Labor Services at Will

Regulation of Dismissal and Investment in Industrial Robots

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Cross-country Differences in Automation - Why?

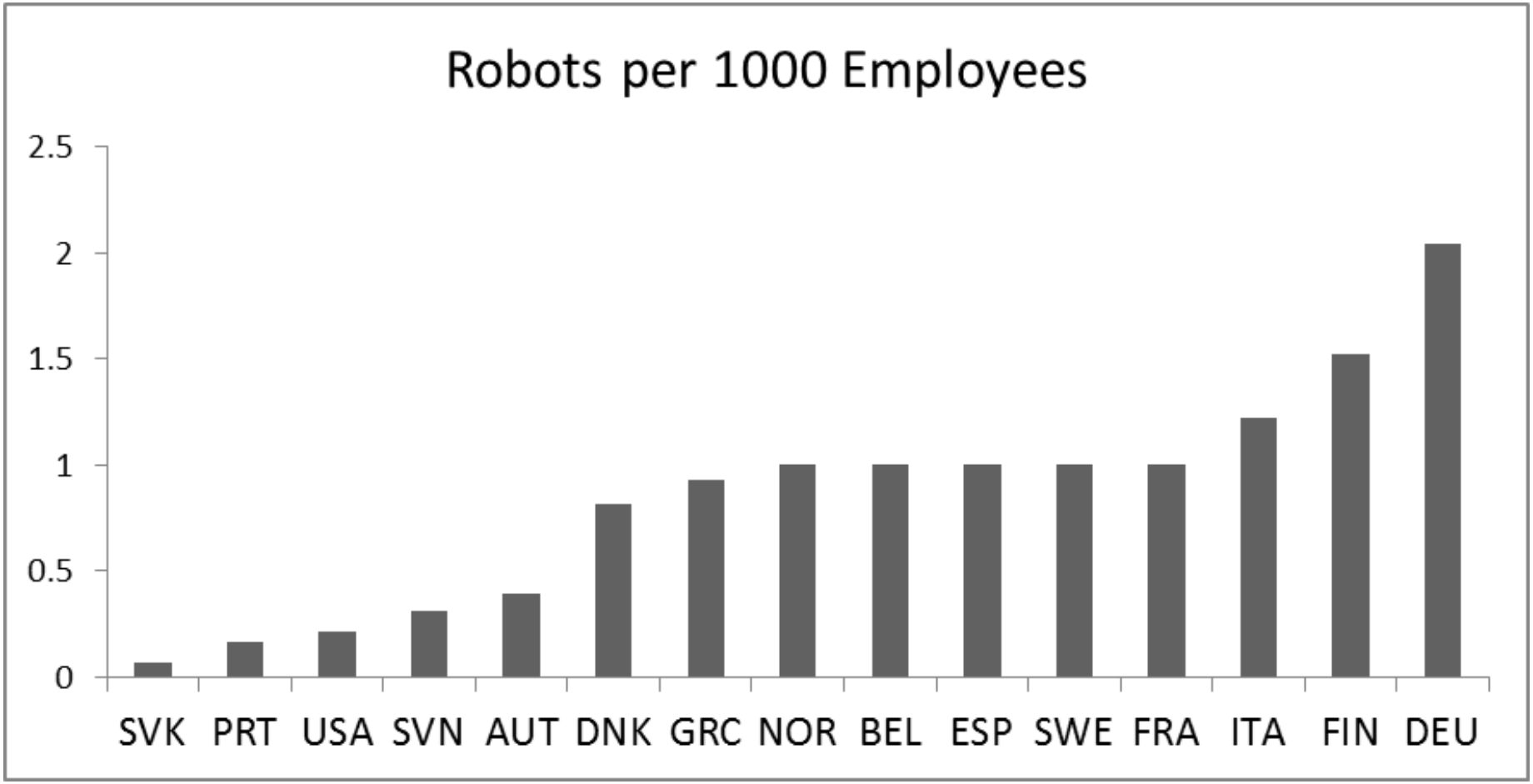


Figure: Median sector values. Average 1993-2013. Source: International Federation of Robotics.

Can Regulation of Dismissal (EPL) Explain Differences in Automation?

Frictionless markets (employment "at will")

- Hire/fire to meet demand
- Optimal capacity

Impact of EPL

- Hiring/firing restrictions create adjustment costs
- Firms too small in booms, too large in slumps
- Inefficiency

Use of industrial robots not subject to regulation

- Substitute technology
- Flexible output rate (24/7, shut down)

Hypothesis

EPL increases profitability of automation relative to labor *especially in volatile sectors*

Differences in Regulation of Dismissal

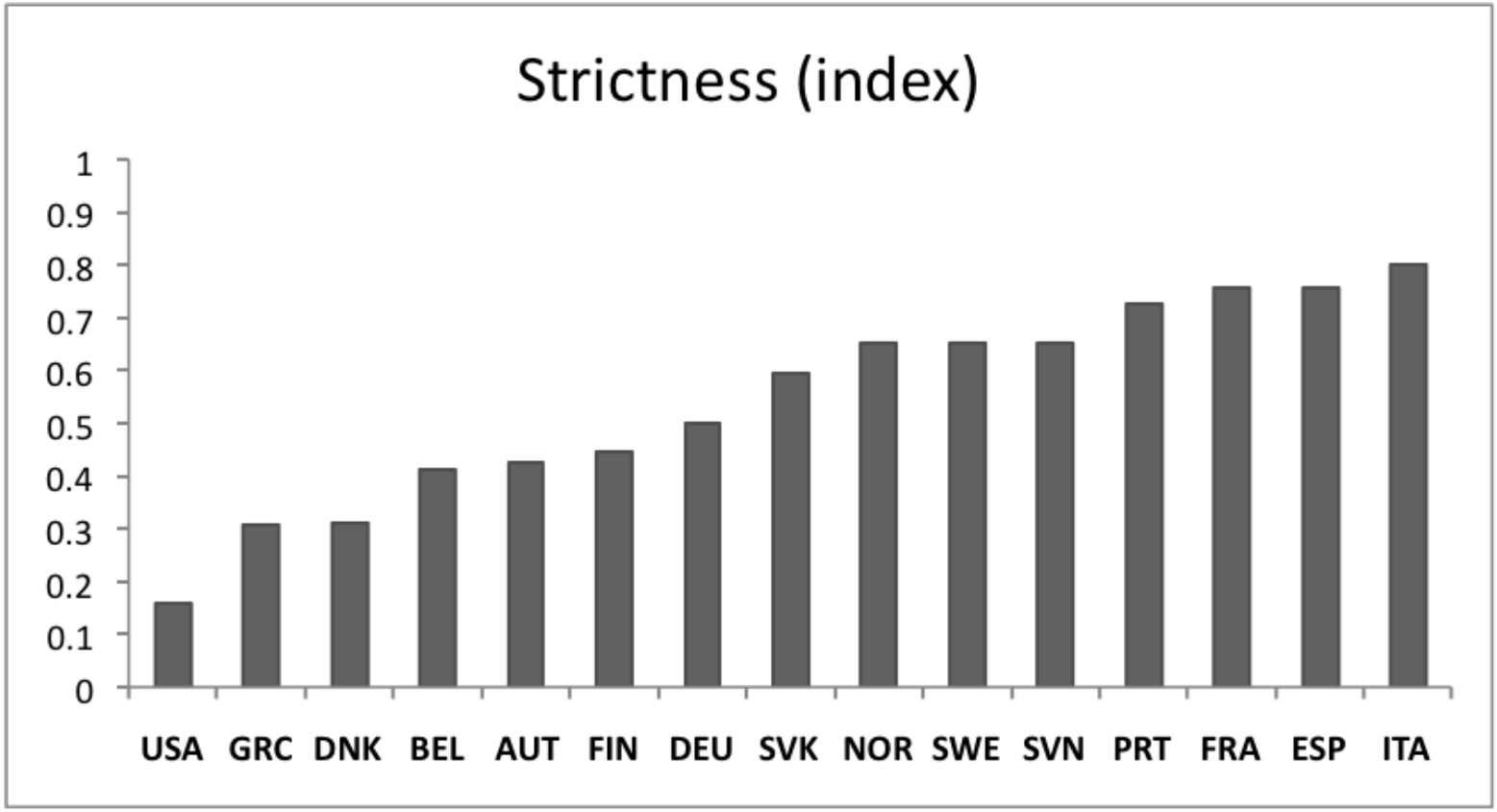
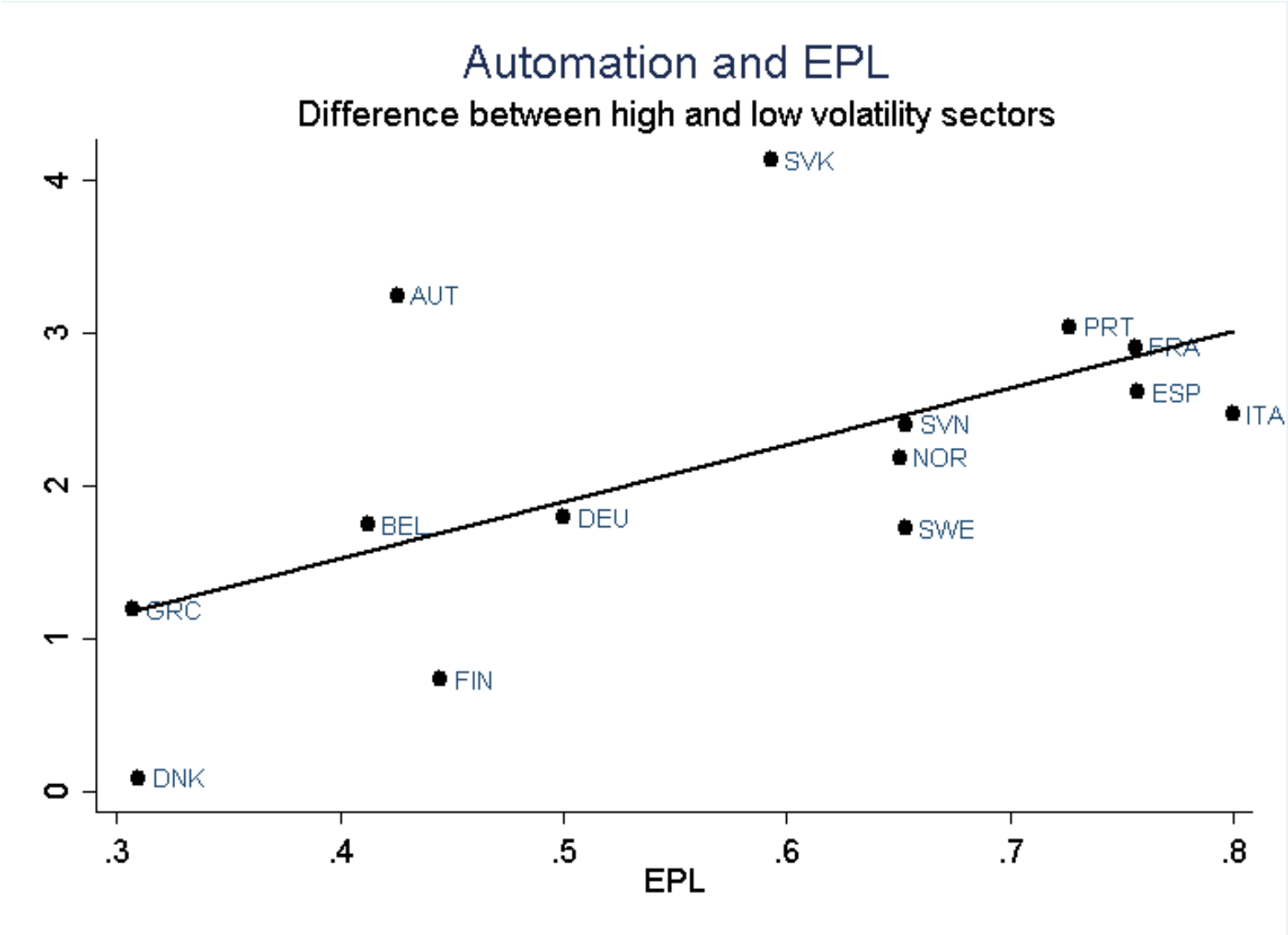


Figure: Average 1993-2013. Source: International Labour Organization.

- USA: no unjust dismissal legislation; no redundancy compensation
- ITALY: need a *valid* reason; reinstatement remedy for unfair dismissal; redundancy compensation (TFR) 10.6 weeks salary

Volatile Sectors are Disproportionately Automated in Strict EPL Countries



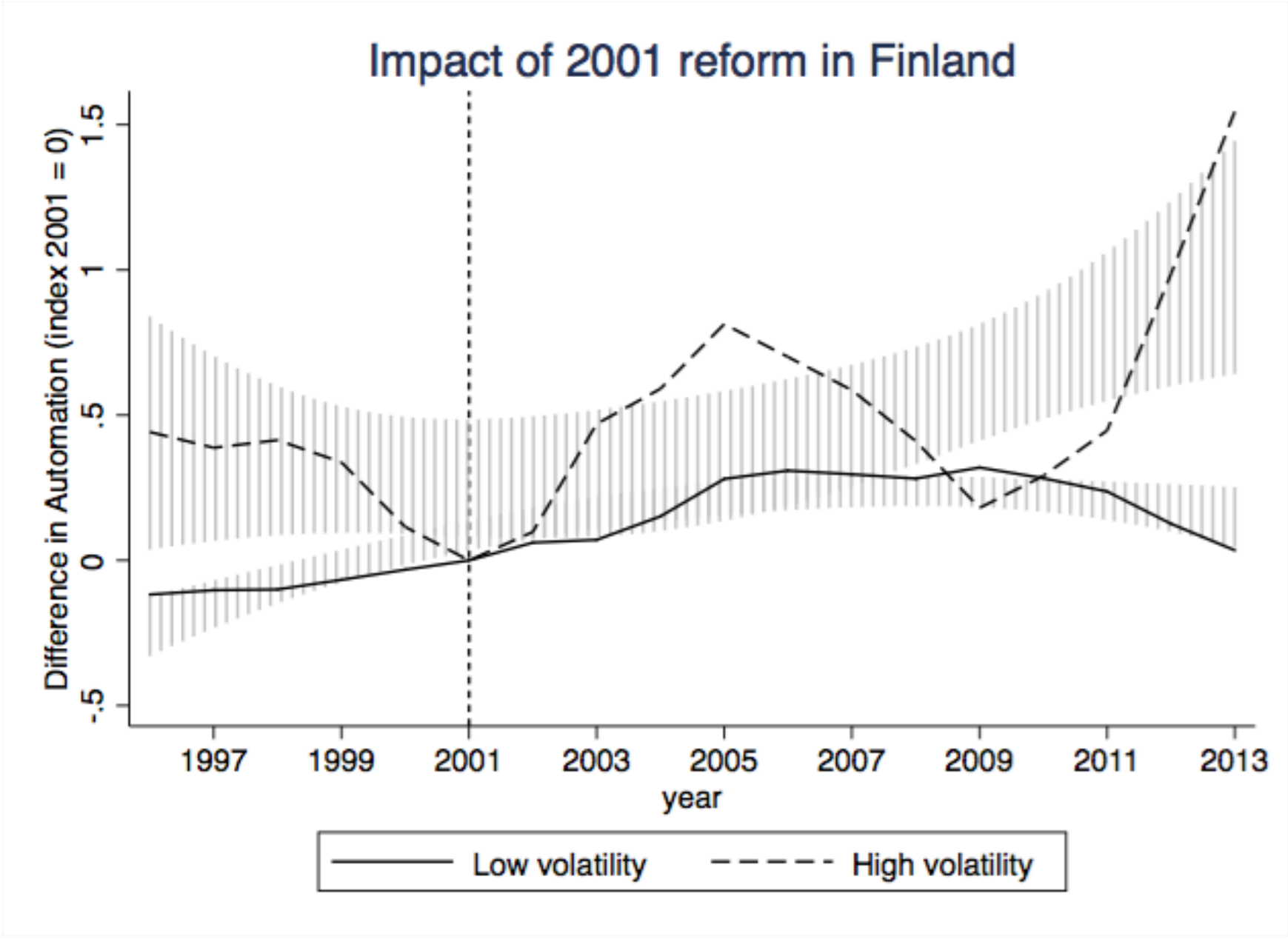
Empirical Specification (Structural)

$$\delta_{cst} = \beta_0 + \beta_1 (EPL_{ct} \times \sigma_s) + \beta_2 \tilde{w}_{cst} + \boldsymbol{B}\boldsymbol{X}_{cst} + \epsilon_{cst}$$

- δ_{cst} robots per employee
- EPL_{ct} strictness of dismissal regulation
- σ_s sectoral uncertainty
- $\tilde{w}_{cst}$ relative price of labor
- $\boldsymbol{X}$ includes country and sector FE, year dummies, interactions

- Panel 14 countries, 18 manufacturing and non-manufacturing sectors, 1993-2013
- Identification: automation in reformed countries (treatment), vis-a-vis countries where EPL did not change (control)

Identification Strategy: Visual Diff-in-diff



Data

Dependent variable:

- Shipment of industrial robots (IFR, 2016)
- Number of employees (OECD-STAN)

Main explanatory variable:

- Strictness of dismissal regulation (ILO, 2015)

  example
- Output growth - time series volatility / cross sectional dispersion

  on uncertainty correlation

Controls:

- Relative prices
- Human capital/institutions
- Routine intensity
- Global shocks

Baseline Results

robustness

$$\delta_{cst} = \beta_0 + \beta_1 (EPL_{ct} \times \sigma_s) + \beta_2 \tilde{w}_{cst} + \boldsymbol{B}\boldsymbol{X}_{cst} + \epsilon_{cst}$$

	Proxy of uncertainty	
Robot-density	std. dev. forecast error	std. dev. cross-section
EPL $\times$ Uncertainty	34.8***	32.3***
	(4.06)	(4.94)
Relative price labor	1.4***	0.9***
	(0.11)	(0.13)
Country, sector, year FE + interactions	yes	yes
Observations	4,581	3,291
R^2	0.63	0.71

Drivers of Automation

R^2 contribution of:

- Dismissal regulation 1 - 12%
- Institutional system affects automation

- Cost of labor 1 - 10%
- Sector-specific trends 30%
- Country-specific trends 20%

- Country-specific trends: e.g. endowments, complementary factors (skilled/unskilled labor), institutional developments
- Sector-specific trends: e.g. production volumes, standardisation

Drivers of Automation

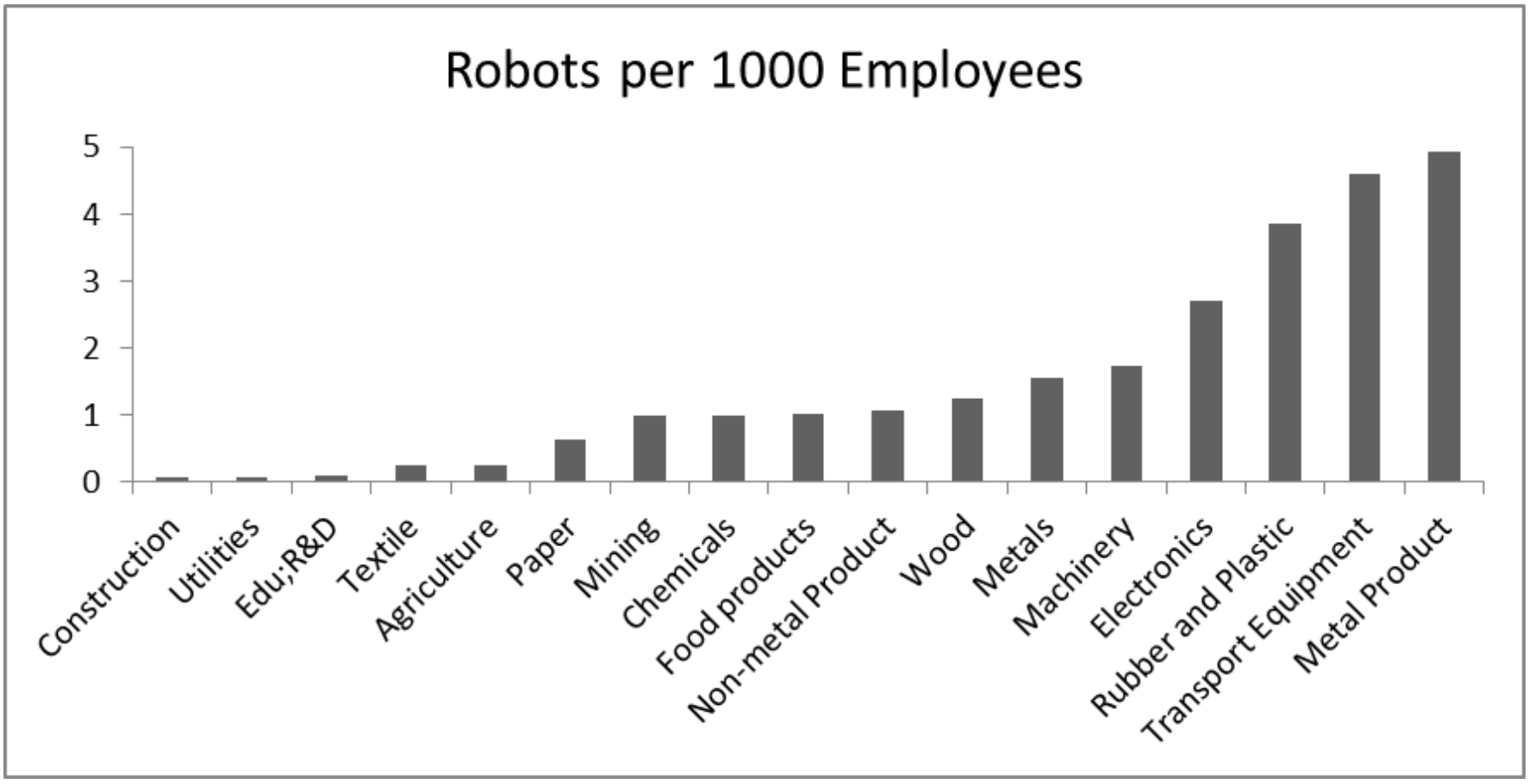


Figure: Median country values. Average 1993-2013. Source: International Federation of Robotics.

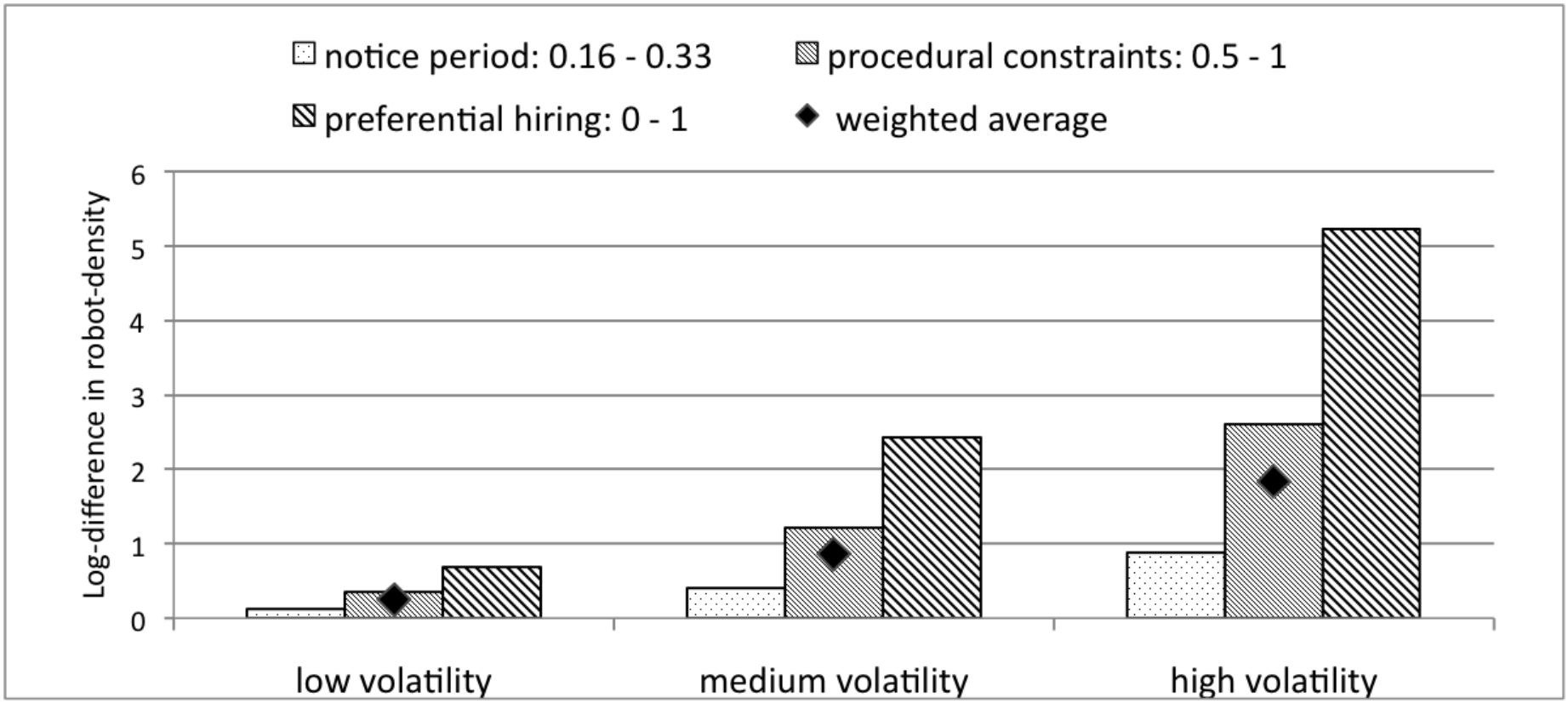
Marginal Effect of Dismissal Regulation

- 10% increase EPL index: +50% robot-density
- 10% increase cost of labor: +25% robot-density

- Counterfactual: relaxing regulation in ITA to US-level? $\Rightarrow$ -60% robot-density

Within-country Variation

Simulated impact of 2001 Finland's Reform by policy measure



Conclusions

- EPL contributes explaining differences in automation
- Adjustment costs due to EPL increase the profitability of automation over labor
- Much still to be explored...

Institutional system affects demand for automation

- Labor market policy to achieve automation outcomes? ($\sim$ environment tax)
- Is EPL welfare enhancing? (general equilibrium)

Robustness

back to results

IV estimates

Clustered errors

IV-EPL slopes

OECD-EPL indicators

Endogeneity of σ_{cs}

- σ_{cs} proxy of sectoral uncertainty
- EPL affects sectoral volatility/dispersion $\Rightarrow$ endogenous interaction term

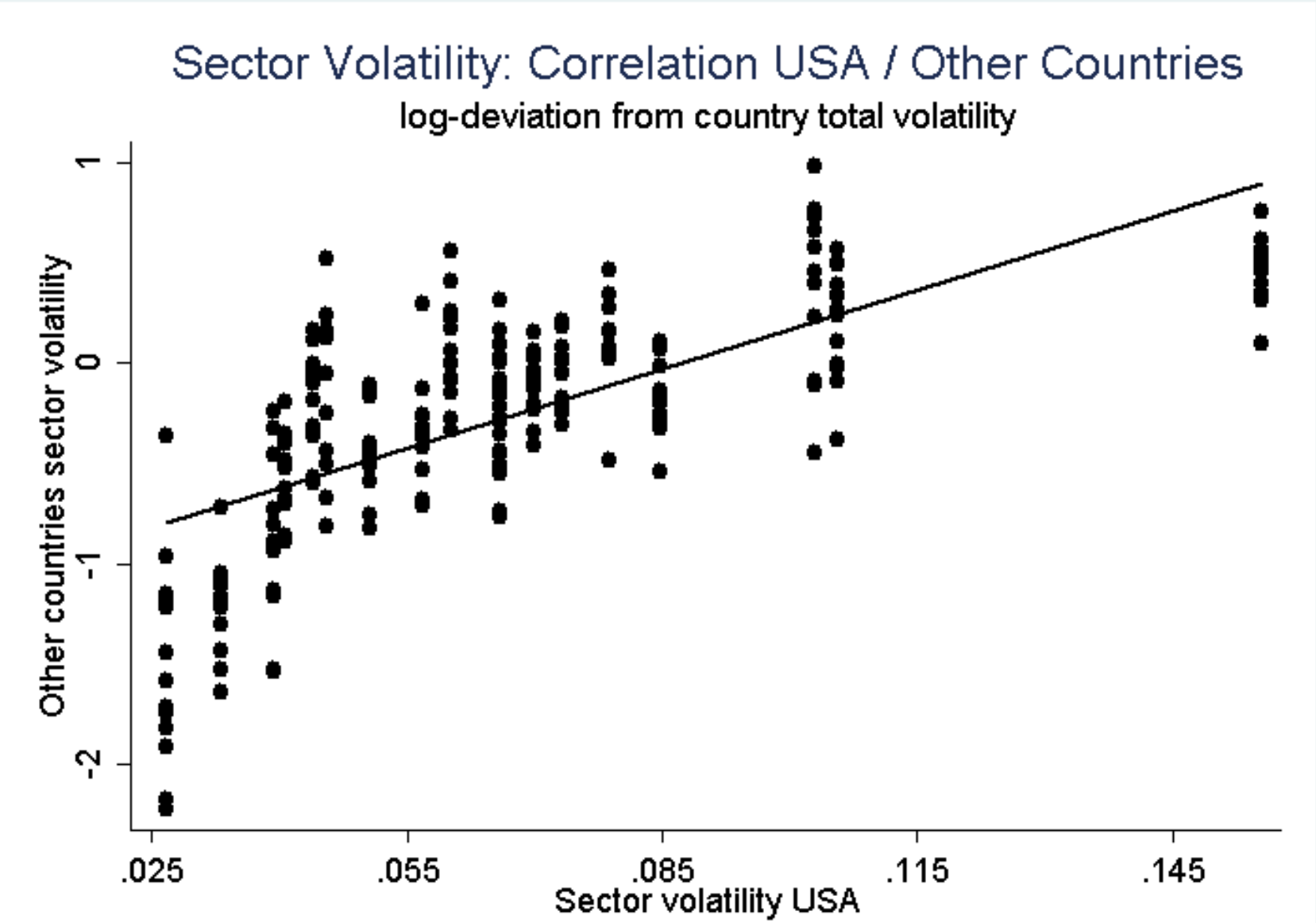
Rajan and Zingales (1998):

- Pick least regulated country (USA)
- Compute proxy of sectoral uncertainty (technology/structural market factors)
- E.g. durable/non-durable; rate of scientific discovery; cost of inputs

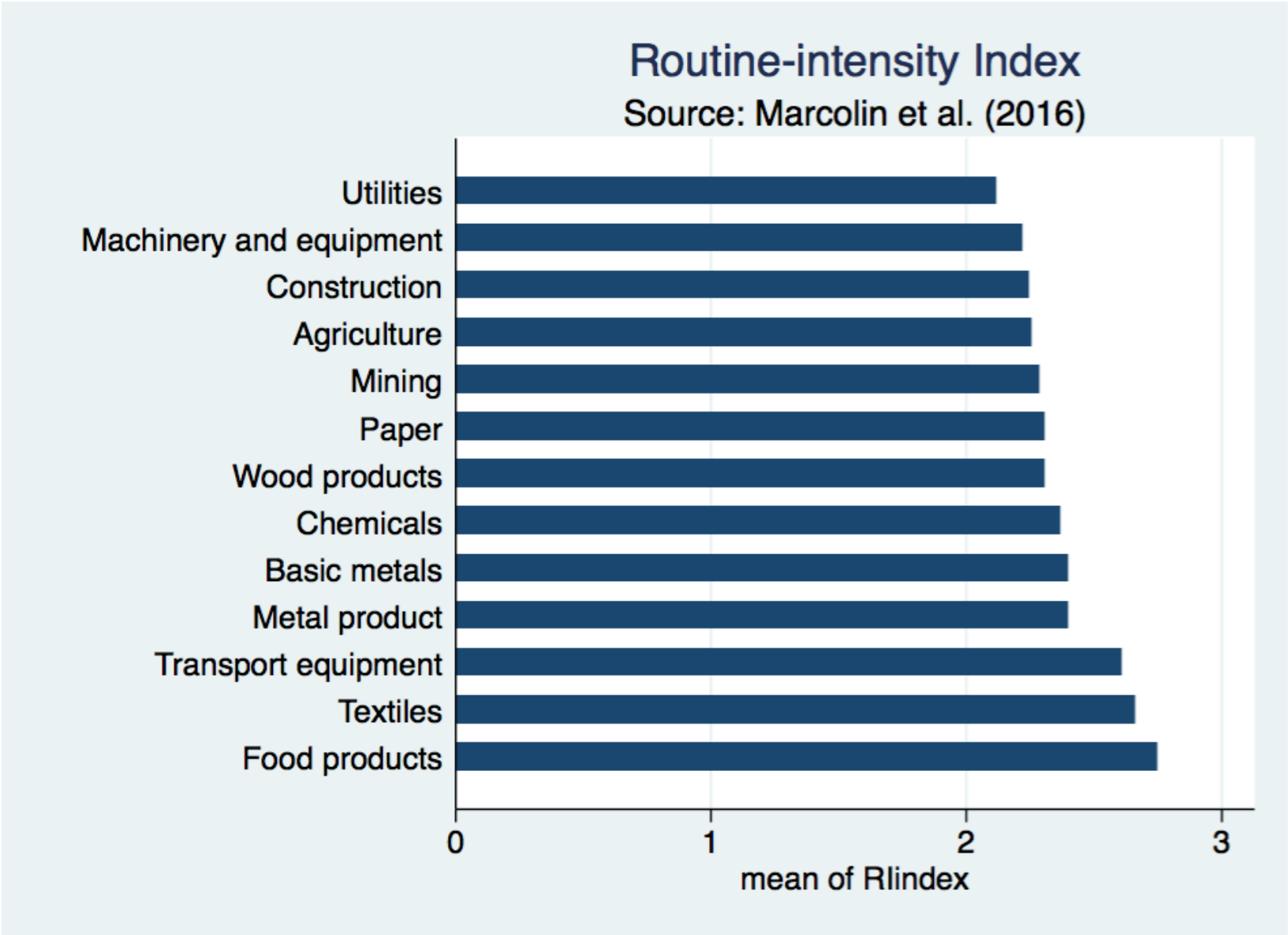
Structural factors $\rightarrow$ uncertainty ranking carries over to other countries

Is USA Sectoral Uncertainty a Good Proxy?

regression | USA sector volatility



Routine Intensity Index from Marcolin et al.



Routine Intensity Index vs Sector FE

Endogeneity of Sectorial Wages

- Routine-intensive sectors easiest to automate (Autor, Levy, and Murnane, 2003)
- Tight regulation increases labor cost
- High substitutability $\rightarrow$ wages fall more in routine-intensive sectors

$$w_{cst}^{iv} = BARGAIN_{ct} \times Routine_{s}$$

- Strength of employees representation (ILO, 2015)
- Routine-intensity index (Marcolin et al. 2016); Sector FE

Results - IV

back

$$\delta_{cst} = \beta_0 + \beta_1 (EPL_{ct} \times \sigma_s) + \beta_2 \tilde{w}_{cst} + + \boldsymbol{BX}_{cst} + \epsilon_{cst}$$

	2SLS; w = routine index $\times$ BARGAIN	
Robot-density	std. dev. forecast error	std. dev. cross-section
EPL $\times$ Uncertainty	35.2***	90.3***
	(4.95)	(10.48)
Relative price labor	1.3***	0.5**
	(0.32)	(0.27)
Country, sector, year FE + interactions	yes	yes
Observations	3,333	2,301

First Stage Estimation

	std. dev. time series	std. dev. cross-section
VARIABLES	sector wage	sector wage
REPRESENT × Routine	-0.685***	-0.760***
	(0.136)	(0.124)
EPL × Uncertainty	1.450***	10.21***
	(0.560)	(1.149)
Constant	-0.872***	-0.757***
	(0.214)	(0.205)
Observations	3,333	2,301
R-squared	0.984	0.991

Clustered Errors - IV

	2SLS; w = routine index $\times$ BARGAIN	
Robot-density	std. dev. forecast error	std. dev. cross-section
EPL $\times$ Uncertainty	35.27**	90.31**
	(16.08)	(38.82)
Relative price labor	1.354***	0.554
	(0.483)	(0.380)
EPL	13.29***	-5.771
	(1.135)	(3.815)
Country, sector, year FE + interactions	yes	yes
Clustered errors (country level)	yes	yes
Observations	3,333	2,301

Clustered Errors - Benchmark back

Robot-density	Proxy of uncertainty: std. dev. forecast error	Proxy of uncertainty: std. dev. cross-section
EPL × Uncertainty	34.83***	32.34**
	(12.50)	(14.76)
Relative price labor	1.337**	0.867**
	(0.535)	(0.432)
EPL	9.938***	-2.322
	(1.488)	(1.661)
Country, sector, year FE + interactions	yes	yes
Clustered errors (country level)	yes	yes
Observations	4,581	3,291

Ciccone - Papaioannou Instrument

back

	Robot-density
VARIABLES	std. dev. forecast error
EPL × Uncertainty	108.2***
	(7.204)
Relative price labor	1.291***
	(0.113)
Country, sector, year FE + interactions	yes
Observations	4,581

OECD Regulatory Indicators back

Robot-density	Proxy of uncertainty: std. dev. forecast error	Proxy of uncertainty: std. dev. cross-section
EPL × Uncertainty	8.243***	6.884***
	(1.207)	(1.457)
Relative price labor	1.342***	-
	(0.11)	-
Country, sector, year FE + interactions	yes	yes
Observations	4,437	3,187

Sectoral Factor Demand back

Sector demand for robots

- $\rho(i) \equiv \rho(1+i)$

$$R(s) = \ln(1+i^*)\rho^{-1} \exp\left\{\frac{\epsilon-1}{2}\sigma(s)^2\right\}$$

Sector demand for labor

$$N(s) = (1-i^*)w^{-1} \exp\left\{-(1-f)\frac{\sigma(s)^2}{2}\right\}$$

- Volatility increases demand for robots, decreases demand for labor

Coding of Labor Laws (Deakin, 2015) back to data

VARIABLE	EXPLANATION	CODING
Legally mandated notice period (all dismissals)	Length of notice in weeks to be given to an employee with more than 3 years service	0 weeks=0, 12 weeks=1
Legally mandated redundancy compensation	Amount payable to a worker made redundant after more than 3 years service	0 weeks of pay=0, 12 weeks of pay=1
Minimum qualifying period of service for normal case of unjust dismissal	Period of service after which an employee qualifies for unjust dismissal	3 years or more=0, 0 months=1
Law imposes procedural constraints on dismissal		Equals 1 if dismissal is necessarily unjust if the employer fails to follow procedural requirements, equals 0.67 if failure to follow procedure will normally lead to unjust dismissal, equals 0.33 if becomes just one factor to examine, equals 0 if there are no procedural requirements for dismissal
Law imposes substantive constraints on dismissal		Equals 1 if dismissal ionly permissible for serious misconduct, equals 0.67 if there are several legittimate reasons, equals 0.33 if dismissal is permissible if it is just “fair” or “just” as defined by case law, equals 0 if employment is at will
...	...	...

- Scope for further gradiation between 0 and 1 reflects changes in the strenght of the law
- There are 9 DISMISSAL sub-indicators

▸ Link

Is US Volatility a Good Proxy for Structural Uncertainty?

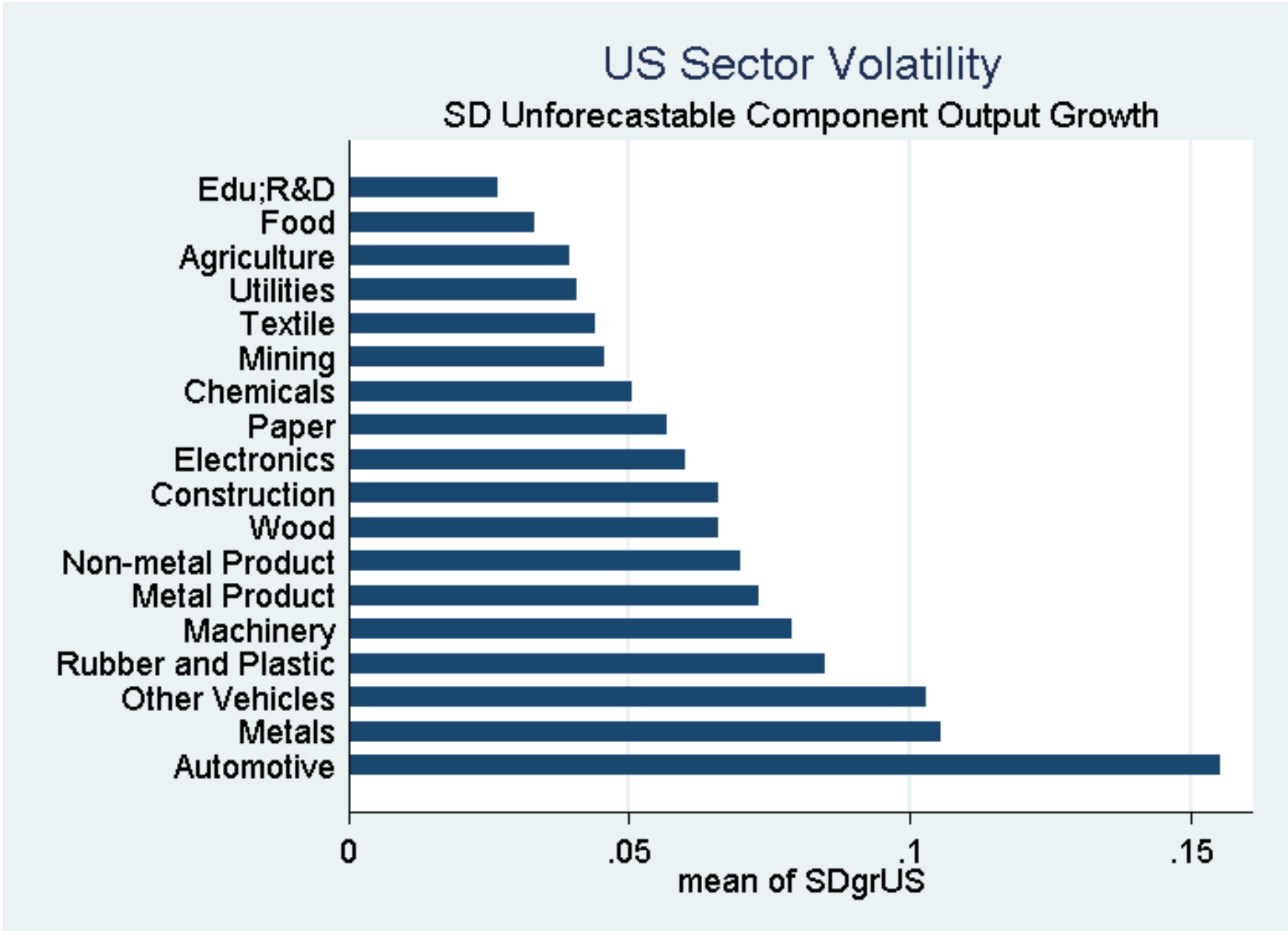
back

$$\sigma_{cs} = \beta_0 + \beta_1 \sigma_s^{us} + u_c + \epsilon_{cs}$$

VARIABLES	(1) Sectorial volatility
σ_s^{us}	0.83*** (0.118)
Country FE	yes
Observations	211
R-squared	0.332

US Sector Volatility

back



Proxies of Uncertainty back to data

Bloom (2009) and Bloom et al (2012):

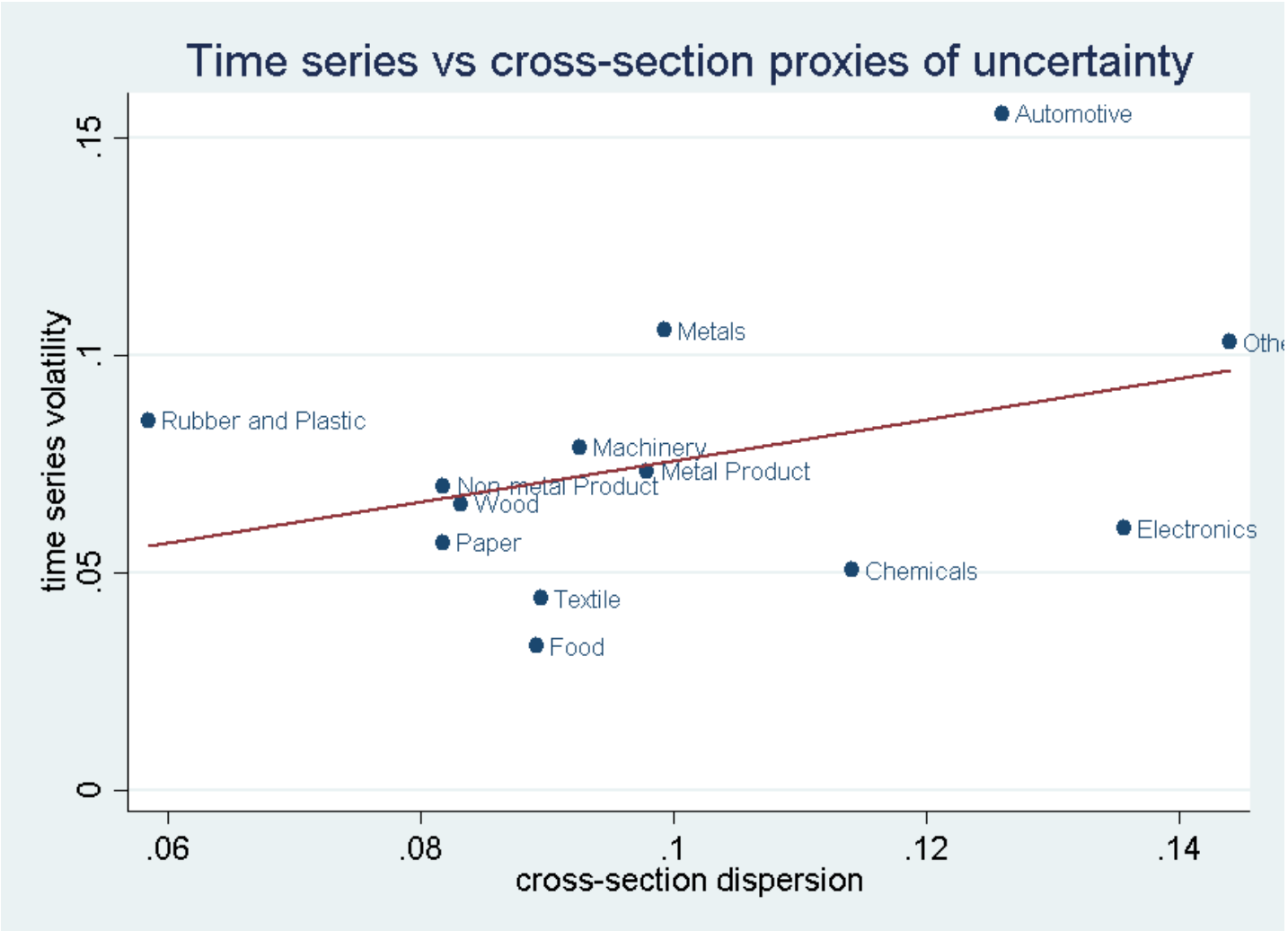
- dispersion/volatility as proxies of uncertainty
- cross-section dispersion drives time series volatility
- e.g. cross-section dispersion growth rates and stock market volatility

This paper:

1. Standard deviation residuals output forecasts

$$g_t^y = \mu + \rho g_{t-1}^y + secFE + \epsilon_t$$

2. Standard deviation cross-section output growth 6-digits manufacturing industries


Time series vs cross-section proxies of uncertainty
time series volatility
0
.05
.1
.15
cross-section dispersion
.06
.08
.1
.12
.14
Automotive
Metals
Rubber and Plastic
Machinery
Metal Product
Non-metal Product
Wood
Paper
Electronics
Chemicals
Textile
Food