Industrial restructuring and the challenge of an ageing workforce

An empirical assessment using Belgian firm-level data on productivity and labour costs

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Presentation outline

1. Motivation
2. Existing literature
3. Methodology
4. Data
5. Results and conclusions

This presentation draws heavily on Vandenberghe, V. (2011a) Boosting the employment rate of older men and women. An empirical assessment using Belgian firm-level data on productivity and labour costs, ***De Economist***, 159(2), pp. 159-191.

1. Context, motivation

IR & Ageing

- Over the past 3 decades, industrial restructuring (IR) has become a structural feature of the economic landscape
- Many economists argue that the recent financial crisis will act as a strong catalyst of IR

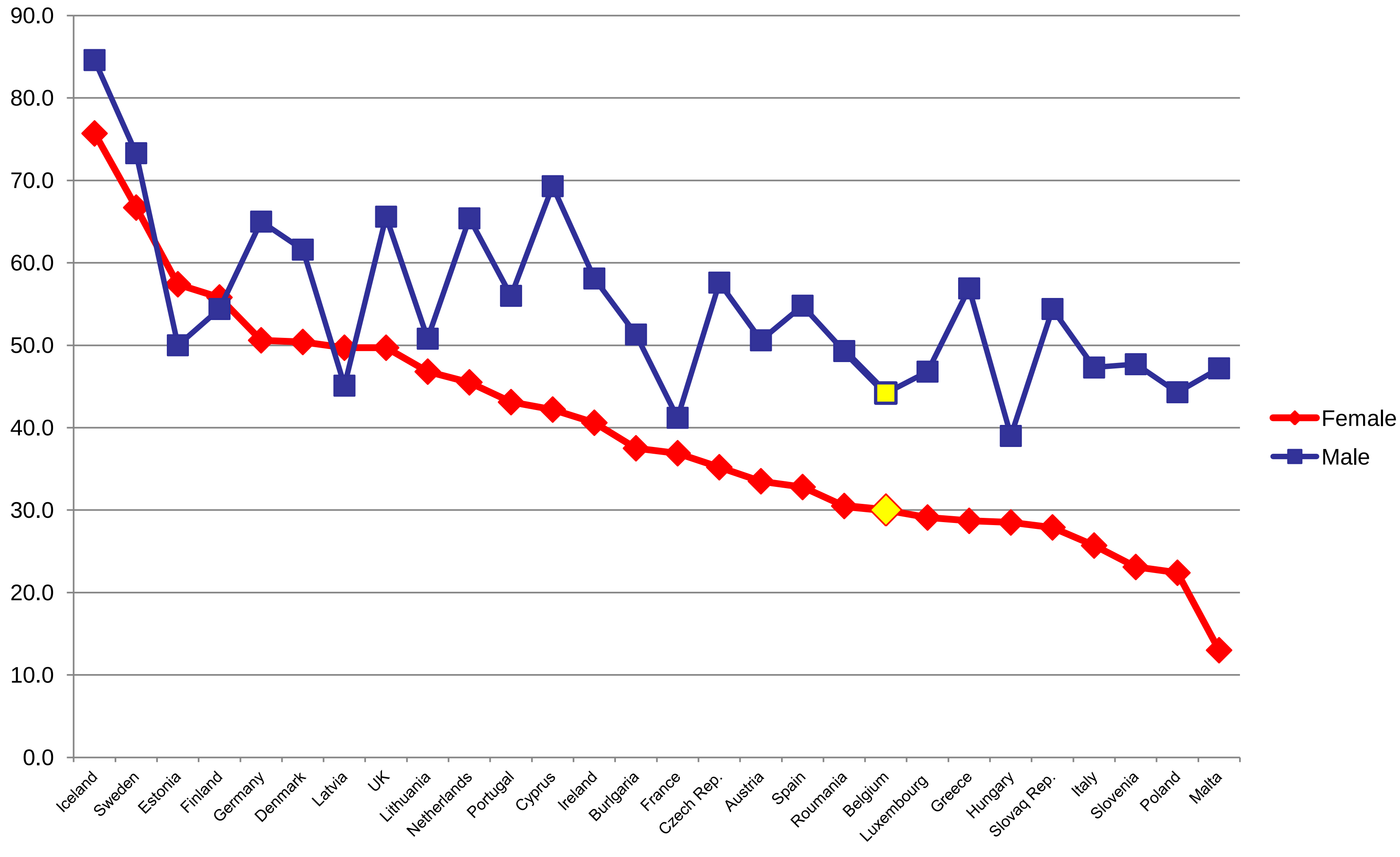
- The purpose of this paper is to draw the attention of decision makers on the fact that future IR will take place in a context synonymous with **ageing workforces**

1. Context, motivation (cont.)

Policy & scientific context

- Political initiatives to increase (currently low) older empl. rates mainly consist of increasing the **supply** of older labour
- Existing literature looks mainly at…
  - the consequences of an ageing population, in terms of welfare cost or growth (Gruber and Wise, 2004)
  - the retirement behaviour of older individuals (i.e. their **supply** of labour) (replacement rates, pension, early-retirement schemes, role of health, joint-decision within households…) (Mitchell & Fields, 1983)
- **Not so much** the determinants of the labour **demand** by firms (e.g. labour costs, productivity...)
- **Not** the demand for old labour **by gender**

Male vs. Female aged 50-64 employment rate. Europe, 2010



Source: EU-LFS, 2010

1. Context, motivation (cont.)

Two questions

- Do ageing workforces negatively affect productivity performance of firms? [Growth]

- Are employers willing to (re)employ older workers? *

[Employment]

=> Key assumption: a sizeable negative impact of more older (male or female) workers on the **productivity- vs. labour costs ratio** is likely to adversely affect the labour demand

2. Existing literature on age, productivity (and labour costs)

- Individual-level data

"Individual job performance is found to decrease from around 50 years of age, which contrasts almost life-long increases in wages.

- Productivity reductions at older ages are particularly strong for work tasks where problem solving, learning and speed are needed,
- while in jobs where experience and verbal abilities are important, older individuals' maintain a relatively high productivity level."
- (Skirbekk, 2004: SURVEY)

2. Existing literature (cont.)

- Country-level data

"(…) large macro-data panel (…) explores the impact of the age composition of the labour force on (…) growth . The results point to an inversely U-shaped relationship"

(Werding, 2007)

- Firm-level data***

*Hellerstein et al. (1999) [USA]: relative productivity of 55+ is **1.15** whereas rel. wage is **1.19**=> no significant effect on prod- wage ratio.

*Hellerstein et al. (2007) [USA]: relative productivity of 55+ is **.87** whereas rel. wage is **1.13**, significant effect on prod- wage ratio.

Gründ & Westergård-Nielsen (2008) [DK]: find that mean age in Danish firms is inversely u-shaped related to firm productivity

Skirbekk, (2008) [International survey]: The most common finding from these studies is inversely u-shaped relation between job performance and age. Of the **14** studies, **11** find a productivity decline in the 50s relative to the 30s and 40s

*Aubert & Crépont (2003) [FR],

A negative impact on productivity-wage ratio is observed only for workers aged 55+

*Roger & Wasmer (2009) [FR],

In manuf. & services => significant negative impact on productivity-wage ratio for 55+ (particularly low-educated ones)

*Dostie (2006), [Canada] Significant negative effect on productivity-wage ratio only with educated males 55+

Göbel & Zwick (2009) [Germany] find that productivity increases with the share of employees until the age of 55 and only decreases slightly afterwards

*van Ours & Stoeldraijer (2011), [Netherlands] find little evidence of age influencing productivity-pay ratio in manufacturing

*Cataldi, Kampelmann & Rycx (2011), [Belgium] Significant negative effect on productivity-wage ratio of rising shares of 50+

3. Methodology

Equ.1:average productivity

$$ln\,(Y_{i,t}/L_{i,t}) = lnA + \boldsymbol{\alpha}\ \mathbf{ln}\ \mathbf{QL_{i,t}} + ß\ lnK_{i,t} - lnL_{i,t}$$

where: $Y_{i,t}$ is the firm's value added

and $\mathbf{QL_{it}}$ a « labour quality index »

$$\mathbf{QL_{it}} = \sum_k \mu_{i,k} L_{i,k,t} = \mu_{i,ref} L_{i,t} + \sum_{k \neq ref} (\mu_{i,k} - \mu_{i,ref}) L_{i,t,k}$$

μ_k reflecting the productivity of type *k* workers (e.g. old) … see appendix for more details

4. Our Data

- Employers-employees matched data
  - ~10.000 firms with 20+ workers (*BEL-FIRST- BNB*)
  - using firm identifiers, we are able to inject information from *banque Carrefour de la sécurité sociale* on the age of (all) workers employed by these firms: ~1.200.000 workers
  - …..we do not need to assign workers to firms using matching methods like in Hellerstein et al. (1999)
- Data aggregated at firm level
- Long Panel 1998-2006 (9 years)

- Information on firms from the (now dominant) **service sector**, where administrative and intellectual work is predominant

- Like Aubert & Crépon (2003) and Dostie (2006), we have a measure of firms' productivity (the net valued added), which is measured independently from firms' wage cost

- Contrary to Dostie (2006), we do have a measure of firms' capital stock, such that no imputation method is required.

Table 1 : Bel-first-Carrefour panel. Main variables. Descriptive statistic.

Variable	**Mean**	**Std. Dev.**
Productivity (ie value added) per worker (th. €) (log)	4.08	0.56
Labour cost per worker (th. €) (log)	3.71	0.38
Capital (th. €) (th. €) (log)	6.85	1.75
Number of workers (th. €) (log)	3.94	1.00
------------	------------	------------
Share of 18-29	0.423	0.18
Share of 30-49	0.424	0.13
Share of 50-65	0.153	0.11
------------	------------	------------
Use of intermediate inputs (th. €) (log)	8.97	1.56
Share of blue collar workers in total workforce	0.55	0.35
Share of Manager in total workforce	0.01	0.04
Number of hours worked annually per employee (log)	7.37	0.22
------------	------------	------------
Share of firm from the manufacturing sector (spells)	0.31	0.46
Share of firms with a consistent[a] training record (spells)	0.71	0.45
Share of firms in 10-90th perc. size[b] bracket (spells)	0.88	0.32
------------	------------	------------
Number of spells	8.73	0.94

a: That spend on training during the whole duration of the panel

b: Size is defined as the firms' overall labour force

Source: Bel-first-Carrefour

Figure 0 : Mean age of workers: density, year 2006 (Bel-First, Carrefour)

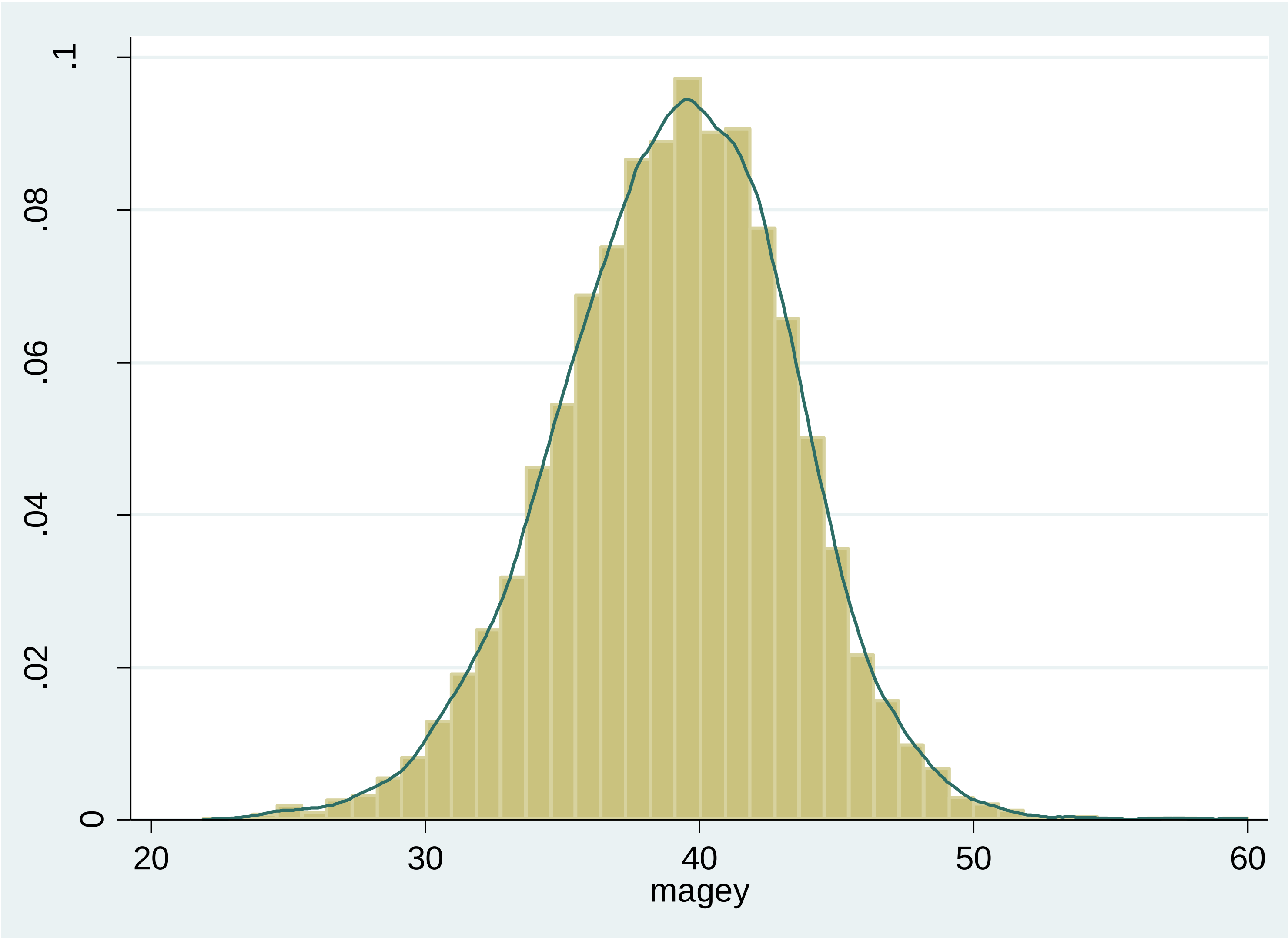


Figure 1: (Left panel) Average productivity and average labour costs. (Right panel) Productivity-Labour cost ratio (%) according to mean age. Year 2006

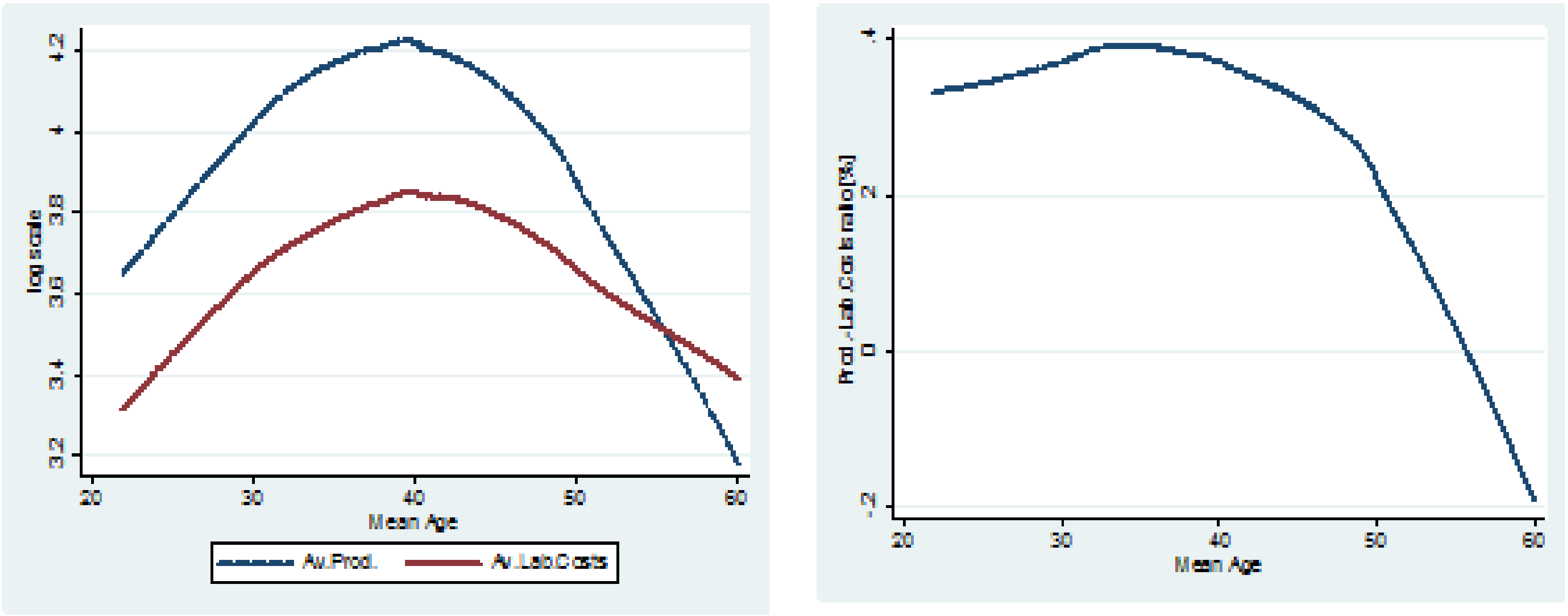
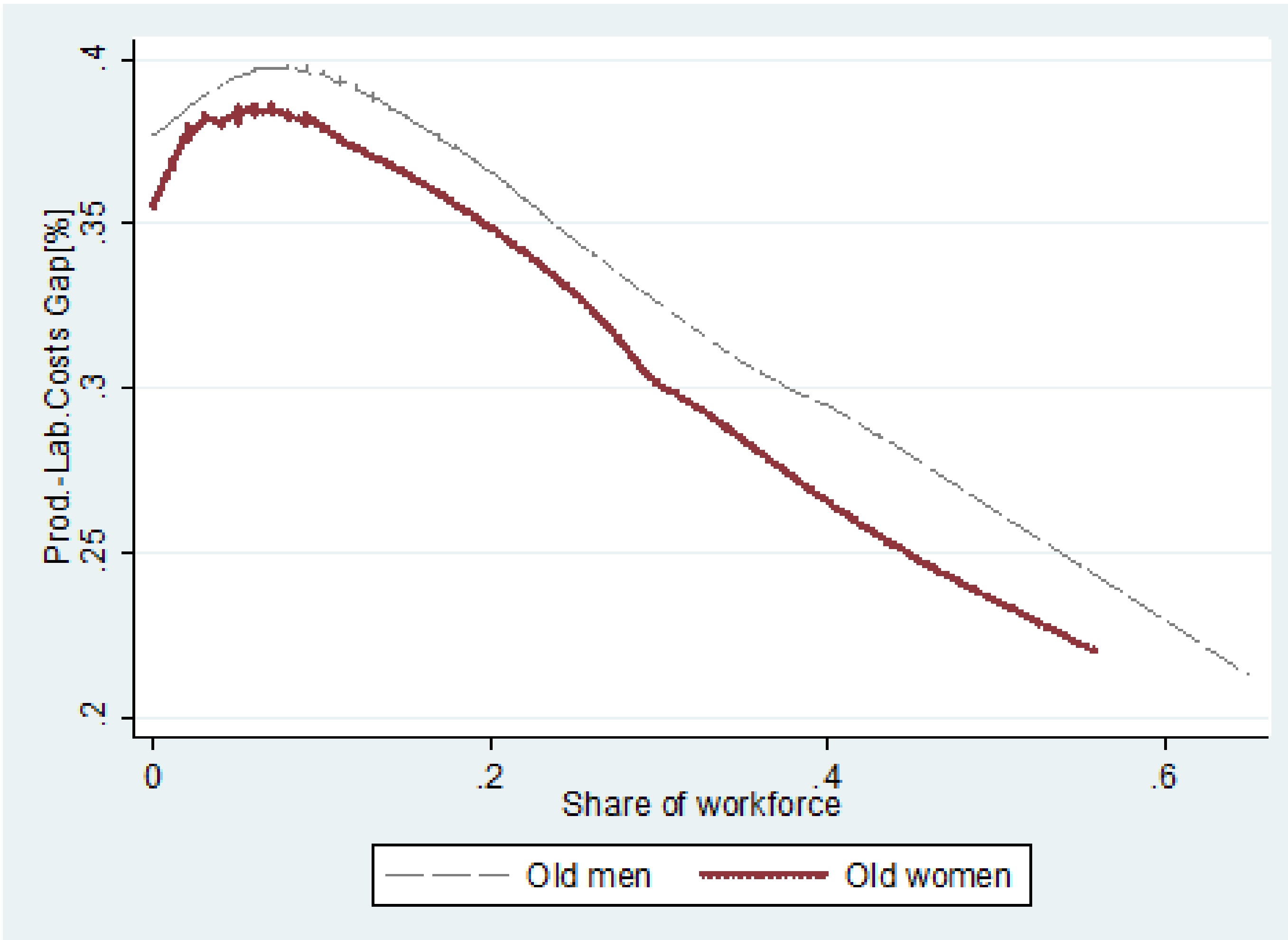


Figure 2: Productivity-Labour cost ratio (in %) according to share of older men or women



Natural experiment thanks to EU-ruling ➔ 1997 reform alining men and women

	Share 50-64 men (%)	Share 50-64 women (%)	Share 50-64 men	share 50-64 women
1998	9.92%	2.13%	100.00	100.00
1999	10.33%	2.30%	104.08	107.62
2000	10.73%	2.48%	108.13	116.25
2001	11.22%	2.72%	113.06	127.53
2002	11.69%	2.92%	117.76	136.82
2003	12.90%	3.31%	130.02	155.06
2004	13.47%	3.56%	135.75	166.73
2005	14.04%	3.83%	141.43	179.29
2006	14.72%	4.20%	148.31	196.86

Legal retirement age in Belgium following EU ruling

	1996	**1997**	2000	2003	2006	**2009**
M	65	65	65	65	65	65
F	60	61	62	63	64	65

5. Results

- Table 2 - Parameter estimates (*standard errors*[£]). Older (50-64) male/female and prime-age (30-49) female workers productivity (η), average labour costs (η^w) and productivity-labour cost ratio (η^G). Overall, unbalanced panel sample.

	[1] OLS	[2] First Differences	[3] First Differences + IV-GMM	[4] First Differences + intermediate inputs LP[$$]
Share of 50-64 (Men)				
Productivity (η_{3m})	-0.233***	-0.095***	-0.039	-0.115***
std error	*(0.023)*	*(0.028)*	*(0.038)*	*(0.035)*
Labour Costs (η^w_{3m})	-0.176***	-0.023*	-0.020	-0.046***
std error	*(0.013)*	*(0.012)*	*(0.016)*	*(0.014)*
Prod.-Lab. Costs ratio (η^G_{3m})	-0.063***	-0.071***	-0.016	-0.069**
std error	*(0.020)*	*(0.027)*	*(0.037)*	*(0.034)*
Share of 30-49 (Women)				
Productivity (η_{2f})	-0.293***	-0.035	-0.114**	-0.034
std error	*(0.021)*	*(0.033)*	*(0.046)*	*(0.040)*
Labour Costs (η^w_{2f})	-0.351***	-0.042***	-0.033*	-0.027*
std error	*(0.012)*	*(0.014)*	(0.019)	*(0.016)*
Prod.-Lab. Costs ratio (η^G_{2f})	0.053***	0.005	-0.081*	-0.006
std error	*(0.018)*	*(0.032)*	*(0.045)*	*(0.040)*
Share of 50-64 (Women)				
Productivity (η_{3f})	-0.610***	-0.229***	-0.252***	-0.250***
std error	*(0.039)*	*(0.053)*	*(0.071)*	*(0.063)*
Labour Costs (η^w_{3f})	-0.643***	-0.060***	-0.052*	-0.120***
std error	*(0.022)*	*(0.023)*	*(0.029)*	*(0.025)*
Prod.-Lab. Costs ratio (η^G_{3f})	0.022	-0.169***	-0.201**	-0.130**
std error	*(0.033)*	*(0.052)*	*(0.070)*	*(0.061)*

Two extensions

- Balanced* vs. unbalanced panel
- Restrict the sample to the services industry.

* The sample of firms that are observed every year between 1998 and 2006.

Table 5 - Parameter estimates (*standard errors*[£]) and hypothesis testing. Older (50-64) male/female and prime-age (30-49) female workers productivity (η), average labour costs(η^{w}) and productivity-labour cost ratio (η^{G}). Balanced panel sample, services industry.

	Coefficient (unbal.)	Coefficient (bal.)	Coefficient (bal. SERVICES)	Hyp Test $\eta_{3f}=\eta_{3m}$: $\eta_{3f}-\eta_{3m}$	F	Prob>F	Hyp Test $\eta_{3f}=\eta_{2f}$: $\eta_{3f}-\eta_{2f}$	F	Prob>F	Hyp Test $\eta_{3f}-\eta_{2f}=\eta_{3m}$: $(\eta_{3f}-\eta_{2f})-\eta_{3m}$	F	Prob>F
[3] - First Differences + IV-GMM[$]												
Productivity												
Men 50-64 (η_{3m})	-0.039	-0.036	-0.067									
	(0.038)	*(0.039)*	*(0.055)*									
Women 30-49 (η_{2f})	-0.114**	-0.098**	-0.116*	-0.298***	9.03	0.0027	-0.250***	7.43	0.0064	-0.183*	2.91	0.0881
	(0.046)	*(0.048)*	*(0.061)*									
Women 50-64 (η_{3f})	-0.252***	-0.293***	-0.365***									
	(0.071)	*(0.073)*	*(0.092)*									
Prod.-Lab. Costs ratio												
Men 50-64 (η^{G}_{3m})	-0.016	0.000	-0.004									
	(0.037)	*(0.038)*	*(0.053)*									
Women 30-49 (η^{G}_{2f})	-0.081*	-0.067	-0.095	-0.356***	13.57	0.0002	-0.265***	8.84	0.0029	-0.261*	6.26	0.0123
	(0.045)	*(0.046)*	*(0.059)*									
Women 50-64 (η^{G}_{3f})	-0.201**	-0.250***	-0.360***									
	(0.070)	*(0.072)*	*(0.089)*									
#obs	49,211	46,006	24,330									
[4] First-Differences + intermediate inputs LP[$$]												
Productivity												
Men 50-64 (η_{3m})	-0.115***	-0.093***	-0.089*									
	(0.035)	*(0.035)*	*(0.050)*									
Women 30-49 (η_{2f})	-0.034	-0.035	-0.026	-0.232**	6.62	0.0101	-0.294***	13.46	0.0002	-0.206*	4.68	0.0305
	(0.040)	*(0.042)*	*(0.053)*									
Women 50-64 (η_{3f})	-0.250***	-0.276***	-0.320***									
	(0.063)	*(0.064)*	*(0.080)*									
Prod.-Lab. Costs ratio												
Men 50-64 (η^{G}_{3m})	-0.069**	-0.038	-0.010									
	(0.034)	*(0.034)*	*(0.049)*									
Women 30-49 (η^{G}_{2f})	-0.006	-0.013	0.015	-0.167*	3.60	0.0576	-0.192**	5.98	0.015	-0.182*	3.82	0.0505
	(0.040)	*(0.041)*	*(0.052)*									
Women 50-64 (η^{G}_{3f})	-0.130**	-0.160**	-0.177**									
	(0.061)	*(0.063)*	*(0.079)*									
#obs	52,162	47,658	25,506									

Conclusion

Ageing will affect more than welfare systems, as it will also affect the age structure of the workforce.

The share of older workers (aged 50+) will rise significantly due to demographics & policy

A greying European workforce should also become more female.

Optimists may believe that an ageing (and feminized) workforce will have only a minimal impact on firms‟ performance and on labour markets.

We produce evidence suggesting the Opposite

In Belgium, he age/gender structure of firms is a key determinant of their productivity-labour cost ratio.

– Using prime-age men as a ref., an increase of 10%-points in the share of older female workers (50-64) causes a change of productivity-labour cost ratio of -1.8 to -3.6%

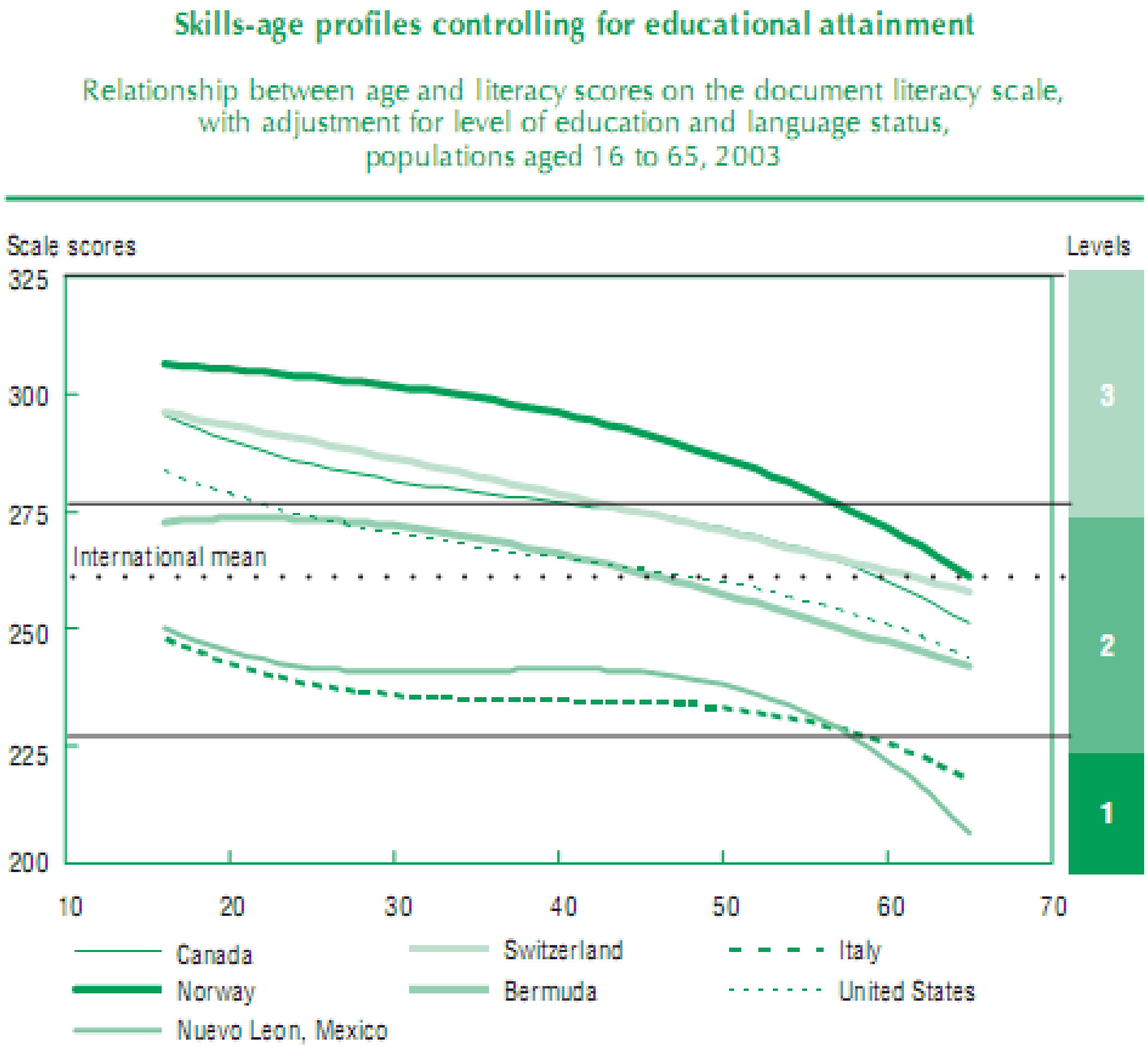
– The equivalent results for old men range from 0 to – 0.69%.

The lax rules in terms of access and relatively high replacement rates characterizing the Belgian (pre)pension regimes are traditionally emphasized to explain Belgium’s low employment rate among 50+.

Our work contains evidence that it could also be demand-driven. = > *Ceteris-paribus*, firms based in Belgium face financial disincentives to employing older workers - particularly older women

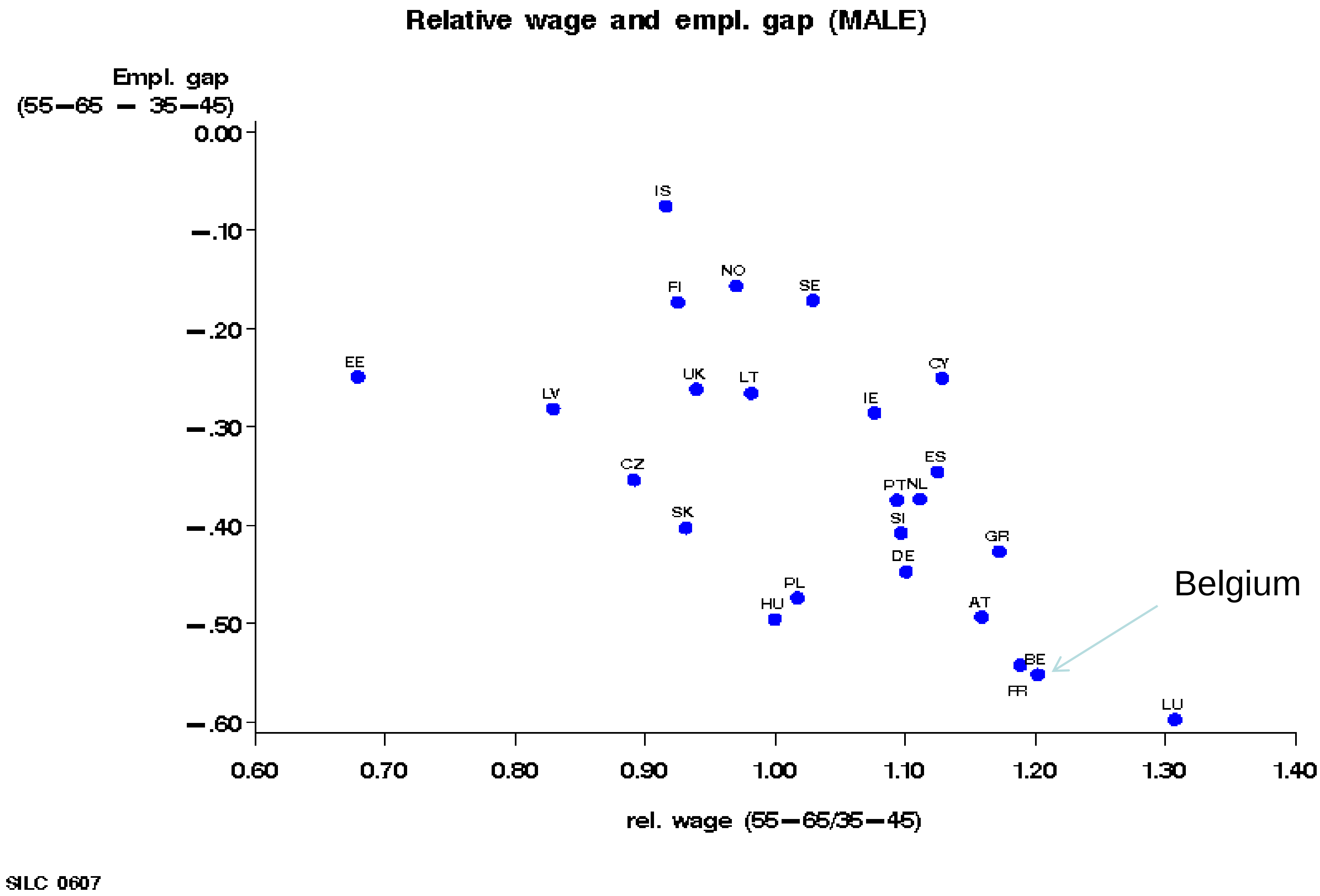
APPENDIX

Age and cognition

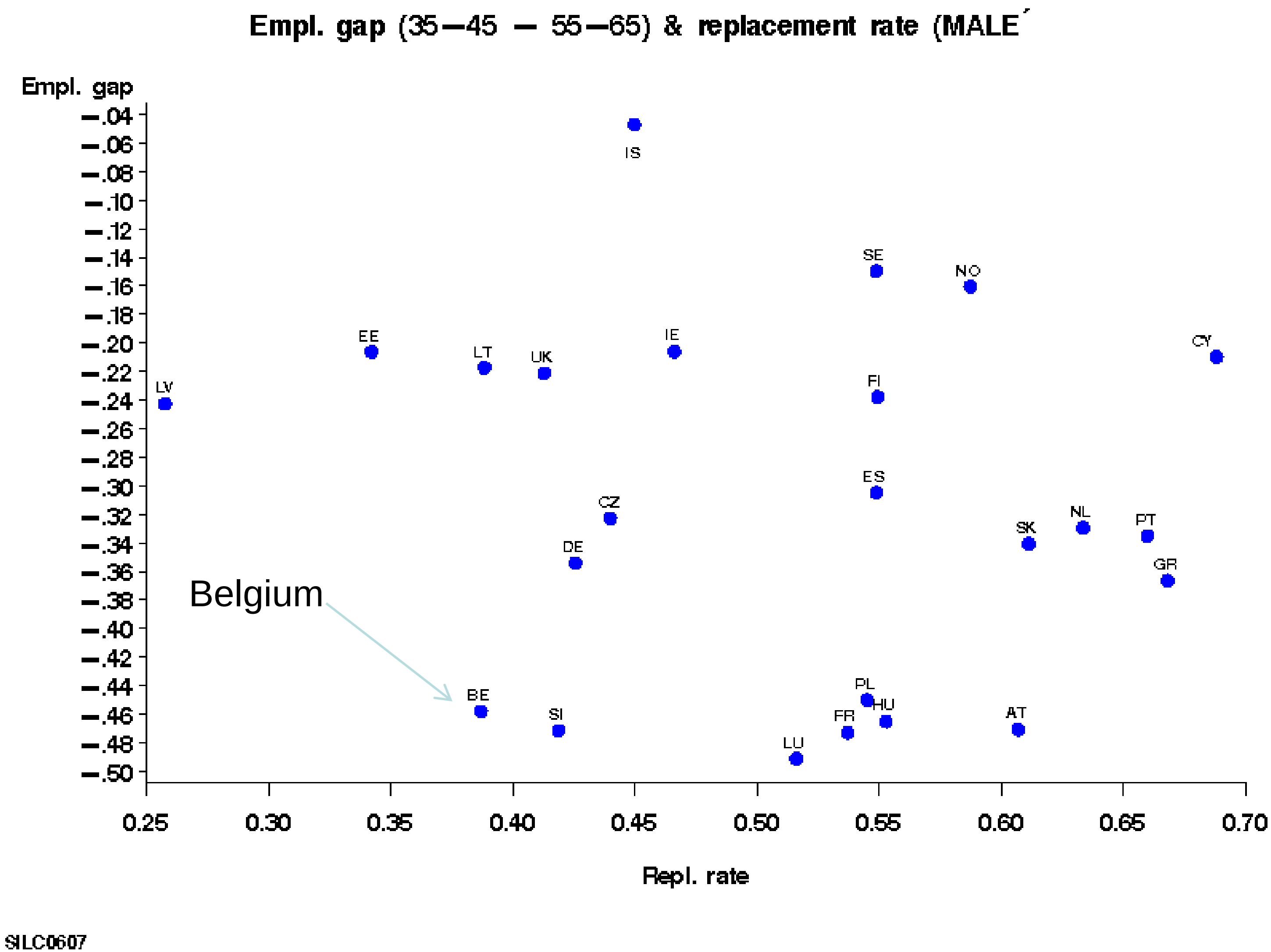


Source: Adult Literacy and Life Skills Survey, 2003.

Relative wage and employment



Replacement rate and relative empl.



3. Methodology (details)

Equ.1:average productivity

$ln\ (Yi,t\ /Li,t\ ) = lnA + \alpha\ ln\ QL_{i,t} + ß\ lnK_{i,t} – lnL_{i,t}$

where: $Y_{i,t}$ is the firm‟s value added

and QL_{it} a “labour quality index” à-la-Hellerstein

$QL_{it} = \sum_k \mu_{i,k} L_{i,k,t} = \mu_{i,ref} L_{i,t} + \sum_{k \neq ref} (\mu_{i,k} - \mu_{i,ref}) L_{i,t,k}$

μ_k reflecting the productivity of type *k* workers (e.g. old)

• If we assume same marginal product across firms, we can drop subscript *i* . After taking logarithms and doing some rearrangements *QL* becomes:

$$\ln QL_{i,t} = \ln \mu_{ref} + \ln L_{i,t} + \ln \left(1 + \sum_{k \neq ref} (\lambda_k - 1) P_{i,t,k}\right)$$

Where

– $\lambda_k \equiv \mu_k / \mu_{ref}$ is the relative productivity of type *k* Workers

– $P_{i,t,k} \equiv L_{i,t,k} / L_{i,t}$ the proportion/share of type *k* workers

- Since $ln(1+x) \approx x$, we can further linearize

$Ln\ QL_{it} = ln\ \mu_{ref} + ln\ L_{i,t} + \sum_{k \neq ref} (\lambda_k - 1)\ P_{i,t,k}$

- And the production function becomes:

$ln(Y_{i,t}/L_{i,t}) = lnA + \alpha\ [ln\ \mu_{ref} + ln\ L_{i,t} + \sum_{k \neq ref} (\lambda_k - 1)\ P_{ikt}]$
$+ \beta\ lnKit - lnLik$

- Or, equivalently

$ln\ (Y_{it}/L_{it}) = B + (\alpha-1) l_{it} + \sum_{k \neq ref} \eta_k\ P_{ikt} + \beta\ k_{it}$
where:

  - $B = lnA + \alpha\ ln\ \mu_{ref}$
  - $\eta_k = \alpha\ (\lambda_k - 1)$; $\lambda_k = \mu_k/\mu_{ref}$ $\quad k \neq ref.$
  - $l_{it} = lnL_{it}$; $k_{it} = lnK_{it}$

Equ.2: labour costs

$$W_{it}/L_{it} = \sum_k \pi_k L_{ikt} / L_{it} = \pi_{ref} + \sum_{k \neq ref.} (\pi_k - \pi_{ref}) L_{ikt} / L_{it}$$

Taking the logarithm and using $log(1+x) \approx x$, we can approximate this by:

$$ln(W_t/L_{it}) = ln\ \pi_{ref} + \sum_{k \neq ref} (\Phi_k - 1) P_{i,t,k}$$

where

- $\Phi_k = \pi_k / \pi_{ref}$
- $P_{i,t,k} = L_{i,t,k} / L_{i,t}$

• The logarithm of the average labour cost finally becomes:

$$ln\ (W_{it}/L_{it}) = B^{w} + \sum k \neq ref\ \eta^{W}_{k}\ P_{itk}$$

where:

- $B^{w} = ln\ \pi_{0}$
- $\eta^{W}_{k} = (\Phi_{k} - 1)$
- $\Phi_{k} \equiv \pi_{k} / \pi_{ref}$

$k \neq ref.$

Formulating the key hypothesis test of this paper is now straightforward

Assuming spot labour markets and cost-minimizing firms the null hypothesis of no impact on the productivity-labour cost ratio for type k worker implies $\eta_k = \eta^w{}_k$.

Any negative (or positive) difference between these two coefficients can be interpreted as a quantitative measure of the disincentive (incentive) to employ the category of workers considered.

The hyp. test = easily implemented if one adopts strictly equivalent econometric specifications

$$ln\ (Y_{it}\ /L_{it}) = B + (\alpha\text{-}1)l_{it} + \sum_{k \neq ref} \eta_k\ P_{itk} + ß\ k_{it} + \gamma F_{it} + \varepsilon_{it}$$

$$ln\ (W_{it}\ /L_{it}) = B^w + (\alpha^w\text{-}1)l_{it} + \sum_{k \neq ref} \eta^w{}_k\ P_{itk} + ß^w\ k_{it} + \gamma^w F_{it} + \varepsilon^w{}_{it}$$

Taking the difference

$$ln\ (Yi_t) - ln\ (W_{it}) = B^G + \alpha^G l_{it} + \sum_{k \neq ref} \eta^G{}_k\ P_{itk} + ß^G\ k_{it} + \gamma^G F_{it} + \varepsilon^G{}_{it}$$

where:

$B^G = B - B^w$; $\alpha^G = \alpha - \alpha^w$; $\eta^G{}_k = \eta_k - \eta^w{}_k$; $ß^G = ß - ß^w$; $\gamma^G = \gamma - \gamma^w$ and $\varepsilon^G{}_{it} = \varepsilon_{it} - \varepsilon^w{}_{it}$.

$\eta^G{}_k$ = direct estimate of null hypothesis of no impact on the productivity-labour cost ratio

Identification challenge

$ln\ (Y_{it}\ /L_{it}) = B + (\alpha\text{-}l)l_{it} + \sum_{k \neq ref} \eta_k P_{itk} + \ ß\ k_{it} + \gamma F_{it} + \varepsilon_{it}$

$\varepsilon_{it} = \theta_i + \boldsymbol{\omega_{it}} + \sigma_{it}$

θ_i *unobservable (time-invariant) heterogeneity between firms*

$\boldsymbol{\omega_{it}}$ *short-term (asymmetrically) observed productivity shocks*

σ_{it} *random error* $E(\sigma_{it}) = 0$

Identification (cont.)

One can deal with θ_i by resorting to first differences (Δ)

$$\Delta ln(Y_{it} / L_{it}) = (\alpha\text{-}l)\Delta l_{it} + \sum_{k \neq ref} \eta_k \, \Delta P_{itk} + ß\Delta k_{it} + \gamma\Delta F_{it} + \Delta\varepsilon_{it}$$

$$\Delta\varepsilon_{it} = \Delta\omega_{it} + \Delta\sigma_{it}$$

where $cov(\Delta\omega_{it}, \Delta P_{it}) \neq 0$ and $E(\Delta\sigma_{it})=0$

The biggest challenge= coping with $\Delta\omega_{it}$

=> two methods:

- IV: lagged values $\Delta P_{i,t-1,k}$; $\Delta P_{it,-2,k}$ as instruments (Aubert and Crépon, 2003, 2007; van Ours & Stoeldraijer, 2011)

* more structural approach Olley & Pakes (1998), Levinsohn & Petrin (2003), ACF(2006).

Identification (cont.)

In ACF Intermediate goods are used to proxy the short -term productivity term

$$int_{it} = f(\omega_{it}, k_{it}, ql_{it})$$

Assuming this function can be inverted

$$\omega_{it} = f^{-1}(int_{it}, k_{it}, ql_{it})$$

with $f^{-1}(.)$ that can be approximated by a polynomial expansion in *int, k* and *ql* [and its consituents]

=> Our specificity it to combine this strategy with first differences

$$\Delta\, \omega_{it} = g^{-1}(\Delta\, int_{it}, \Delta k_{it}, \Delta ql_{it})$$

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