m = \frac{X_{ijk}^m}{X_{ijk}}$, m is sea, air, inland

$$E\left[s_{ijk}^m \mid X_{ijk} > 0\right] = \alpha_i + \alpha_k + \upsilon V_{ij} + \lambda IMR_{ijk} \tag{3}$$

$$V_{ij} = [dist_{ij}, cborder_{ij}, continent_j, landlocked_j, GDPcap_j]$$

- Intra-EU shares projected and transport sub-samples defined with obs in the upper third of the transport share distributions (overlapping obs left out).

Results by transport mode sub-samples

		Treatment effect	Border number	Wait hours	Customs survey
Sea	Coef	-0.045***	0.027	-0.005	-0.021
	Robust s.e	[0.008]	[0.030]	[0.011]	[0.016]
	Adj. within R^2	0.18	0.18	0.20	0.18
	N	7507	7507	6301	7507
	Chow F	0.63	0.21	0.26	0.01
Air	Coef	-0.082***	-0.001	-0.004	-0.036**
	Robust s.e	[0.008]	[0.021]	[0.006]	[0.016]
	Adj. within R^2	0.24	0.24	0.24	0.24
	N	7028	7028	6058	7028
	Chow F	17.22***	0.68	0.10	1.55
Inland	Coef	-0.022**	-0.031***	-0.006*	-0.024**
	Robust s.e	[0.009]	[0.011]	[0.003]	[0.012]
	Adj. within R^2	0.23	0.23	0.27	0.23
	N	9568	9568	7485	9568
	Chow F	10.94***	1.46	0.13	0.51

Notes: Equation (2) estimated for each sub-sample. 1st column: treatment effect when no timeliness variable is included. 2nd-4th columns: coefs on timeliness variables, included one-by-one. Additional controls: REER, per capita GDP, Grubel-Lloyd index, capital share differences. Country-pair and industry fixed effects, common year effects included.

Cross-check 2: Time-sensitivity of industries

- I expect the effects of timeliness to be stronger for time-sensitive industries.
- Classify industries based on Hummels (2001b) estimates.
  H explains the probability that air is chosen relative to ocean transportation with the relative freight rates (normalized by the price) and the difference in transport time.

Time-sensitive		Time-insensitive	
NACE	industry	NACE	industry
29	Machinery and equipment	17	Textiles
30	Office machinery and computers	18	Wearing apparel
31	Electrical machinery and apparatus	19	Leather, luggage, footwear, etc.
32	Radio, tv and communication equip.	20	Wood, excl. furniture
33	Medical, precision and optical instr.	21	Pulp, paper products
34	Motor vehicles, trailers, semi-trailers	22	Publishing, printing
35	Other transport equipment	26	Other non-metallic mineral prods
		27	Basic metals

Source: Hummels (2001b)

Results by time-sensitivity

Time-sensitivity	Treatment effect	Border number	Wait hours	Customs survey	N
yes	-0.065***	-0.025**	-0.012***	-0.025***	10736
	[0.005]	[0.010]	[0.004]	[0.010]	
no	-0.057***	-0.018	-0.001	-0.022*	14492
	[0.007]	[0.014]	[0.004]	[0.012]	
			$y <^{c} n$		

Notes: 1st column: treatment effect when no timeliness variable is included.
2nd-4th cols: coefs on timeliness variables included one-by-one. Additional controls, country-pair and industry fixed effects, common year effects included. $<^{a}$, $<^{b}$, $<^{c}$ significantly smaller for the 'sensitive' than for the 'insensitive' sub-sample at 1, 5, 10%.

Cross-check 3: International fragmentation of production

- Geographically fragmented production processes are more time-sensitive.
- Parts and accessories trade as proxy for intra-firm trade.
  classified at 6-digit product level, shares for each countrypair-industry, 2002-2003 average.
- Sample divided along the median share.

Proxy	Treatment effect	Border number	Wait hours	Customs survey	N
large	-0.052***	-0.025**	-0.012***	-0.040***	15682
	[0.004]	[0.010]	[0.003]	[0.007]	
small	-0.059***	-0.020	-0.002	-0.015	15402
	[0.006]	[0.012]	[0.003]	[0.011]	
			$l <^b s$	$l <^c s$	

Notes: 1st column: treatment effect when no timeliness variable is included. 2nd-4th cols: coefs on timeliness variables included one-by-one. Additional controls, country-pair and industry fixed effects, common year effects included. $<^a$, $<^b$, $<^c$ significantly smaller for the 'large' than for the 'small' sub-sample at 1, 5, 10%.

Conclusion

Summary

- The episode of the 2004 EU enlargement was used to infer the cost of time in trade.
- Trade barriers were computed and estimation done in a DID framework.
- Variables that capture timeliness were found significant in explaining the effect.
- Results by and large seem to correspond with the likely mode of transportation, the time-sensitivity of industries and the extent of international production fragmentation.

Thank you!