Does trade liberalization boost innovation? Evidence from French industrial sectors in the 19th century

Carla Salvo

Sapienza University of Rome

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Outline

In a nutshell

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- Case study: industrial follower (France) *relaxed import tariffs* from a technological leader (England) during the 1860s
- *Diff-in-diff* approach
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Results:

- Positive effect of trade openness on innovation
- Stronger in areas more exposed to competition

Motivation

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- How do *domestic* firms react to increased *international competition*?
- Coming from a technological *leader* country?
- Because trade-barriers are being *removed*?
- Investment in new technology (innovation)? Or give up?

Earlier works: trade openness on innovation

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- Positive effect
  - China competition on Europe innovation (Bloom et al 2016)
- Negative effect
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Most related to my work *(but different)*

- Effect of (temporary) trade restriction
  - Increasing capacity in mechanized cotton spinning after Napoleonic blockade (Juhász 2018)

Why historical France?

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- Data superiority: especially for regional studies
- Trade openness shock to *technological follower country*

The Cobden-Chevalier Treaty of 1860

Anglo-French trade agreement

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- Removed trade barriers

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  (French producers against free-trade with UK)

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  - Power use: steam vs old powers (water wind and animal)
  - Sub-industry level data
  - Other such as info as employment and wages
  - 373 districts *(arrondissements)*
  - 82 sub-industries from 16 macro-sectors (textile, iron, chemical etc)

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- Sample restriction (exclusion of)
  - State-owned (0.3%)
  - Only one time period (50%)
  - No power (38%)
    Note: robustness checks!

An example

Outcome variable: innovation

$$Steam\ intensity_{it}\ (outcome) = \frac{steam_{it}}{(steam_{it} + water_{it} + wind_{it} + animal_{it})} \quad (1)$$

- i=1,..1313 where i=sub-sector x district
- t=1843,1863

Defining trade liberalization: treatment

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- The text of the Cobden-Chevalier Treaty
  - Tariff duties
  - Prohibited products
- I matched industrial and (product) tariff data
  - 58 out of 82 sub-sectors involved

$$Treatment(explained): tariff\ \ reduction\ \ or\ \ prohibition\ lifted, yes/no$$

Outline

Strategy

- *Diff-in-diff* approach
- Sample: 1313 local-sub-industries observed both time periods
- Period: 1843 (pre-Treaty) and 1863 (post-Treaty)
- Outcome: steam intensity
- Treatment: trade liberalization (tariff reduction or lifting prohibition) yes/no

Outline

Analysis

(i) Pre-Treaty differences

(ii) Baseline results

(iii) Pseudo-pre-trends and post-trends

(iv) Alternative outcome

(v) Robustness checks (appendix)

- Alternative treatments
- Propensity score matching

(i) Was the Treaty biased?

Table: Differences in mean between Treated and Controls in 1843 (*pre-Treaty*) by sub-sectors

	Mean		
Pre-treatment variables	Treated	Control	$p > \|t\|$
Steam intensity	0.29	0.37	0.273
Steam machines	30.35	30.5	0.990
Total workers	16812	9201	0.205
Male workers	10285	7209	0.440
Male wage	214	208	0.588
Value of production	46	61	0.653
Distance from waterways	7.02	7.011	0.859
Distance from customs	80.18	87.54	0.357
Coal price	3.23	3.19	0.723

The table includes all the data from the Industrial census of 1843 aggregated by industrial sub-sectors. Geographical variables are calculated as the mean.

(ii) Baseline result: graphically

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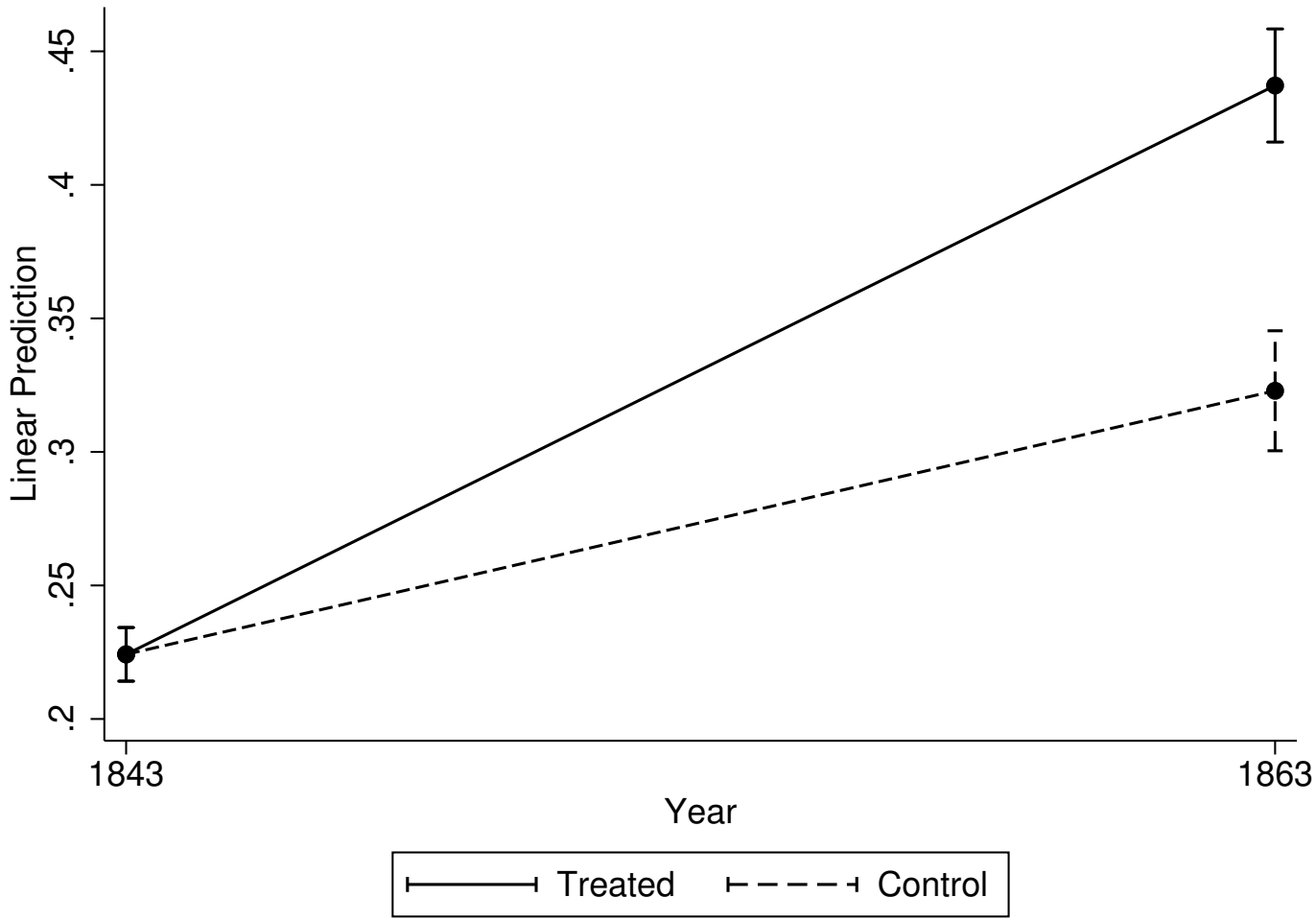
Figure: Steam intensity pre and post-trade liberalization



(ii) Baseline results

Table: The role of trade liberalization on innovation: baseline

	Steam intensity							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Trade liberalization	0.114***	0.114***	0.114***	0.108***	0.109***	0.112***	0.114***	0.106***
	(0.012)	(0.021)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.021)
Male wage in 1843		0.005						-0.023
		(0.029)						(0.032)
Coal price in 1843			-0.030					-0.019
			(0.025)					(0.024)
Railway y/n in 1860				0.083***				0.077***
				(0.021)				(0.022)
Machine sector in the district y/n in 1843					0.117†			0.106
					(0.072)			(0.074)
Distance from customs						-0.009		-0.004
						(0.007)		(0.009)
Distance from waterways							0.003	0.005
							(0.009)	(0.009)
r2	0.181	0.181	0.182	0.190	0.183	0.183	0.181	0.192
N	2626	2626	2626	2626	2626	2626	2626	2626

† p<0.15, * p<0.10, ** p<0.05, *** p<0.010. Clustered standard errors in parentheses.

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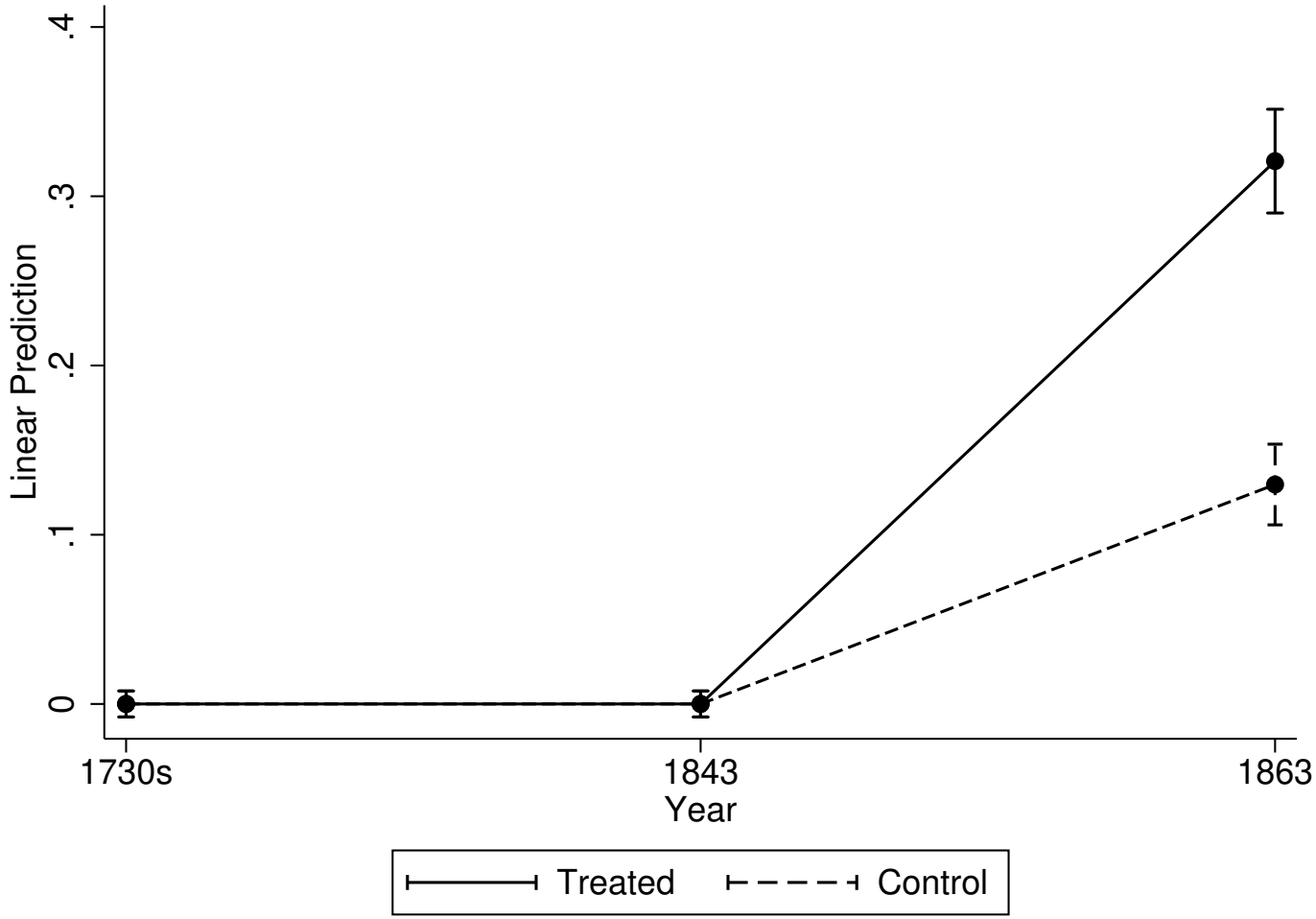
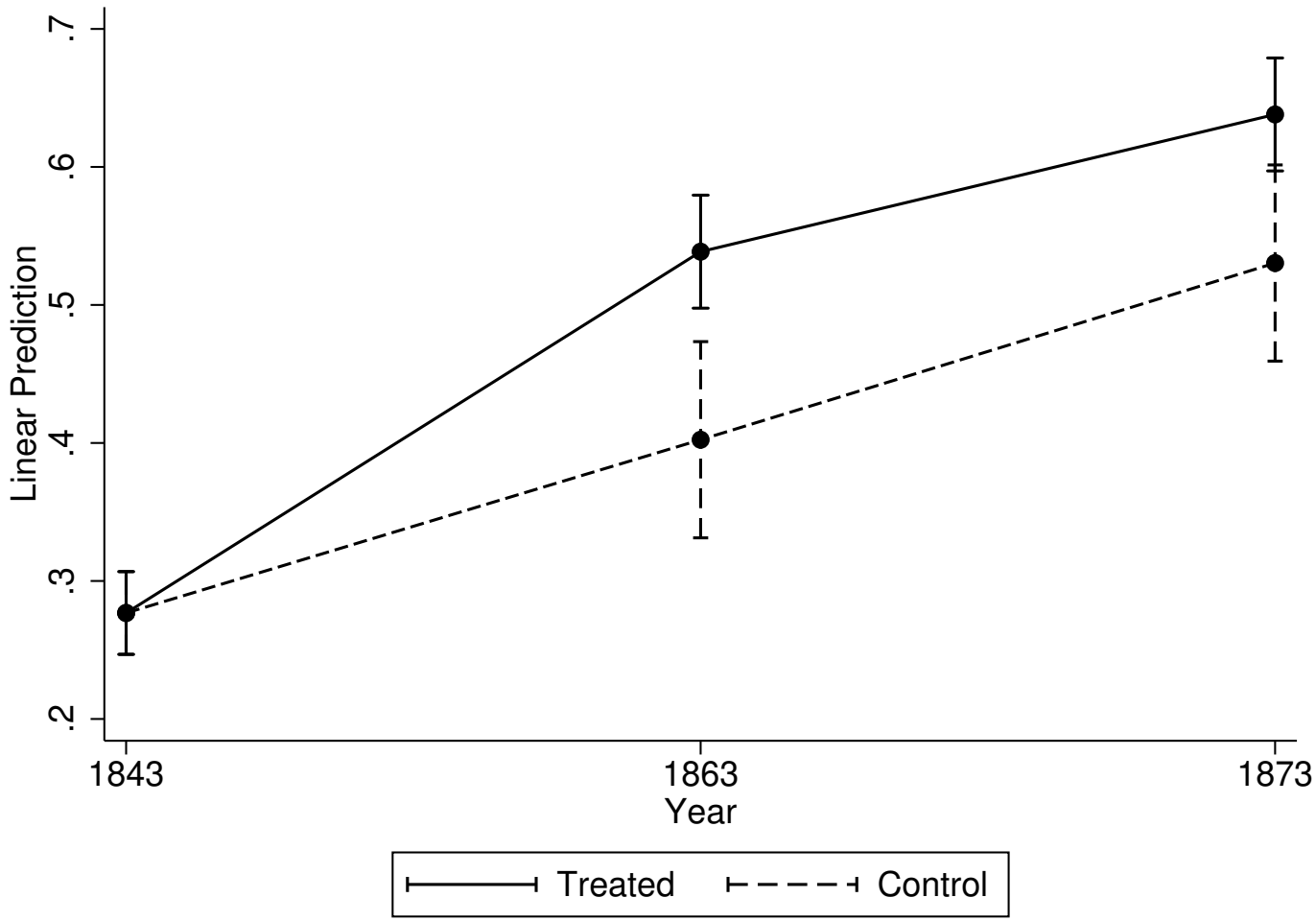
(iii) *Pseudo* pre-trends

Figure: Steam intensity pre and post-trade liberalization: no-steam in 1843



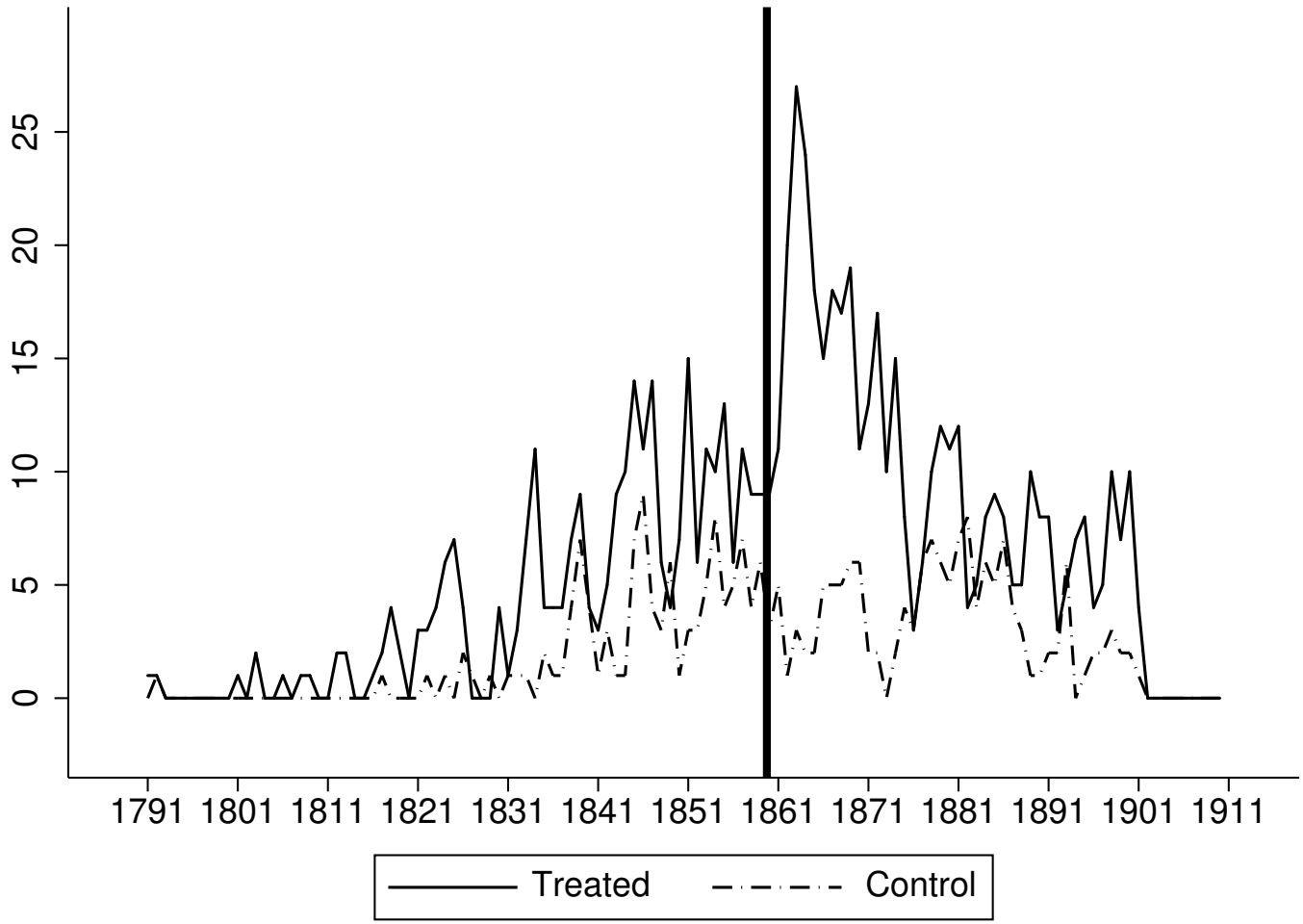
(iii) Post-trends

Figure: Steam intensity pre and post-trade liberalization: two post periods



(iv) Alternative outcome: Patents

Figure: N of patents in cotton (Treated) and flour mills (Control) 1791-1910



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The mechanism

- Producers *increase (fast)* the use of new technology
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- Railways
- Closeness to London

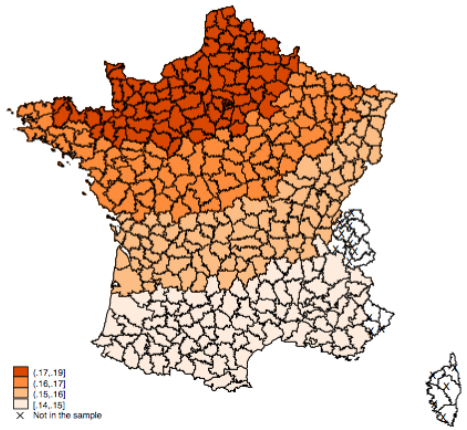

Table: Trade liberalization interacted with exposition to trade

	Steam intensity			
	(1)	(2)	(3)	(4)
Effect × railways (yes)	0.087***	0.075**		
	(0.032)	(0.033)		
Effect × closeness to London			1.786*	1.444†
			(0.919)	(1.006)
			*0.068**	*0.055†*
Effect	0.051*	0.054*	-0.670*	-0.527
	(0.030)	(0.030)	(0.404)	(0.441)
Controls	no	yes	no	yes
r2	0.187	0.189	0.184	0.194
N	2626	2626	2626	2626

† p<0.15, * p<0.10, ** p<0.05, *** p<0.010. Clustered standard errors in parentheses.

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  - *Probably* response to increased *foreign competition*
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  - Key to the contrasting: outcome?

- Differently from Juhász (2018) that focuses on *infant* cotton industries, my work consider a wider industrial landscape
  - Complementary: after temporary protection, trade liberalization is needed to boost innovation

Thank you!

carla.salvo@uniroma1.it

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Restricted sample

Table: The role of trade liberalization on innovation matched and restricted sample by *pre* intensity

	Steam intensity							
	Matched sample		*pre* intensity =0		*pre* intensity >0		0 <*pre* intensity <1	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Trade liberalization	0.102***	0.100***	0.191***	0.153***	0.065*	0.075*	0.116***	0.105**
	(0.026)	(0.026)	(0.023)	(0.022)	(0.038)	(0.039)	(0.042)	(0.044)
Male wage in 1843		-0.042		0.077***		-0.099*		0.045
		(0.037)		(0.030)		(0.059)		(0.090)
Coal price in 1843		-0.022		-0.093***		0.025		0.015
		(0.030)		(0.029)		(0.041)		(0.043)
Railway y/n in 1860		0.051**		0.105***		0.064		0.038
		(0.026)		(0.022)		(0.052)		(0.052)
Machine sector in the district in 1843		0.114†		0.464***		0.055		0.014
		(0.075)		(0.095)		(0.064)		(0.085)
Distance from customs		-0.013†		-0.044***		0.0045		0.003
		(0.008)		(0.009)		(0.009)		(0.010)
Distance from waterways		0.006		-0.002		0.017		0.023
		(0.010)		(0.009)		(0.017)		(0.020)
r2	0.180	0.191	0.353	0.435	0.031	0.042	0.261	0.266
N	2142	2142	1622	1622	1004	1004	664	664

† p<0.15, * p<0.10, ** p<0.05, *** p<0.010. Clustered standard errors in parentheses.

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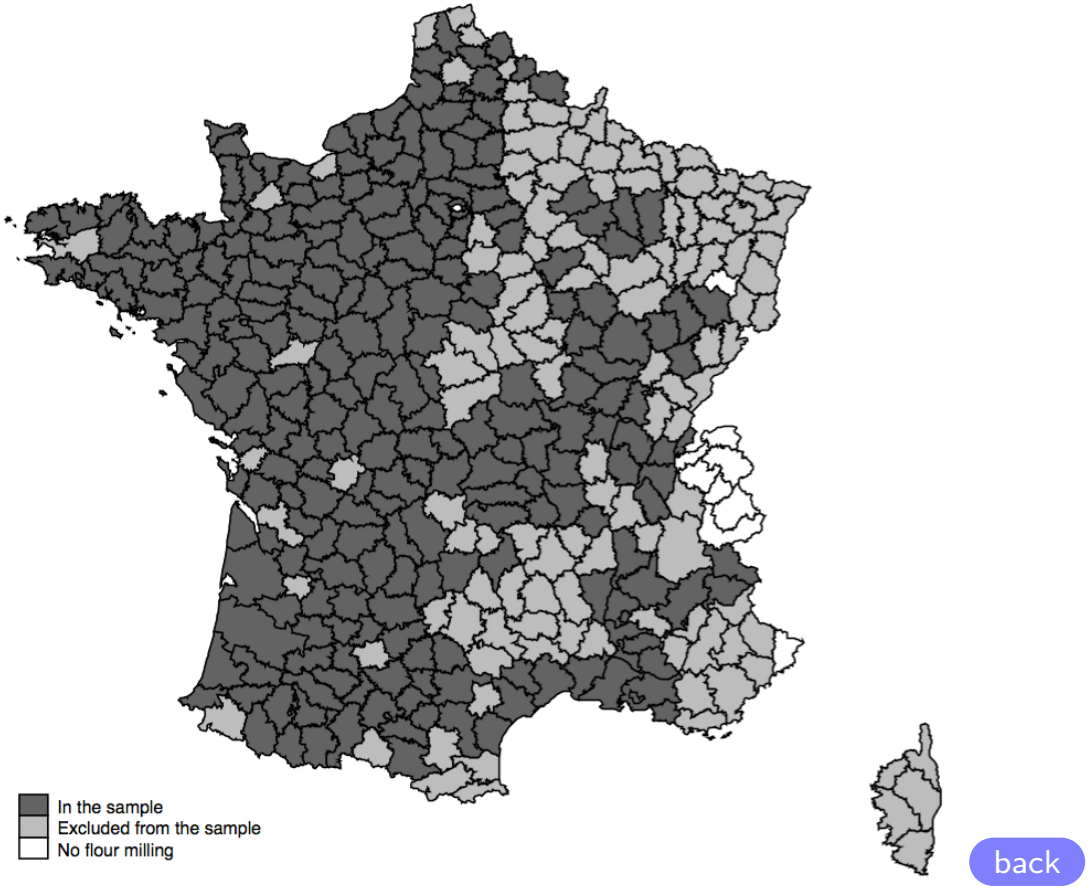
Alternative treatment

Table: The role of trade liberalization on innovation: *alternative* treatment

	Steam intensity				Only textile	
	(1)	(2)	(3)	(4)	(5)	(6)
Prohibited y/n	0.122***	0.111***				
	(0.021)	(0.022)				
Tariff reduction			0.139***	0.127***	0.257**	0.264**
			(0.025)	(0.026)	(0.124)	(0.122)
			*0.126****	*0.115****	*0.281***	*0.288****
Male wage in 1843		-0.006		-0.005		0.077**
		(0.031)		(0.032)		(0.034)
Coal price in 1843		-0.025		-0.014		-0.013
		(0.026)		(0.025)		(0.038)
Railway y/n in 1860		0.080***		0.075***		0.089**
		(0.022)		(0.022)		(0.042)
Machine sector in the district in 1843		0.090		0.109†		0
		(0.076)		(0.075)		(.)
Distance from customs		-0.007		-0.005		0.0221
		(0.007)		(0.007)		(0.016)
Distance from waterways		0.006		0.007		-0.029*
		(0.009)		(0.009)		(0.017)
r2	0.187	0.201	0.180	0.192	0.224	0.258
N	2314	2314	2529	2529	534	534

† p<0.15, * p<0.10, ** p<0.05, *** p<0.010. Clustered standard errors in parentheses.

Figure: An example of local-sub-industry: flour milling



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