

# The Macro-economic Benefits of Adult learning: Further Education, Innovation and Growth

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## Content

1. Background
2. Introduction
3. Further education and growth
4. Adult learning and innovation
5. Summary and Conclusion

## 1. Background



When conducting a study for Cedefop on learning and innovation in enterprises (2012), we identified an interesting relationship between work organisation, further education and innovation

When running a study for the European Commission/DG Education and Culture, we complemented this with an analysis for the relationship between the participation in adult learning and growth and found statistically significant correlations (FiBS/DIE 2013)

These analyses are the starting point of a project on „The role of further education for growth and innovation as macro- and regional level“

We are presenting first (preliminary) results

## 2. Introduction



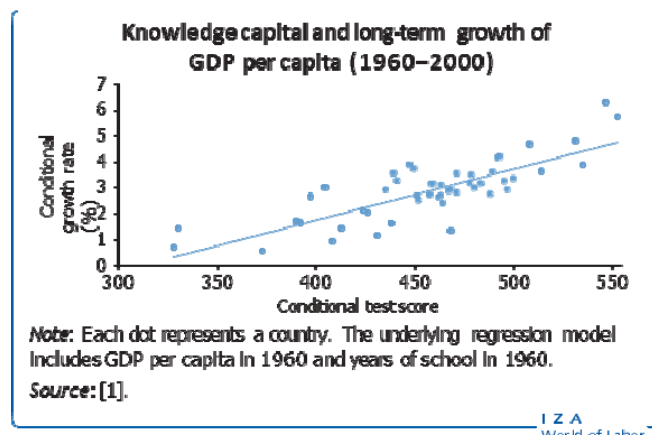
The link between education and growth or education and innovation is investigated from different angles:

- Education and innovation with a focus on tertiary education
- Education and growth with a focus on initial education (quantity and, in recent times, quality of education)

Hanushek and Woessmann are key researchers, stating the following picture explains almost everything:

It suggests that the growth rates of countries can be explained almost completely by education quality, measured by PISA scores

Pisa measures the competence levels of 15-year olds



2. Introduction: Why might initial education be overvalued?



How do competencies develop over time?  
The birth cohort 1985 participated as ...

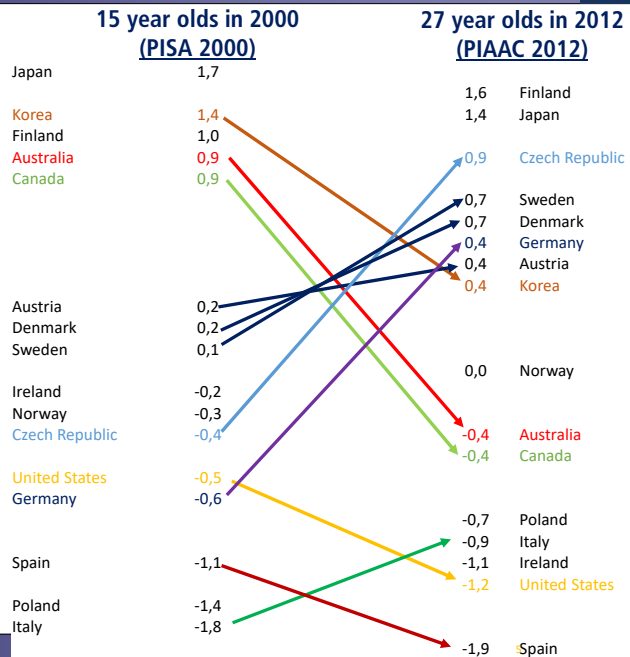
While some countries score similarly in relation to the average, ...

... others do not, but show remarkable changes, instead

Looking at the groups of countries, it is obvious that this is not randomly, but likely due to education and training systems

This casts doubts whether the competence levels of initial education are really as important for growth as stated in some studies (e.g. Hanushek/Woessman 2015)!

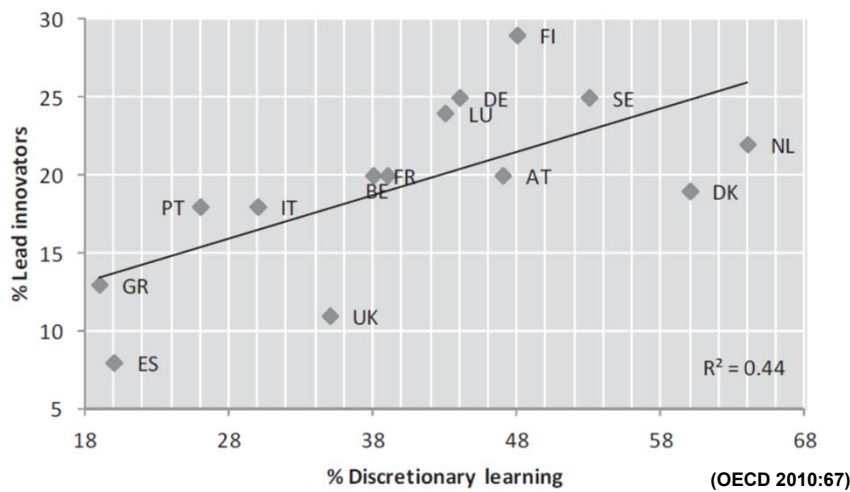
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2. Innovation and learning-in-the-workplace



Another strand of research is based on the role of workplace organisation



The graph shows that countries are more innovative, where a larger share of workplaces allows/enables learning in the workplace (decretionary learning)

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Macro-economic benefits of adult learning

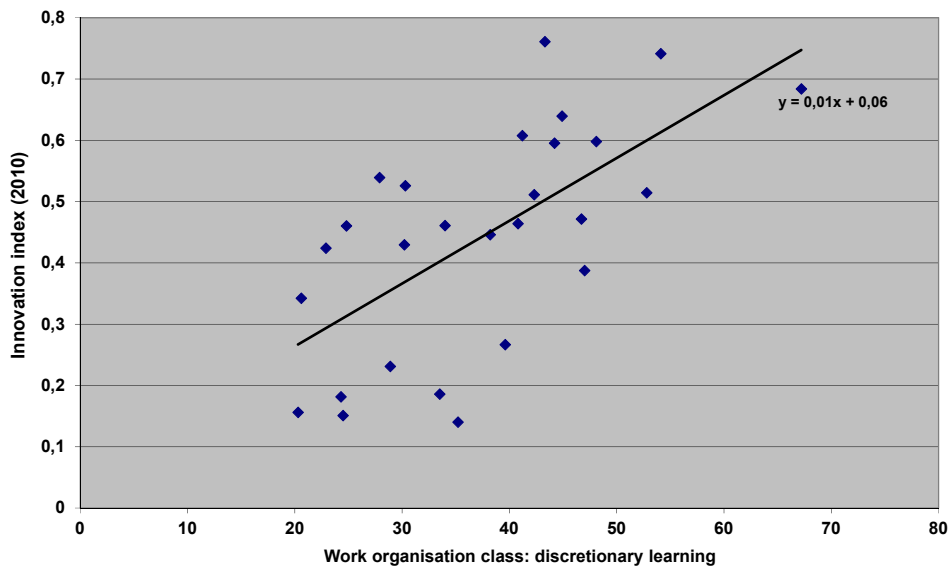
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2. Country clusters according to work organisation, workplace learning, and innovation

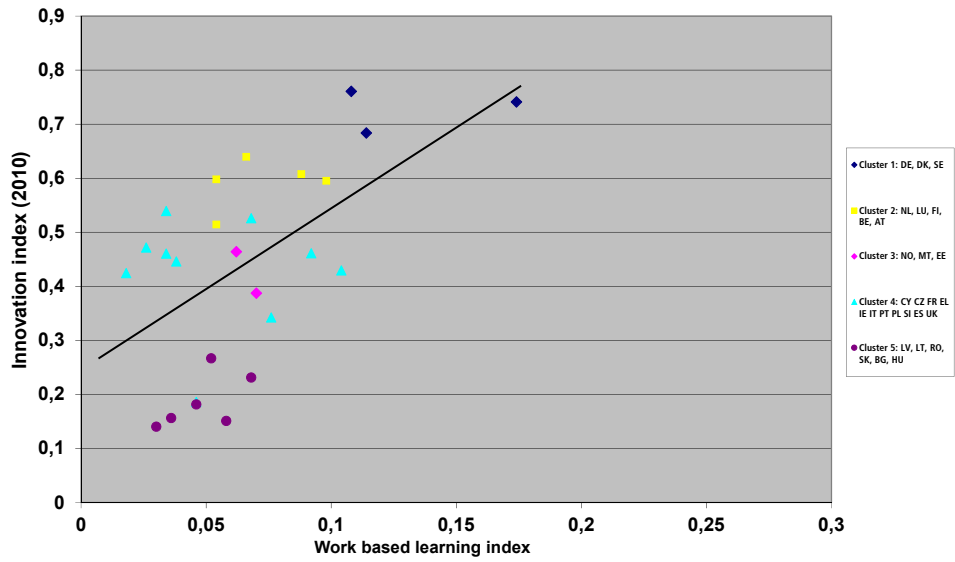


Advanced	Follower	Moderate 1: High learning, moderate innovation	Moderate 2: Low learning, moderate innovation	Catching up
Work organisation high (0.680)	Work organisation high (0.659)	Work organisation high (0.700)	Work organisation low (0.585)	Work organisation low (0.580)
Workplace learning high (0.132)	Workplace learning moderate (0.072)	Workplace learning moderate (0.074)	Workplace learning low (0.042)	Workplace learning low (0.048)
Innovation high (0.729)	Innovation moderate to high (0.591)	Innovation moderate (0.413)	Innovation moderate (0.461)	Innovation low (0.187)
Denmark	Austria	Estonia	Cyprus	Bulgaria
Germany	Belgium	Malta	Czech Republic	Hungary
Sweden	Finland	Norway	France	Latvia
	Luxemburg		Greece	Lithuania
	Netherlands		Ireland	Poland
			Italy	Romania
			Portugal	Slovakia
			Slovenia	
			Spain	
			United Kingdom	

2. Discretionary learning and innovation



2. Work-based learning and innovation

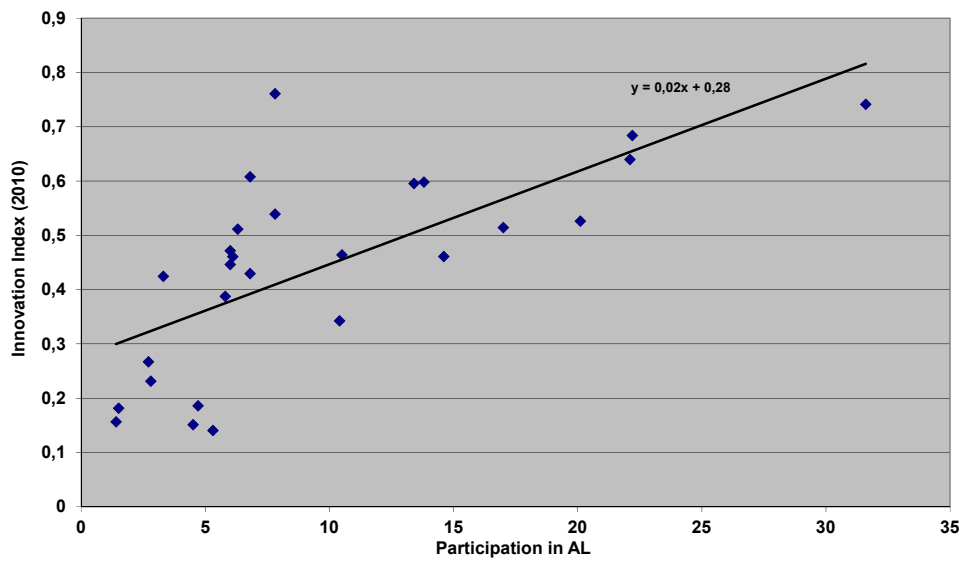


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4

2. Participation in ALE and Innovation



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5

## 2. What drives innovation? – (bi-variate) Regressions

Dependent	Independent	C	Sig. C	B	Beta	Sig.	R <sup>2</sup>
Innovation index (2010)	R&D/GDP (2009)	0,19	0,00	0,15	0,82	0,00	0,67
Innovation index (2010)	GDP per capita	0,20	0,01	0,00	0,61	0,00	0,37
Innovation index (2010)	Cognitive factors	-0,60	0,06	1,53	0,57	0,00	0,57
Innovation index (2010)	Labour productivity per hour	0,09	0,19	0,00	0,74	0,00	0,55

Innovation Index (2010)	Participation in AL (LFS)	0,28	0,00	0,02	0,69	0,00	0,46
Innovation index (2010)	Work Based Learning index (2005)	0,23	0,00	3,08	0,57	0,00	0,33
Innovation index (2010)	Work organisation index new (2010)	-0,16	0,62	1,10	0,35	0,07	0,12
Innovation index (2010)	Share of training enterprises as % of total (2005)	0,05	0,57	0,01	0,70	0,00	0,49
Innovation index (2010)	Employee participation in CVT courses (2005)	0,17	0,05	0,01	0,57	0,00	0,32

Innovation index (2010)	Work orga: discretionary learning	0,06	0,54	0,01	0,65	0,00	0,42
Innovation index (2010)	Work orga: taylorist	0,73	0,00	-0,02	-0,61	0,00	0,37
Innovation index (2010)	Work orga: lean production	0,70	0,00	-0,01	-0,28	0,16	0,08
Innovation index (2010)	Work orga: traditional or simple	0,63	0,00	-0,01	-0,31	0,12	0,09

## 2. What drives innovation? – (multi-variate) regressions

Innovation index (2010)	Work Based Learning index (2005)	0,14	0,01	1,23	0,22	0,13	0,80
	R&D/GDP (2009)			0,13	0,70	0,00	
Innovation index (2010)	Work Based Learning index (2005)	0,12	0,12	1,99	0,38	0,03	0,45
	GDP per capita			0,00	0,47	0,01	
Innovation index (2010)	Work Based Learning index (2005)	-0,34	0,31	1,94	0,36	0,09	0,41
	Cognitive factors			0,95	0,36	0,09	
Innovation index (2010)	Work Based Learning index (2005)	-0,02	0,94	2,78	0,51	0,01	0,35
	Work organisation index new (2010)			0,50	0,16	0,39	
Innovation index (2010)	Work Based Learning index (2005)	0,07	0,57	2,64	0,49	0,01	0,36
	Share of tertiary education			0,01	0,30	0,09	
Innovation index (2010)	Work organisation index new (2010)	0,55	0,08	-0,56	-0,18	0,36	0,50
	Participation AL (LFS)			0,02	0,81	0,00	

**Role of WBL remains positive and visible, even when controlling for other relevant factors (though sometimes not significant at 0.1% level)**

## 1. Background: Correlation between discretionary learning and innovation



Innovation index (2010)	Work Based Learning index (2005)	0,02	0,82	1,75	0,33	0,07	0,52
	Work organisation form: discretionary learning			0,01	0,50	0,01	
Innovation index (2010)	Work Based Learning index (2005)	0,13	0,15	2,01	0,38	0,06	0,43
	Employee participation in CVT			0,01	0,37	0,07	
Innovation index (2010)	Work Based Learning index (2005)	0,45	0,03	2,86	0,53	0,01	0,37
	Work organisation form: lean production			-0,01	-0,21	0,23	
Innovation index (2010)	Work Based Learning index (2005)	0,03	0,74	1,01	0,19	0,35	0,52
	Share of training enterprises			0,01	0,59	0,01	
Innovation index (2010)	Work Based Learning index (2005)	0,24	0,00	0,84	0,16	0,45	0,52
	Participation in AL (LFS)			0,02	0,60	0,01	

**Role of WBL remains positive and largely significant at 0.1%-level when other learning factor are controlled for**

## 1. Background: Correlation between discretionary learning and innovation



Innovation index (2010)	Work Based Learning index (2005)	-0,27	0,40	1,31	0,25	0,20	0,54
	Cognitive factors			0,66	0,25	0,21	
	GDP per capita			0,00	0,44	0,02	
Innovation index (2010)	Work Based Learning index (2005)	0,24	0,00	0,84	0,16	0,45	0,52
	Participation AL (LFS)			0,02	0,60	0,01	
	Cognitive factors						
Innovation index (2010)	Work based learning index	-0,34	0,31	1,94	0,36	0,09	0,41
	Cognitive factors			0,95	0,36	0,09	
	Share of tertiary education						

**Role of WBL turns insignificant when controlling for GDP per capita and/or participation in AL (LFS)**

## 1. Background: Correlation between discretionary learning and innovation



Innovation index (2010)	Work organisation index new (2010)	-0,56	0,10	-0,33	-0,11	0,66	0,33
	Cognitive factors			1,73	0,65	0,01	
Innovation index (2010)	Work organisation index new (2010)	0,25	0,51	-0,97	-0,31	0,16	0,54
	Participation AL (LFS)			0,02	0,68	0,00	
	Cognitive factors			0,83	0,31	0,19	
Innovation index (2010)	Work organisation new (2010)	-0,43	0,17	-0,10	-0,03	0,88	0,50
	Cognitive factors			1,06	0,39	0,08	
	GDP per capita			0,00	0,49	0,01	
Innovation index (2010)	Work organisation index new (2010)	-0,54	0,09	-0,84	-0,27	0,26	0,45
	Cognitive factors			1,76	0,65	0,01	
	Share of tertiary education			0,01	0,37	0,04	

**Role of work organisation is insignificant and usually negative, when controlling for other relevant factor**

**This raises the question, what the role of work organisation is in this regard or whether it has to be specified differently (e.g. discretionary learning)**

## 1. Background: Correlation between discretionary learning and innovation



Innovation index (2010)	Work organisation index new (2010)	-0,56	0,10	-0,33	-0,11	0,66	0,33
	Cognitive factors			1,73	0,65	0,01	
Innovation index (2010)	Work organisation index new (2010)	0,25	0,51	-0,97	-0,31	0,16	0,54
	Participation AL (LFS)			0,02	0,68	0,00	
	Cognitive factors			0,83	0,31	0,19	
Innovation index (2010)	Work organisation new (2010)	-0,43	0,17	-0,10	-0,03	0,88	0,50
	Cognitive factors			1,06	0,39	0,08	
	GDP per capita			0,00	0,49	0,01	
Innovation index (2010)	Work organisation index new (2010)	-0,54	0,09	-0,84	-0,27	0,26	0,45
	Cognitive factors			1,76	0,65	0,01	
	Share of tertiary education			0,01	0,37	0,04	

**Role of cognitive factor (EWCS) or „work complexity“ is often significant and positive, and (will) be investigated more in-depth during the study**



## 3. Statistical analyses in relation to innovation output



Dependent	Independent	Beta coefficient	R <sup>2</sup>
Innovation index (2010)	Factor 1 (Organisation typology)	0.11	0.84
	Factor 2 (Human Capital Formation)	0.27	
	GDP per capita (2010)	0.03	
	Cognitive factors (all years)	0.78***	
	Share of tertiary education (2005)	-0.01	

Whatever statistical analyses we did, cognitive factors – which, in fact, refers to task complexity of the workplace, turned out the most important factor

This finding is in line with the work organisation literature (e.g. Lorenz et al. 2016) ...

... as well as with discussions on the importance of learning in the workplace (e.g. Stiglitz/Greenwald 2014)

## 3. FE and innovation: repeating the analysis with more recent data ...



	Innovation index 2015		Innovation index 2014		Innovation index 2013		Innovation index 2012	
	B	Beta	B	Beta	B	Beta	B	Beta
Constant	-.172		-.256		-.272		-.153	
Factor 1 Organisation typology	-.006	-.027	-.014	-.062	-.015	-.063	-.016	-.071
Factor 2 Human capital formation	.068*	.375*	.063*	.330*	.064*	.322*	.072*	.392*
Cognitive factors	.859	.510	.977*	.544*	.971*	.522*	.837*	.487*
GDP per capita, PPP	1.660 E-6	.147	1.897E-6	.155	2.347 E-6	.177	1.509 E-6	.125
Educational attainment	.001	.067	.002	.081	.002	.089	.001	.062
R Square	86.8		.841		.832		.780	

Cognitive factors still reveals significant and positive correlations with innovation output

In contrast to previous analyses, „Human Capital Formation“ turned out to be significantly correlated to innovation, as well“

HCF is composed of various indicator on LLL (e.g. company participation in CVT, LFS participation rate in ALE, company expenses for training, etc.

According to our analysis, it is further education that matters, not higher education

## 4. Further education and growth

Countries with higher growth rates show higher participation rates in FE

	FE1	FE2	RE1	RE2
	Real GDP growth	Real GDP growth	Real GDP growth	Real GDP growth
AES participation	0.827***	1.048***	0.569**	0.542**
Time lag of AES participation (participation rate in previous year)		0.274**		0.355****
GDP per capita	3.248'	1.142	-0.389'	-0.477***
Year dummy	yes	yes	yes	yes
N	44.000	37.000	44.000	37.000
r2_w	0.627	0.731	0.489	0.609

Standardised Beta Coefficients. Significance levels: 'p < 0.10, \*\*p < 0.05, \*\*\*p < 0.01, \*\*\*\*p < 0.001

Table 1: Fixed effects estimation results of AES participation on growth. Years 2007 and 2011

Accounting for lag effects strengthens this correlation

## 5. Summary and conclusions

Our research challenges the „perceived wisdom“ of the link between (initial) education and growth as well as innovation, and it adds to the research on learning within the organisation,

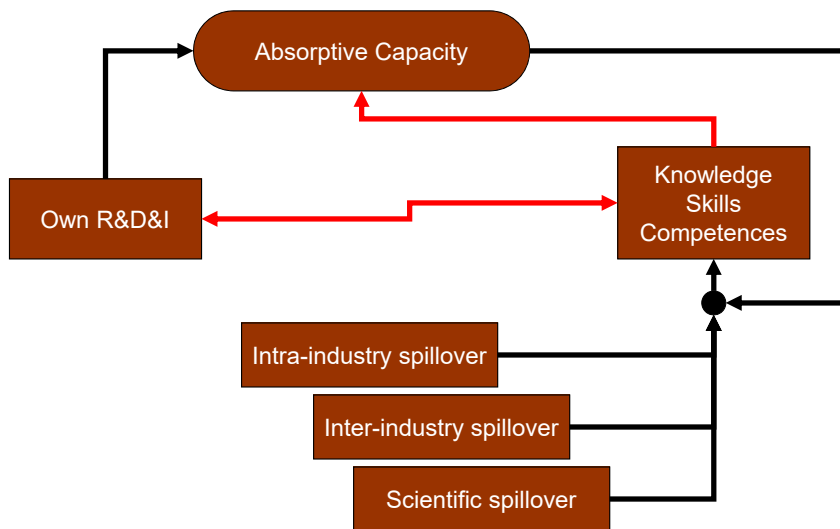
The findings seem to support Sala-i-Martin (1996) amendment to the new growth theory theoretical approach (intra-firm externalities), though not concerning growth, but in relation to innovation.

However it is not yet finally clear, what the causality is, i.e. whether higher innovation levels or growth rates request adult learning or whether adult learning is a driver for growth and innovation

Yet, the preliminary conclusion is that the latter might be the case

Eventually, adding PISA or PIAAC-data to the model does not alter the results.

## 5. Summary and conclusions



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## 1. Background: Work organisation



•The learning-orientation of types of work organisation can be measured with items of the European Working Conditions Survey. The following items were chosen:

- The eight original items within the category 'work organisation' (excluding the composed index 'Level of group autonomy')
  - Are you able to choose or change your order of tasks? (q50a)
  - Are you able to choose or change your methods of work? (q50b)
  - Are you able to choose or change your speed or rate of work? (q50c)
  - Are you involved in improving the work organisation or work processes of the department or organisation? (q51d)
  - Do you have a say in the choice of your working partners? (q51e)
  - Can you take a break when you wish? (q51f)
  - Can you influence decisions that are important for your work? (q51o)
  - Do you work in a group or team that has common tasks and can plan its work? (q56)
- Six of the nine items from the category 'cognitive factors', which also address organisational issues, in terms of task allocation:
  - Do you assess the quality of your own work? (q49b)
  - Does your work involve solving unforeseen problems on your own? (q49c)
  - Does your work involve monotonous tasks? (q49d)
  - Does your work involve complex tasks? (q49e)
  - Does your work involve learning new things? (q49f)

## 1. Background: Workplace learning



Workplace-related forms of learning can be measured with an item within the 3<sup>rd</sup> continuing vocational training survey (CVTS3, Eurostat 2006):

- Participants in other form of CVT as a percentage of employees in all enterprises by SIZE and type of training [trng\_cvts3\_50].
- Within this item, several sub-categories are coded:
  - WS: Continuing vocational training in work situation
  - JROT: Job rotation, exchanges or secondments
  - LQUC: Learning/quality circles
  - SLEAR: Self-learning
  - CONF: Continued training at conferences, workshops, lectures and seminars
- For the analysis within this study, the last sub-category (CONF) was excluded, because it refers to learning activities not related to the workplace

## 1. Background: Innovation



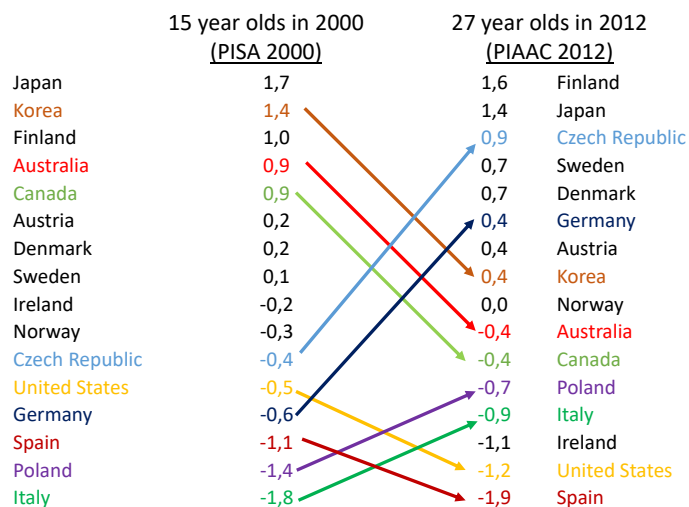
Innovation is measured by the European innovation Scoreboard (EIS, InnoMetrics, 2010). Only throughput and output parameters were included in the analysis:

- Linkages & entrepreneurship
  - 2.2.1 SMEs innovating in-house
  - 2.2.2 Innovative SMEs collaborating with others
  - 2.2.3 Public-private co-publications
- Intellectual Assets
  - 2.3.1 PCT patent applications
  - 2.3.2 PCT patent applications in societal challenges
  - 2.3.3 Community trademarks
  - 2.3.4 Community designs
- Innovators
  - 3.1.1 SMEs introducing product or process innovations
  - 3.1.2 SMEs introducing marketing/organisational innovations
- Economic effects
  - 3.2.1 Employment in knowledge-intensive activities
  - 3.2.2 Medium and high-tech product exports
  - 3.2.3 Knowledge-intensive services exports
  - 3.2.4 Sales of new to market and new to firm innovations
  - 3.2.5 Licence and patent revenues from abroad

## 2. Why might initial education be overvalued?



How do competencies develop over time?  
The birth cohort 1985 participated as ...

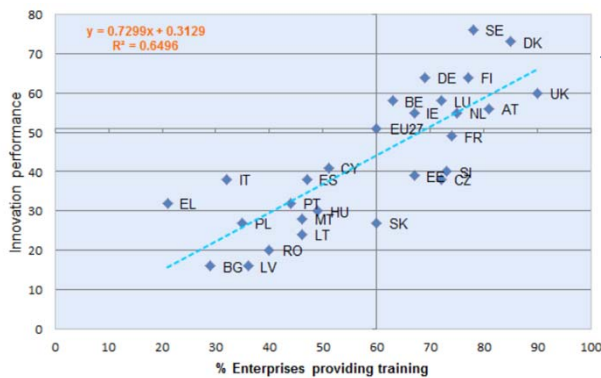


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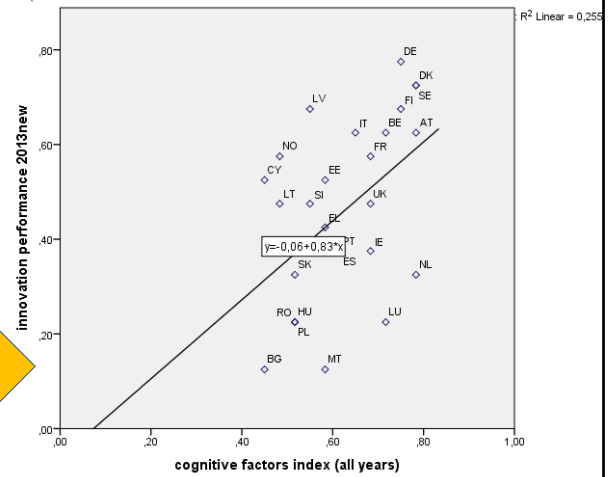
This casts doubts whether the competence levels of initial education are really as important for growth as stated in some studies (e.g. Hanushek/Woesman 2015)!

2. Further education and innovation

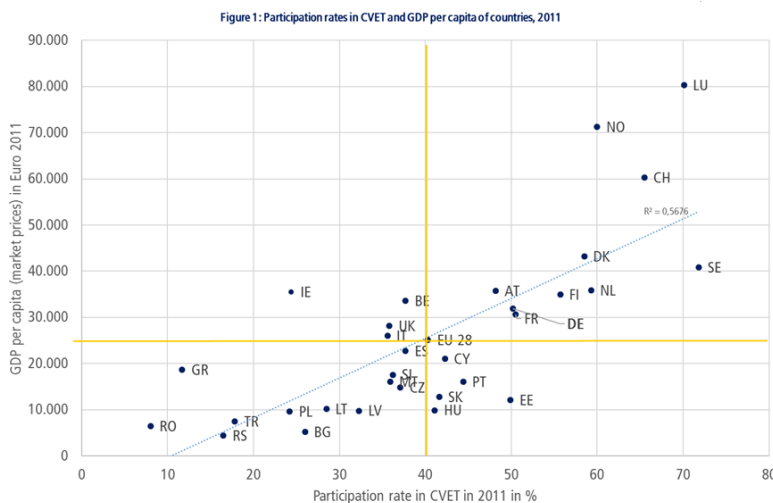


Innovation performance is higher in countries where more companies are engaged in continuing training

Innovation performance is higher in countries where learning in the workplace through task complexity takes place

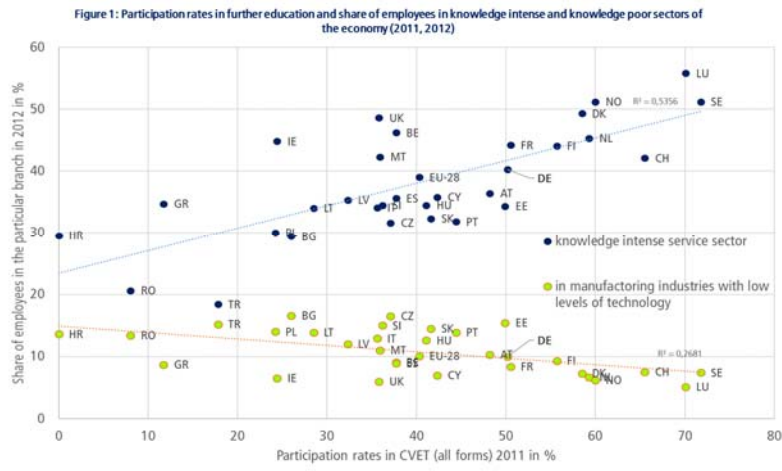


2. Further education and growth



Participation in adult learning is higher in countries with higher GDP per capita

2. Further education and growth



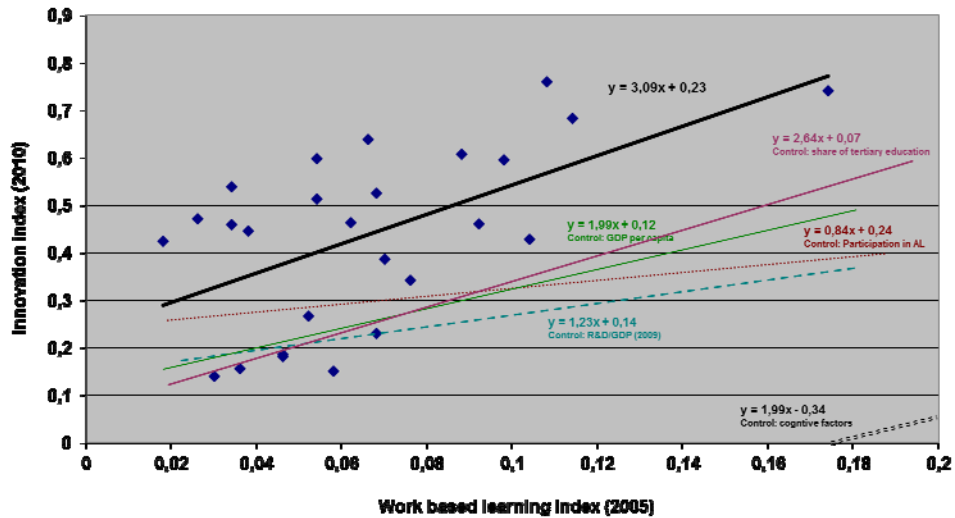
2. Further education and employment



...

...

## 3. What



## 5. Summary and conclusions

Our results clearly indicate that task complexity is a major driver of innovation output,  
 Human capital formation (i.e. further education) plays an important role, as well,  
 While, in contrast, higher education is unimportant