

# The impact of workplace conditions on firm performance

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# Outline

- Introduction
- Determinants of good work environment
- Work environment and firm performance
- Summary/Conclusions

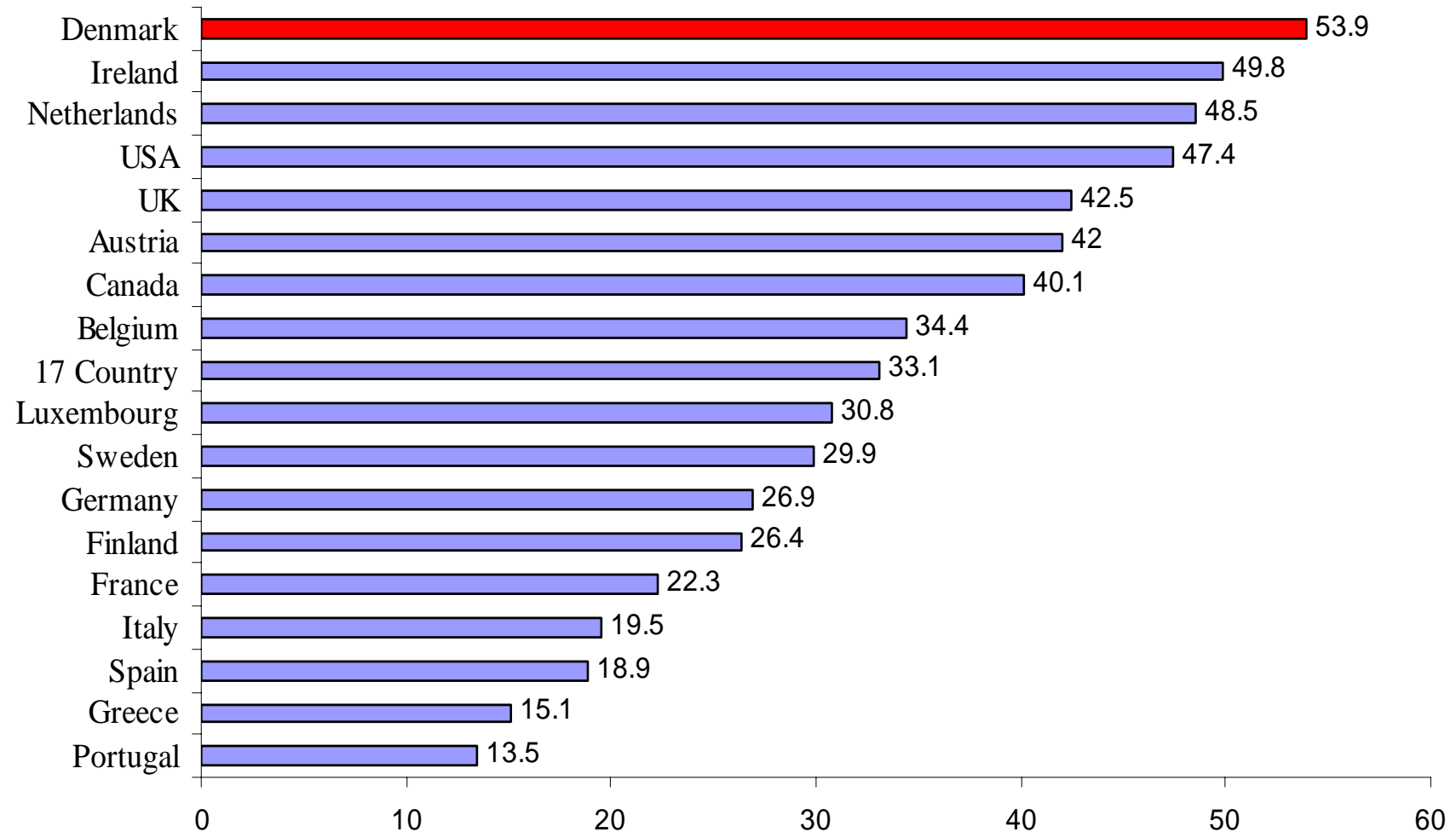
# Scope of this study

- Determinants of good work environment and work environment practice:
  - What differentiates the firms that have a good work environment from those that do not?
- Impact of work environment on firm performance
  - What is the relative contribution of good work environment practice to enhancing firm productivity and is there evidence of hazard premia w.r.t work conditions?

# Policy relevance

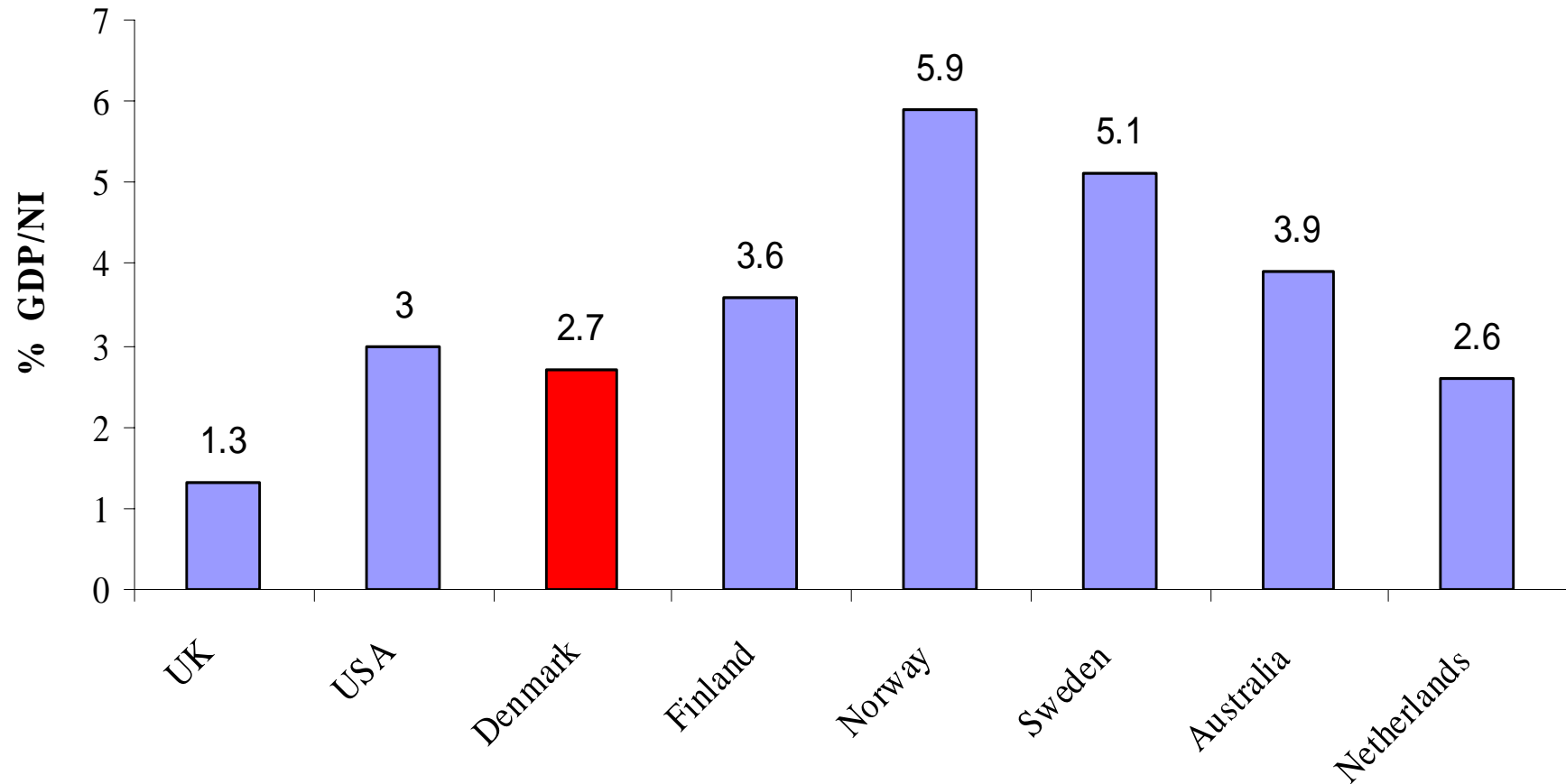
- European Summit Laeken (Dec 2001): adopted work environment indicators, included in the EU social policy agenda before; EU directives since 2002
- OHS concerns for years within the Danish Working Environment Authority and the Danish Ministry of Labour
- European Commission (June 2001):  
*“The evolution of job quality in the EU in recent years was generally positive, with the exception of working conditions which do not seem to have improved. Accidents at the workplace and occupational diseases remain a challenge to the EU economies, with direct and indirect costs due to work-related health risks and accidents at work estimated to amount to between 2.6% and 3.8% of GNP in the EU”*

## Percentage of workers that report being "very satisfied" with working conditions in their main paid job, by country



Source: Data for Europe taken from the *Third European Study on Working Conditions 2000* (ESWC), Canada and USA from *Ekos Rethinking North America Integration Survey* (ERNAIS) 2002

## Estimates of the aggregate economic cost of occupational injury and disease (%), by country



Source: Beatson and Coleman (1997) and for USA only Leight et al.(1996)

## Related literature

- *On the substance* (investigating work environment determinants and implications): **NONE**. Within Economics we are the first to tackle these questions.
- *On the methodology*: analogy with the organizational change/ information technology literature. Examples: **Osterman** (1994, 2000, ILRR), **Black and Lynch** (2001, ReStat; 2004, EJ), **Zwick** (2004, LabEc),)

# Data overview

## **Merging:**

- Company Surveillance Data 2001 (VOV)- the pivot dataset in the merger
- Integrated Labour Market Data (IDA)
- Business account statistics (REGNSKAB)

## **Unavoidable sample reduction during the merging:**

- initial VOV 2001: 1339 (followed after NAK) + 623 (drawn directly)=**1962 firms** (in fact, *establishments*) with 2 obs per firm, so 3924 obs in total
- step 1: matching identifier for VOV and IDA ("cvrnr")- we are able to find the cvrnr (via yet another dataset: KOB) for 849 out of the 1339 firms (but 66 from those cannot be found in IDA)
- step 2: out of the 1962 firms in VOV, we can match only 847 to REGNSKAB, and from these only 730 have reliable information on the data (values are imputed for the others);
- step 3: since we merge based on firm identifiers, our core analysis needs to be done only on single-plant firms. This leaves us with **572 firms** in VOV-IDA and **465 firms** in VOV-REGNSKAB.
- in the analysis we will have missing obs., hence even lower samples, as shown in the (many) following tables



Employee rep

Employer

GENWE	Type=1		Type=2		Total	
ALL PLANTS	N	%	N	%	N	%
very good	156	13.15	362	30.57	518	21.9
good	707	59.17	693	58.53	1400	59.1
not bad	286	24.16	123	10.39	409	17.3
poor	30	2.53	5	.42	35	1.5
very poor	5	.42	1	.08	6	.2
Total	1184		1184		2368	

GENWE	Type=1		Type=2		Total	
NR PLANTS=1	N	%	N	%	N	%
very good	64	14.35	84	18.83	148	16.6
good	274	61.43	304	68.1	578	64.8
not bad	95	21.3	56	12.56	151	16.9
poor	13	2.9	2	0.45	19	1.6
Total	446		446		892	

	allplants		nrplants=1	
	N	%	N	%
Agriculture, fishing, mining and quarrying	33	3.6	27	4.7
Manufacturing	546	59.7	357	62.4
Electricity, gas and water supply	1	0.1	1	0.2
Construction	59	6.5	47	8.2
Wholesale and retail trade	68	7.4	45	7.9
Hotels and restaurant	5	0.5	4	0.7
Transport, post and communication	45	4.9	32	5.6
Financial intermediation	17	1.9	6	1
Real Estate, renting and business activities	39	4.3	14	2.4
Public Administration and defense	46	5	4	0.7
Education	32	3.5	20	3.5
Health and social work	12	1.3	6	1
Other community, social and personal service activities	11	1.2	9	1.6
Total	914		572	

Table 1: Descriptive Statistics VOV, IDA and REGNSKAB 2001

variable	definition	mean	s.d.	N
VOV2001				
GENWE	work environment standard at the company is 5=VG,4=G, 3=NB, 2=B, 1=VB	3.86	.68	449
HLIFT	1 if problems related to heavy lifting have been solved, 0 otherwise	.76	.43	448
REPWO	1 if problems related to repetitive strenuous work have been solved, 0 otherwise	.78	.41	442
CHEM	1 if problems related to chemical loads have been solved, 0 otherwise	.88	.33	441
NOISE	1 if problems related to noise causing deafness have been solved, 0 otherwise	.77	.42	444
YOUNG	1 if problems related to young people's work have been solved, 0 otherwise	.94	.24	436
PSYCH	1 if problems related to psychological conditions have been solved, 0 otherwise	.78	.41	439
ICLIM	1 if problems related to internal climate have been solved, 0 otherwise	.71	.45	441
ACC	1 if problems related to accidents or danger of accidents have been solved, 0 otherwise	.80	.40	441
COURS	1 if courses with general work environment content have been held at the firm, 0 otherwise	.24	.43	426
ACTWE	1 if action plans have been drawn up to solve the work environment problems, 0 otherwise	.57	.49	437
PRIWE	1 if work environment problems have been prioritised to be solved, 0 otherwise	.68	.47	441
WRIT	1 if the firm has a Written Work Environment Policy, 0 otherwise	.32	.46	363
IDA				
pfem	women as a proportion of all employees	.25	.26	572
pturn	employees with tenure less than two years as a proportion of all employees	.21	.22	572
punsk	unskilled as a proportion of all employees	.10	.19	572
pman	managers as a proportion of all employees	.078	.15	572
educ	average years of education among all employees	12.22	1.58	572
fsize	number of employees in the firm	49.37	96.09	572
agefirm	age of the firm	12.05	9.38	572
wage	mean wage in the firm	171.48	35.7	565
REGNSKAB				
capital		15780.5	42698.6	465
sales		72639.3	190177	465
materials		54673.6	170577.6	465

Table 7: Descriptive Statistics VOV2001, IDA and REGNSKAB, ALL PLANTS

variable	definition	mean	s.d.	N
VOV2001				
GENWE	work environment standard at the company is 1=VG,2=G, 3=NB, 4=B, 5=VB	3.82	.69	1190
HLIFT	1 if problems related to heavy lifting have been solved, 0 otherwise	.78	.41	1182
REPWO	1 if problems related to repetitive strenuous work have been solved, 0 otherwise	.79	.41	1182
CHEM	1 if problems related to chemical loads have been solved, 0 otherwise	.88	.32	1174
NOISE	1 if problems related to noise causing deafness have been solved, 0 otherwise	.77	.42	1182
YOUNG	1 if problems related to young people's work have been solved, 0 otherwise	.93	.24	1158
PSYCH	1 if problems related to psychological conditions have been solved, 0 otherwise	.65	.47	1169
ICLIM	1 if problems related to internal climate have been solved, 0 otherwise	.65	.47	1179
ACC	1 if problems related to accidents or danger of accidents have been solved, 0 otherwise	.78	.41	1171
COURS	1 if courses with general work environment content have been held at the firm, 0 otherwise	.36	.48	1155
ACT	1 if action plans have been drawn up to solve the work environment problems, 0 otherwise	.64	.47	1135
PRIOR	1 if work environment problems have been prioritised to be solved, 0 otherwise	.75	.43	1154
WRIT	1 if the firm has a Written Work Environment Policy, 0 otherwise	.48	.49	985
IDA				
pfem	women as a proportion of all employees	.28	.24	914
pturn	employees with tenure less than two years as a proportion of all employees	.22	.22	914
punsk	unskilled as a proportion of all employees	.10	.17	914
pman	managers as a proportion of all employees	.10	.16	914
educ	average years of education among all employees	12.41	1.45	914
fsize	number of employees in the firm	592.53	1959.87	914
nplant	1 if firm has one plant only, 0 otherwise	.44	.49	1472
plantsize	number of employees in the plant	268.1	1116.6	1197
agefirm	age of the firm	13.84	11.03	914
wage	mean wage in the firm	176.41	33.7	907
REGNSKAB				
capital		186325	834905	730
sales		605866	2230668	730
materials		395065	1545223	730

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# Model and estimation methodology

*What are the firm characteristics associated to a good work environment practice?*

Our empirical methodology is similar to Osterman (1994) and we consider the following model:

$$WE_i = \alpha + \beta X_i + \gamma Z_i + \varepsilon_i$$

# Outcome indicator

- *What do you consider the work environment related standard to be at the company?*
  - **GENWE** (0=not bad/poor/very poor & 1=very good/good)
- *To what extent are these work environment problems being solved? Majority/(Few/ None)*
  - heavy lifting (**HLIFT**)
  - repetitive and strenuous work (**REPWO**),
  - chemical loads (**CHEM**)
  - noise causing deafness (**NOISE**),
  - problems in connection with young's people work (**YOUNG**)
  - psychological condition (**PSYCH**)
  - internal climate problems (**ICLIM**)
  - accidents or danger of accident (**ACC**)

Table 2: Logit estimates of work environment on firm characteristics in 2001, marginal effects

	GENWE	HLIFT	REPWO	CHEM	NOISE	YOUNG	PSYCH	ICLIM	ACC
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
pfem	.083 (.119)	.041 (.131)	.140 (.118)	.035 (.038)	-.025 (.076)	.066* (.036)	.023 (.121)	-.195 (.137)	.225 (.165)
punsk	-.0007 (.148)	.205 (.179)	-.184 (.165)	-.016 (.057)	.163 (.128)	-.051 (.065)	.026 (.134)	.195 (.199)	-.118 (.139)
pturn	-.020 (.150)	-.030 (.125)	.137 (.146)	.004 (.051)	-.044 (.091)	-.023 (.032)	-.207 (.134)	-.219 (.166)	.003 (.141)
pman	.049 (.204)	.640** (.310)	.654** (.302)	.074 (.079)	.191 (.141)	.129 (.101)	.676** (.294)	.139 (.259)	.309 (.235)
educ	.014 (.019)	-.008 (.021)	.010 (.022)	-.015 (.012)	.012 (.012)	-.001 (.007)	-.004 (.023)	-.027 (.026)	.001 (.026)
log fsize	-.019 (.023)	-.110*** (.026)	-.076*** (.024)	.001 (.007)	-.041*** (.015)	-.008 (.006)	-.091*** (.024)	-.091*** (.026)	-.078*** (.026)
COURS	.194*** (.056)	-.069 (.060)	.103* (.059)	.020 (.015)	.082** (.033)	-.025 (.016)	-.023 (.055)	-.023 (.062)	-.037 (.052)
WRIT	.059 (.062)	.080 (.063)	.017 (.067)	-.016 (.015)	.040 (.036)	-.002 (.015)	-.026 (.062)	-.031 (.063)	.051 (.058)
ACTWE	.089 (.067)	.053 (.070)	.090 (.079)	-.010 (.017)	-.022 (.047)	-.002 (.017)	-.016 (.074)	-.129 (.085)	.061 (.064)
PRIWE	.104 (.070)	-.045 (.080)	-.073 (.083)	-.008 (.023)	.033 (.053)	-.005 (.019)	.048 (.077)	.176* (.096)	-.106 (.074)
Nobs	305	279	280	230	279	175	297	302	264
Log-lik	-147.06	-129.56	-125.14	-66.86	-129.48	-42.57	-140.79	-152.98	-117.36

Significance levels: \*\*\* 1%, \*\*5%, \*10%; robust standard errors in parantheses. Estimations also include a constant term, regional and industry dummies and dummies for firm age categories, ie. age 0-5, 5-10, 10-15, 15-20, with the baseline 20+



# Summary results

- *Which characteristics differentiate firms*

- *Better or worse?*

COURS, firms that held courses with work environment content

*Which characteristics are associated to **specific** work environment conditions? (If problems have been solved...)*

- **firm size** (HLIFT, REPWO, NOISE, PSYCH, ICLIM, ACC )
- **pman** (HLIFT, REPWO, PSYCH)
- **COURS** (REPWO, NOISE)
- pfem (YOUNG)
- PRIWE (ICLIM)

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## Work Environment and Firm Performance

- A. What is the impact of work environment practice for productivity?
  
- B. Does “work environment practice” affect wages (Compensating Wage Differentials?)?

# Empirical framework/1:

Estimation of standard Cobb-Douglas production functions augmented with firm specific working environment indicators and firm average characteristics. We use three different specifications:

1. OLS

$$\ln(Y/L)_i = c + \alpha \ln(K/L)_i + \beta \ln(M/L) + \delta X_i + \gamma' Z_i + \varepsilon_i$$

2. FE+OLS

$$\begin{aligned} \widetilde{\ln\left(\frac{Y}{L}\right)}_{it} &= a \widetilde{\ln\left(\frac{K}{L}\right)}_{it} + b \widetilde{\ln\left(\frac{M}{L}\right)}_{it} + c \widetilde{X}_{it} + \widetilde{v}_{it} \\ R_i &= d + e' Z_i + \xi_i \end{aligned}$$

$$R_i \text{ (time) average of } R_{it} \equiv \ln\left(\frac{Y}{L}\right)_{it} - \widehat{a} \ln\left(\frac{K}{L}\right)_{it} - \widehat{b} \ln\left(\frac{M}{L}\right)_{it} - \widehat{c} \widetilde{X}_{it}$$

# Empirical framework/2:

1. OLS
2. system GMM+OLS

Analogous to Black and Lynch (2001)- but with some differences\*. We observe all variables except the VOV for many years.

Uses the averaged residuals over time from 1st state in a second, where we regress on Z vector with the VOV vars

Uses lags up to 1998 to instrument levels and changes in capital, material, labor and output. We are also instrumenting prop of managers

Table 3: Augmented Production Functions

	OLS 2001	2-stage FE+OLS	2-stage GMM+OLS
	(1)	(2)	(3)
		1 <sup>st</sup> stage	
K/L	.034* (.017)	.048*** (.011)	.060** (.027)
M/L	.671*** (.026)	.751*** (.022)	.745*** (.061)
pfem	.002 (.106)	-.053 (.053)	-.053 (.053)
punsk	-.262** (.111)	-.022 (.033)	-.013 (.036)
pturn	-.138 (.130)	-.082*** (.021)	-.096*** (.035)
pman	.329 (.217)	.017 (.075)	.127 (.187)
educ	.002 (.016)	-.006 (.006)	.003 (.008)
Nobs 1 <sup>st</sup> stage		1627	1627
Sargan GMM			$\chi^2(15)=19.40$
		2 <sup>nd</sup> stage	
WRIT	.021 (.031)	.018 (.030)	.011 (.029)
COURS	.044 (.035)	.043 (.034)	.040 (.034)
ACTWE	.004 (.047)	-.0006 (.048)	.022 (.046)
PRIWE	-.030 (.046)	-.028 (.047)	-.029 (.046)
HLIFT	-.021 (.044)	-.035 (.044)	-.041 (.044)
REPWO	.070 (.045)	.094** (.042)	.092** (.042)
CHEM	.074 (.073)	.058 (.063)	.059 (.063)
NOISE	-.008 (.035)	.010 (.031)	.006 (.030)
YOUNG	-.022 (.047)	-.043 (.041)	-.043 (.040)
PSYCH	-.025 (.036)	-.013 (.037)	-.012 (.035)
ICLIM	.041 (.037)	.074** (.031)	.080** (.031)
ACC	.011 (.036)	-.008 (.031)	-.015 (.030)
R <sup>2</sup>	0.920	0.225	0.242
Nobs	215	215	215

# Empirical framework/2:

Regressions of firm performance measures as mean wages on ‘work environment actions’, controlling for employee human capital, firm organization proxies and other firm characteristics:

## 1. OLS

$$\ln(Y)_i = c + \alpha X_i + \beta' Z_i + \varepsilon_i$$

## 2. FE+OLS

$$\ln \overline{(Y)}_{it} = a \overline{X}_{it} + \overline{\nu}_{it}$$

$$R_i \equiv d + b' Z_i + \xi_i$$

with  $R_i$  the (time) average of  $R_{it} \equiv \ln \overline{(Y)}_{it} - \widehat{a} \overline{X}_{it}$

Table 4: Mean LogWages and Work Environment

	OLS 2001	2-stage FE+OLS
	(1)	(2)
		1 <sup>st</sup> stage
pfem	-.212*** (.051)	-.159*** (.048)
punsk	.102 (.057)	.015 (.035)
pturn	.022 (.054)	-.0004 (.016)
pman	.335*** (.092)	.012 (.053)
educ	.051*** (.009)	.038*** (.006)
Nobs 1 <sup>st</sup> stage		2095
		2 <sup>nd</sup> stage
WRIT	.020 (.023)	.026 (.023)
COURS	.018 (.020)	.020 (.020)
ACTWE	-.009 (.028)	.018 (.023)
PRIWE	.022 (.033)	.015 (.028)
HLIFT	.029 (.022)	.015 (.021)
REPWO	-.035 (.022)	-.011 (.021)
CHEM	-.004 (.034)	.026 (.027)
NOISE	-.011 (.022)	-.015 (.022)
YOUNG	.054* (.032)	.024 (.030)
PSYCH	.019 (.023)	.034 (.022)
ICLIM	-.020 (.023)	-.040* (.024)
ACC	.030 (.026)	.019 (.025)
R <sup>2</sup>	0.491	0.323
Nobs	295	295



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## Summary. Conclusions?

- First study to investigate which are the firm characteristics associated with a good work environment and what is the impact of good work environment practice on firm performance
- Our data allows eliminating or reducing several problems (typically present in analogous research): omitted variable bias (time-invariant), simultaneity in choice of production inputs
- Few factors are associated with a good work environment practice:  
**proportion managers, training courses with work environment content**
- The work environment practices that contribute to enhancement of firm productivity are solving the majority of problems with respect to (some) 'physical' dimensions: **internal climate & repetitive and strenuous work activities**
- Evidence of CWD with respect to the firm's **internal climate** (supporting the implication for the productivity from above)