

## **Changing skill demand and the comparative advantage of age:**

Job tasks and earnings from the 1980s to the 2000s in Germany

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Second International BIBB/IAB Workshop  
Bonn, January 17-18, 2012

## Outline

- Motivation
- Approach
- Task demands
- Task rewards
- Summary and discussion

## Motivation

- 80s to 2000s: Germany experienced rapid technological and industrial change (increase in the use of computers, fast growth in service and ICT Sectors and a decline in the industrial and agricultural employment).
- Growth in mentally intense work-tasks and adaptation of new technologies.
- Workers in their 50s earned increasingly more relative to workers in the 40s and 30s
- This could be a paradox as most existing micro-level evidence suggests that rapid technological change is biased against the elderly.
- To understand the causes of these changes, we study changes in work tasks for the Germany economy.

## Motivation

- People's abilities tend to differ by age - even if education or occupation should be the same. Cognitive research shows that certain cognitive skills, including immediate recall, processing speed and reasoning, decline with age, while others, including verbal fluency, remain more stable (Verhaegen et al 1997).
- Economists have identified that rapid technological changes in the workplace can decrease labour market outcomes and raise the risk of job loss for seniors, which has been speculated to be because technological shift that worsens the comparative advantages of seniority (Bartel et al 1993, Ahituv et al. 2000).

## Motivation

- Real earnings, however, have consistently declined among younger (25-34 year old) relatively to senior (45-54 year old) male workers across the OECD from the 1980s to the 2000s (Bell et al. 2007)

## Approach

- Data from the German Qualification and Career Survey (BIBB/IAB)
- We exclude the first wave (1979) as the questionnaire for this year was very different
- We categorize tasks into three groups tasks; those that are intense in the use of fluid cognitive abilities (including problem solving), tasks intensive in crystallized cognitive abilities (including communication) and physical demands
- Only men with German nationality working in West Germany (excluding Berlin) have been selected
- Only individuals who work at least 15 hours weekly have been considered
- We distinguish between three age groups: 30-39, 40-49, 50-59

## Development of Task Demands

- Goal: to show how relevant tasks with intense use of fluid abilities, tasks with intense use of crystallized abilities and physical demanding tasks are at the work place.

- Task Measure (following Black and Spitz-Oener 2007,2010):

$$T_{i,k,t} = \frac{\text{Number of activities in category } k \text{ performed by individual } i \text{ in time } t}{\text{Total number of activities in category } k \text{ at time } t} * 100$$

- Where t=1986, 1992, 1999 and 2006 and k represents the task group (in our case k=1 are tasks with intense use of fluid abilities, k=2 are tasks with intense use of crystallized abilities, and k=3 physical tasks) and all activities are considered equally important

# Task Classification

<b>(1) Tasks with intense use of fluid abilities</b>	
<b>1985-86</b>	
v21	Analysieren; forschen, erproben, prüfen, messen
v22	Planen, konstruieren, entwerfen/gestalten, zeichnen
<b>1991-92</b>	
v52	Analysieren, forschen, erproben, prüfen, messen, planen
v53	Konstruieren, entwerfen, zeichnen, Künstlerisch gestalten
<b>1998-99</b>	
v197	Informationen sammeln/auswerten, recherchieren
v199	Entwickeln, forschen
<b>2006</b>	
F311	Entwickeln, forschen, konstruieren
F313	Informationen sammeln, recherchieren, dokumentieren



## (2) Tasks with intense use of crystallized abilities

### 1985-86

v23	Kaufen/verkaufen, kassieren; vermitteln, Kunden beraten verhandeln, werben
v29	Erziehen/lehren/ausbilden; beratend helfen
v31	Publizieren, unterhalten, vortragen
v32	Mitarbeiter anleiten/anweisen, einstellen
v33	Disponieren, koordinieren, organisieren; führen/ leiten /Management, controlling
v24	Schreibarbeiten/Schriftverkehr, Formulararbeiten
v25	Kalkulieren/berechnen, buchen

### 1991-92

v54	Kaufen, verkaufen, kassieren, vermitteln, Kunden beraten, werben
v60	Erziehen/lehren/ausbilden; beratend helfen
v62	Publizieren, unterhalten, vortragen, gestalten
v63	Personal einstellen, Mitarbeiter anleiten, kontrollieren, beurteilen
v64	Entscheiden, koordinieren, organisieren, disponieren
v55	Schreibarbeiten, Schriftverkehr, Formulararbeiten
v56	Kalkulieren, berechnen, buchen

### 1998-99

v189	Ausbilden, lehren, unterrichten
v190	Andere beraten, informieren
v194	Einkaufen, beschaffen, verkaufen
v195	Organisieren, planen
v196	Werben, Öffentlichkeitsarbeit/PR, Marketing, akquirieren
v191	Messen, prüfen, Qualitätskontrolle

### 2006

F307	Einkaufen, beschaffen, verkaufen
F309	Werben, Öffentlichkeitsarbeit/PR, Marketing,
F310	Organisieren, planen und vorbereiten von Arbeitsprozessen. Gemeint sind hier nicht die eigenen Arbeitsprozesse
F312	Ausbilden, lehren, unterrichten, erziehen
F314	Beraten, informieren
F304	Messen, prüfen, Qualitätskontrolle

<b>(3) Tasks that require physically abilities</b>	
<b>1985-86</b>	
v12	Maschinen, Automaten, Anlagen bedienen, steuern, beschicken
v13	Reparieren, warten, instandsetzen
<b>1991-92</b>	
v39	Maschinen, Anlagen bedienen, steuern, beschicken
v40	Maschinen, Anlagen reparieren, warten, instandsetzen
<b>1998-99</b>	
v192	Überwachen, steuern von Maschinen, Anlagen, technische prozessen
v193	Reparieren, instandsetzen
<b>2006</b>	
F305	Überwachen, steuern von Maschinen, Anlagen, technische prozessen
F306	Reparieren, instandsetzen

# Development of Task Demands

	1986	1992	1999	2006
<b>Age group 30-39:</b>				
Tasks with intense use of fluid abilities	14,2	16,4	20,2	33,8
Tasks with intense use of crystallized abilities	21,3	23,3	32,7	33,9
Physical demanding tasks	24,4	23,2	30,7	33,0
<b>Age group 40-49</b>				
Tasks with intense use of fluid abilities	14,3	13,8	21,0	32,7
Tasks with intense use of crystallized abilities	20,9	24,3	34,5	33,0
Physical demanding tasks	26,6	19,3	27,4	32,0
<b>Age group 50-59</b>				
Tasks with intense use of fluid abilities	12,1	10,8	22,3	33,5
Tasks with intense use of crystallized abilities	19,4	19,9	35,6	32,7
Physical demanding tasks	26,6	21,2	24,3	29,0
<b>All ages</b>				
Tasks with intense use of fluid abilities	13,2	13,8	21,0	33,7
Tasks with intense use of crystallized abilities	20,4	21,7	33,8	33,3
Physically demanding tasks	25,4	22,3	28,1	31,0

Source: BIBB-IAB, own calculations. Weighted data.

## Development of Task Demands

- There is an increase in cognitive relative to physical task use for all ages.
- The shift has been stronger toward fluid rather than crystallized abilities.
- Individuals in their 50s experienced a more rapid growth in cognitively intense work tasks than those in their 30s.

## Development of Task Demands

- Average task growth rates relative to 1986:

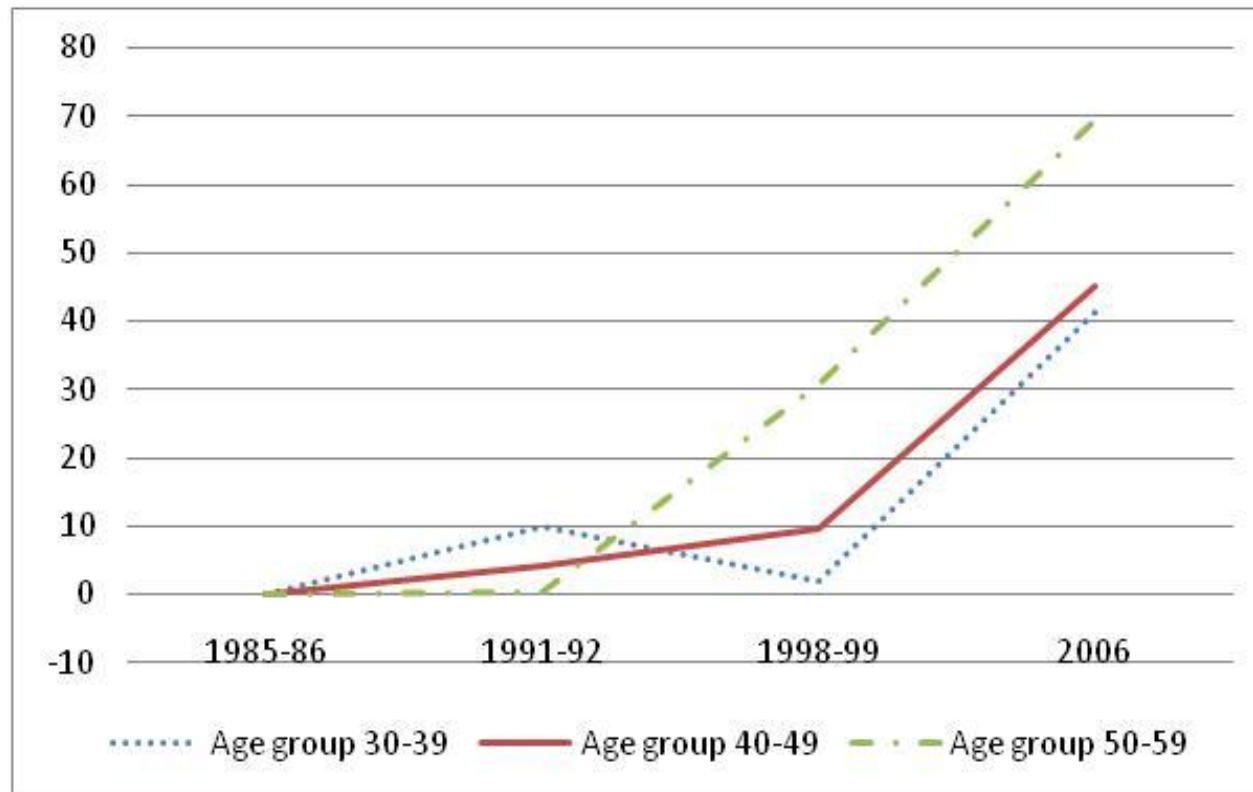
$$\overline{TGR}_{AG,k,t} = \frac{(\bar{T}_{AG,k,t} - \bar{T}_{AG,k,86})}{\bar{T}_{AG,k,86}} * 100$$

where t=1992, 1999, 2006, k represents the task groups (k=1,2,3), and AG represents the different age groups (AG=30-39, 40-49, 50-59)

Tasks measures have been standardized so that for each period and age group the sum of the 3 task measures is equal to 100. In this way we can observe the change relative to the other abilities.

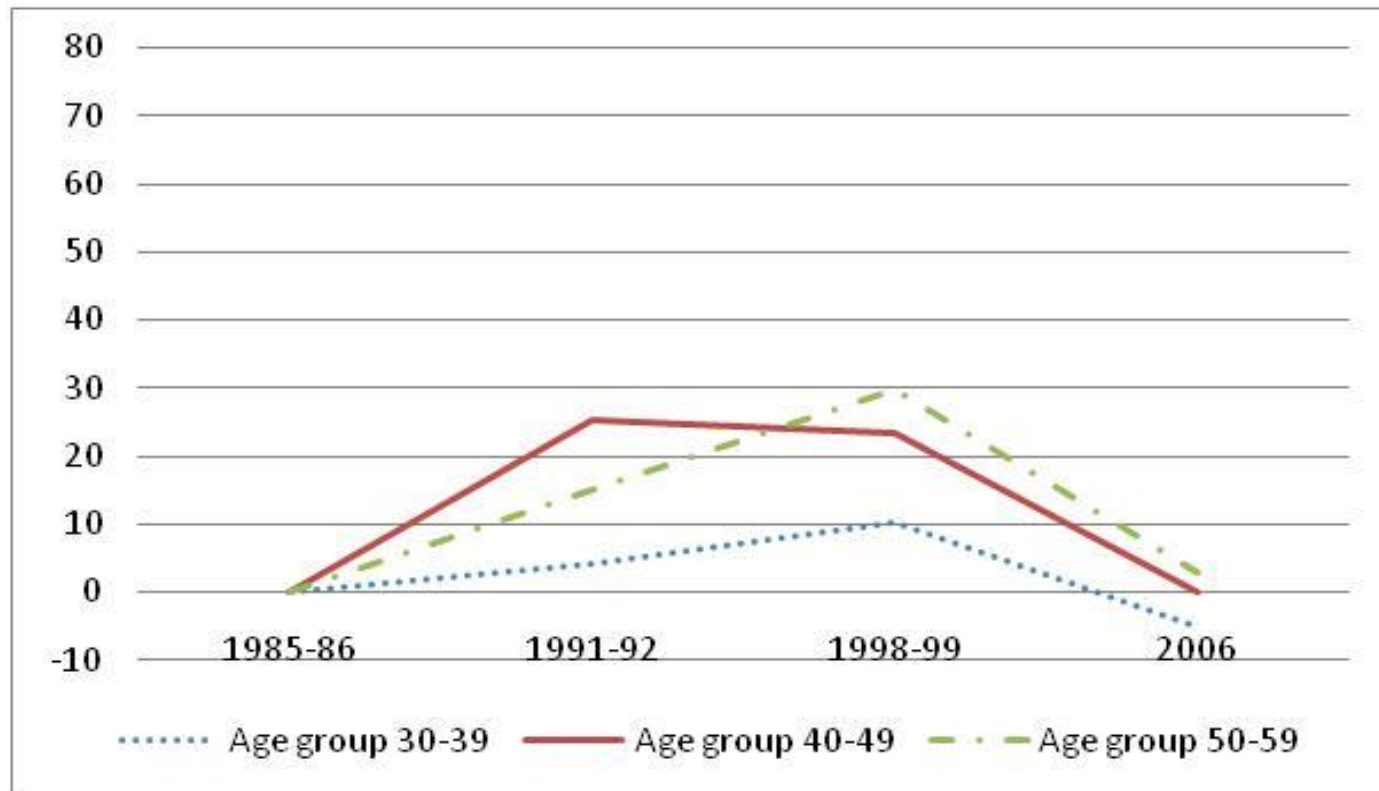
## Development of Task Demands

- Changes in tasks with intense use of fluid abilities



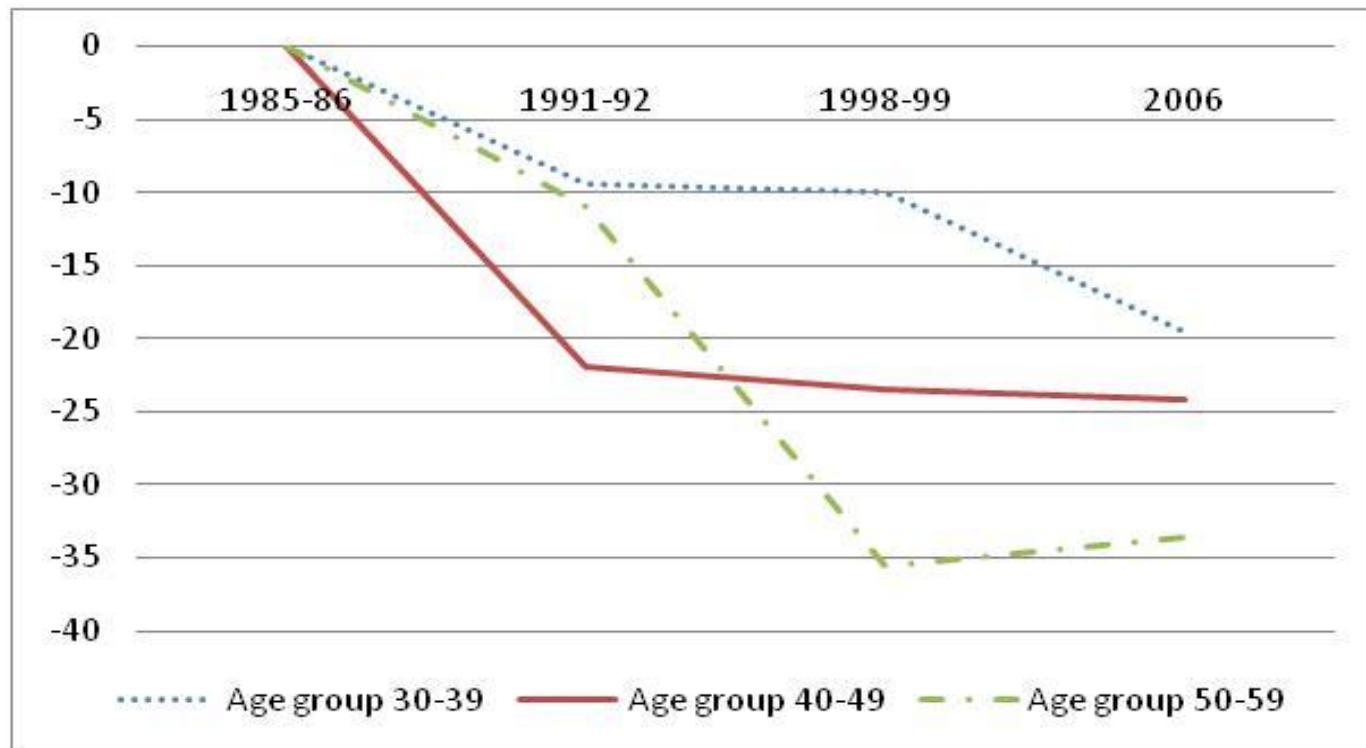
## Development of Task Demands

- Changes in tasks with intense use of crystallized abilities



## Development of Task Demands

- Changes in physical demanding tasks



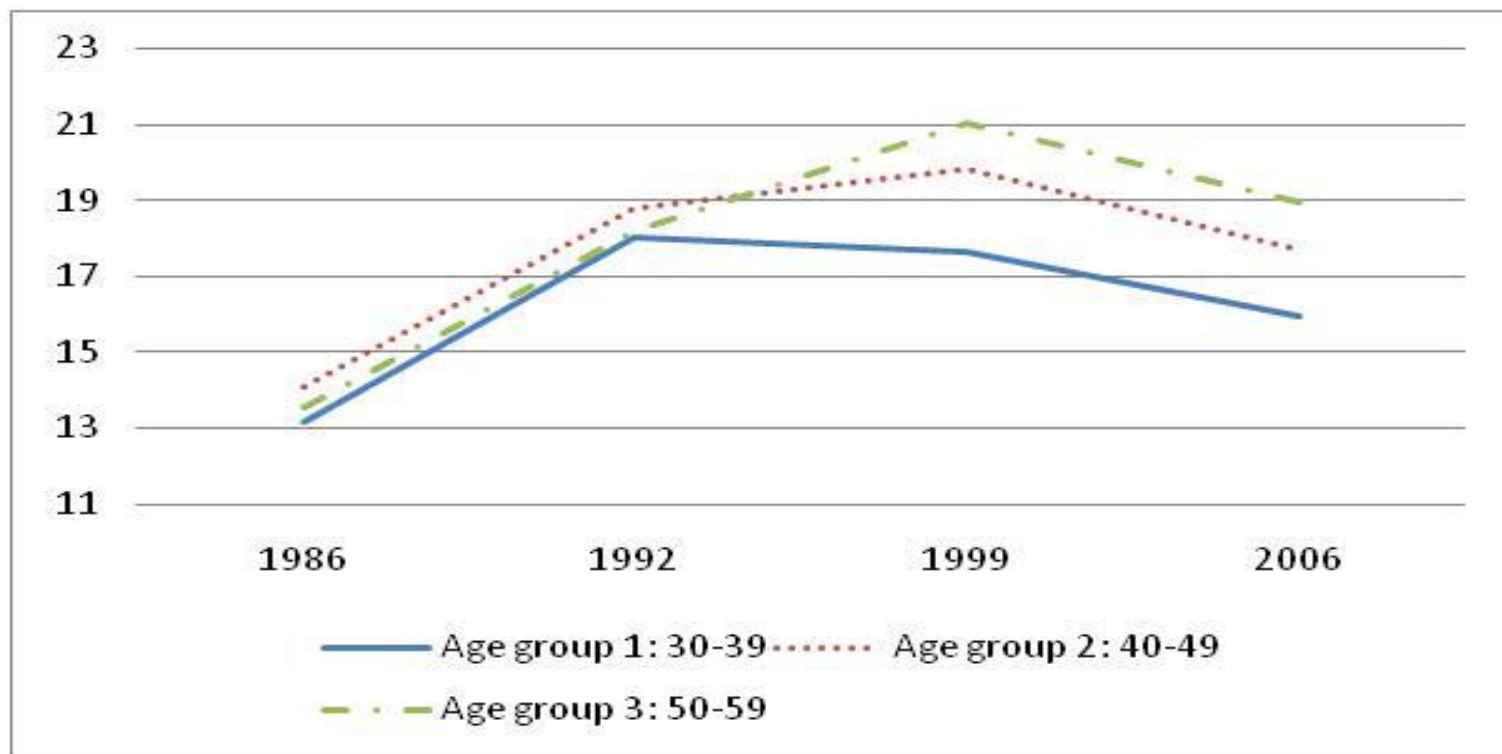


## Development of Task Demands

- In spite of the fact that from 30s onwards one generally performs less well with tasks intense in use of fluid abilities, seniors are increasingly employed in work tasks that are intense in the use of these abilities.
- In terms of employment, seniors may have been „successful“ in terms of increasingly becoming active in job tasks where they may have a comparative disadvantage.

## Development of Task Rewards

–Development of hourly wages



	Model 1		Model 2		Model 3		Model 4	
	Coef./Std.er.		Coef./Std.er.		Coef./Std.er.		Coef./Std.er.	
FLUID	0.000**	(0.00)	0.000*	(0.00)	0.001***	(0.00)	0.000*	(0.00)
CRYSTALLIZED	0.002***	(0.00)	0.002***	(0.00)	0.003***	(0.00)	0.002***	(0.00)
PHYSICAL	-0.001***	(0.00)	-0.001***	(0.00)	-0.001***	(0.00)	-0.001***	(0.00)
FLUID*Aged 40-49	0.001***	(0.00)					0.001***	(0.00)
CRYSTALLIZED*Aged 40-49	0.002***	(0.00)					0.002***	(0.00)
PHYSICAL*Aged 40-49	-0.000*	(0.00)					-0.000*	(0.00)
FLUID*Aged 50-59			0.001	(0.00)	-0.001	(0.00)	0.001	(0.00)
CRYSTALLIZED*Aged 50-59			0.002***	(0.00)	0.000	(0.00)	0.002***	(0.00)
PHYSICAL*Aged 50-59			-0.001**	(0.00)	-0.000	(0.00)	-0.001**	(0.00)
FLUID*Wave 2	-0.000	(0.00)	-0.000	(0.00)	-0.001***	(0.00)	-0.000	(0.00)
CRYSTALLIZED*Wave 2	-0.001***	(0.00)	-0.001***	(0.00)	-0.002***	(0.00)	-0.001***	(0.00)
PHYSICAL*Wave 2	0.001***	(0.00)	0.001***	(0.00)	0.001***	(0.00)	0.001***	(0.00)
FLUID*Wave 3	0.000	(0.00)	0.000	(0.00)	-0.000	(0.00)	0.000	(0.00)
CRYSTALLIZED*Wave 3	-0.000	(0.00)	-0.000	(0.00)	-0.000	(0.00)	-0.000	(0.00)
PHYSICAL*Wave 3	0.001***	(0.00)	0.001***	(0.00)	0.001***	(0.00)	0.001***	(0.00)
FLUID*Wave 4	0.001*	(0.00)	0.001**	(0.00)	-0.000	(0.00)	0.001*	(0.00)
CRYSTALLIZED*Wave 4	-0.001**	(0.00)	-0.001**	(0.00)	-0.003***	(0.00)	-0.001**	(0.00)
PHYSICAL*Wave 4	0.001*	(0.00)	0.001*	(0.00)	0.000	(0.00)	0.001*	(0.00)
FLUID*Aged 40-49*Wave 2	-0.001*	(0.00)					-0.001*	(0.00)
CRYSTALLIZED*Aged 40-49*Wave 2	-0.001**	(0.00)					-0.001**	(0.00)
PHYSICAL*Aged 40-49*Wave 2	0.000	(0.00)					0.000	(0.00)
FLUID*Aged 40-49*Wave 3	-0.001	(0.00)					-0.001	(0.00)
CRYSTALLIZED*Aged 40-49*Wave 3	-0.000	(0.00)					-0.000	(0.00)
PHYSICAL*Aged 40-49*Wave 3	-0.000	(0.00)					-0.000	(0.00)
FLUID*Aged 40-49*Wave 4	-0.001	(0.00)					-0.001	(0.00)
CRYSTALLIZED*Aged 40-49*Wave 4	-0.002***	(0.00)					-0.002***	(0.00)
PHYSICAL*Aged 40-49*Wave 4	-0.000	(0.00)					-0.000	(0.00)
FLUID*Aged 50-59*Wave 2			-0.000	(0.00)	0.000	(0.00)	-0.000	(0.00)
CRYSTALLIZED*Aged 50-59*Wave 2			-0.001	(0.00)	0.000	(0.00)	-0.001	(0.00)
PHYSICAL*Aged 50-59*Wave 2			0.000	(0.00)	0.000	(0.00)	0.000	(0.00)
FLUID*Aged 50-59*Wave 3			0.000	(0.00)	0.001*	(0.00)	0.000	(0.00)
CRYSTALLIZED*Aged 50-59*Wave 3			-0.001	(0.00)	-0.001	(0.00)	-0.001	(0.00)
PHYSICAL*Aged 50-59*Wave 3			-0.000	(0.00)	-0.000	(0.00)	-0.000	(0.00)
FLUID*Aged 50-59*Wave 4			0.000	(0.00)	0.001	(0.00)	0.000	(0.00)
CRYSTALLIZED*Aged 50-59*Wave 4			-0.001	(0.00)	0.001	(0.00)	-0.001	(0.00)
PHYSICAL*Aged 50-59*Wave 4			-0.000	(0.00)	0.000	(0.00)	-0.000	(0.00)
Aged 40-49	-0.012	(0.02)					-0.006	(0.01)
Aged 50-59			-0.043**	(0.02)	-0.026	(0.02)	-0.039**	(0.02)
Wave 2 (1992)	0.351***	(0.01)	0.350***	(0.01)	0.374***	(0.01)	0.351***	(0.01)
Wave 3 (1998)	0.240***	(0.01)	0.240***	(0.01)	0.274***	(0.02)	0.241***	(0.01)
Wave 4 (2006)	0.116***	(0.02)	0.114***	(0.02)	0.238***	(0.02)	0.115***	(0.02)
Aged 40-49*Wave 2	0.022	(0.02)					0.021	(0.02)
Aged 40-49*Wave 3	0.036*	(0.02)					0.035	(0.02)
Aged 40-49*Wave 4	0.126***	(0.03)					0.126***	(0.03)
Aged 50-59*Wave 2			0.013	(0.02)	-0.008	(0.02)	0.013	(0.02)
Aged 50-59*Wave 3			0.096***	(0.02)	0.056**	(0.02)	0.094***	(0.02)
Aged 50-59*Wave 4			0.108***	(0.03)	-0.018	(0.03)	0.107***	(0.03)
No. of Observations	22,976		19,827		18,055		30,429	
R2	0.344		0.358		0.376		0.360	

## Development of Task Rewards

- The reward of the tasks with intense use of fluid abilities has increased during the period.
- The rewards on the tasks with intense use of crystallized abilities is on average higher than the reward of fluid abilities, but it decreases with time (this decline is more pronounced for middle aged workers (40-49) than for younger workers (30-39))

## Summary and Discussion

- Bringing these results together with the results on tasks demand we can conclude that the fact that older workers have adapted to changing labour market demands by increasing the type of fluid work intensive tasks (for which rewards have increased) and by increasing the use of crystallized abilities (for which reward are high) may at least partially explain greater earnings among seniors workers to other workers.
- Other explanations for rising age-earning profiles in Germany: seniority based earning-systems and “last-in, last-out” principle.

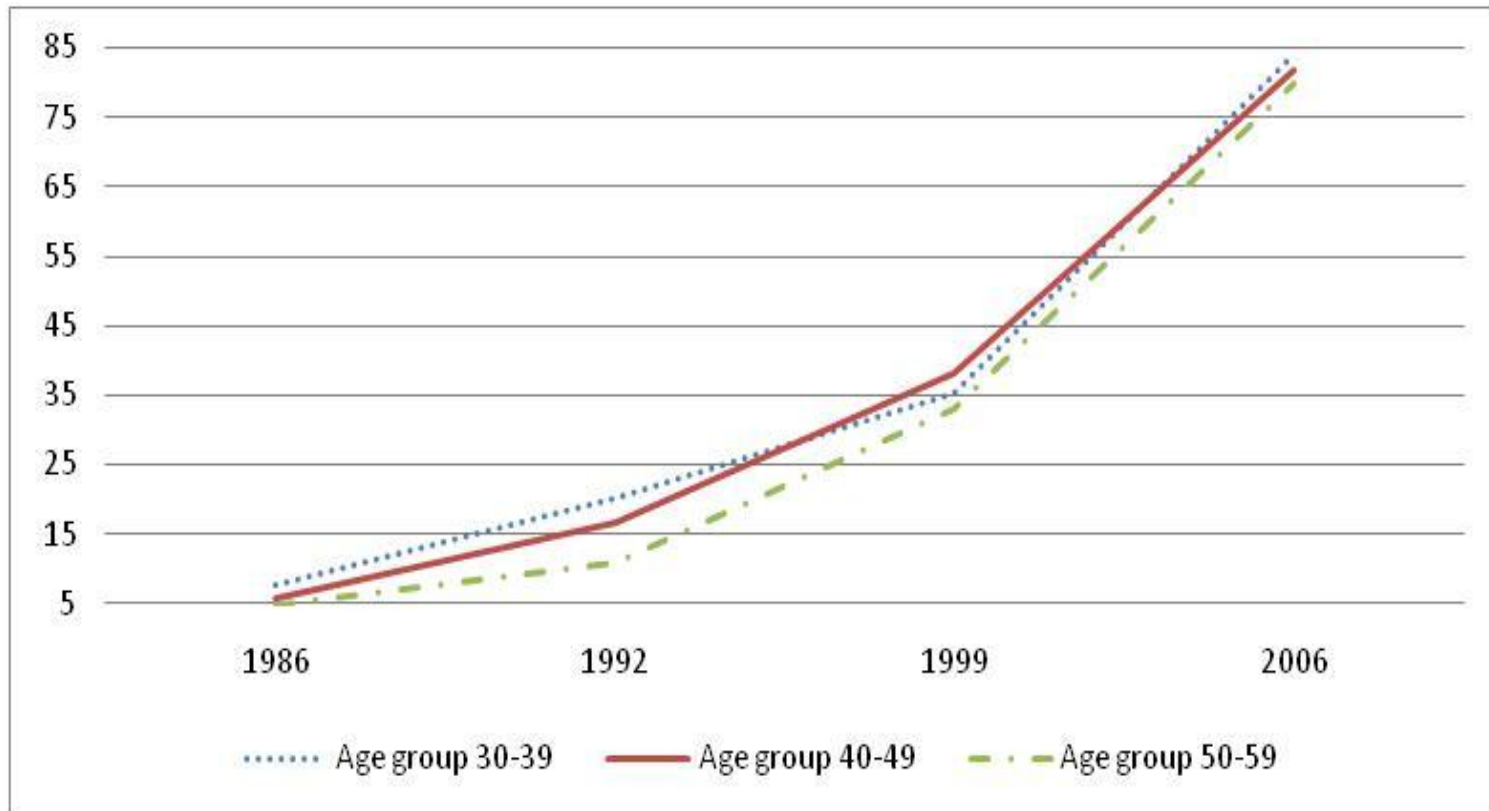
## Task Demands - Standardized

	1986	1992	1999	2006
<b>Age group 1: 30-39</b>				
Tasks with intense use of fluid abilities	23.7	26.1	24.2	33.6
Tasks with intense use of crystallized abilities	35.5	37.0	39.1	33.6
Physical demanding tasks	40.8	37.0	36.7	32.8
	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>
<b>Age group 2: 40-49</b>				
Tasks with intense use of fluid abilities	23.1	24.0	25.3	33.5
Tasks with intense use of crystallized abilities	33.8	42.3	41.6	33.8
Physical demanding tasks	43.1	33.6	33.0	32.7
	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>
<b>Age group 3: 50-59</b>				
Tasks with intense use of fluid abilities	20.8	20.8	27.2	35.2
Tasks with intense use of crystallized abilities	33.4	38.4	43.3	34.4
Physical demanding tasks	45.8	40.8	29.5	30.4
	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>

## Task Demands – By level of education

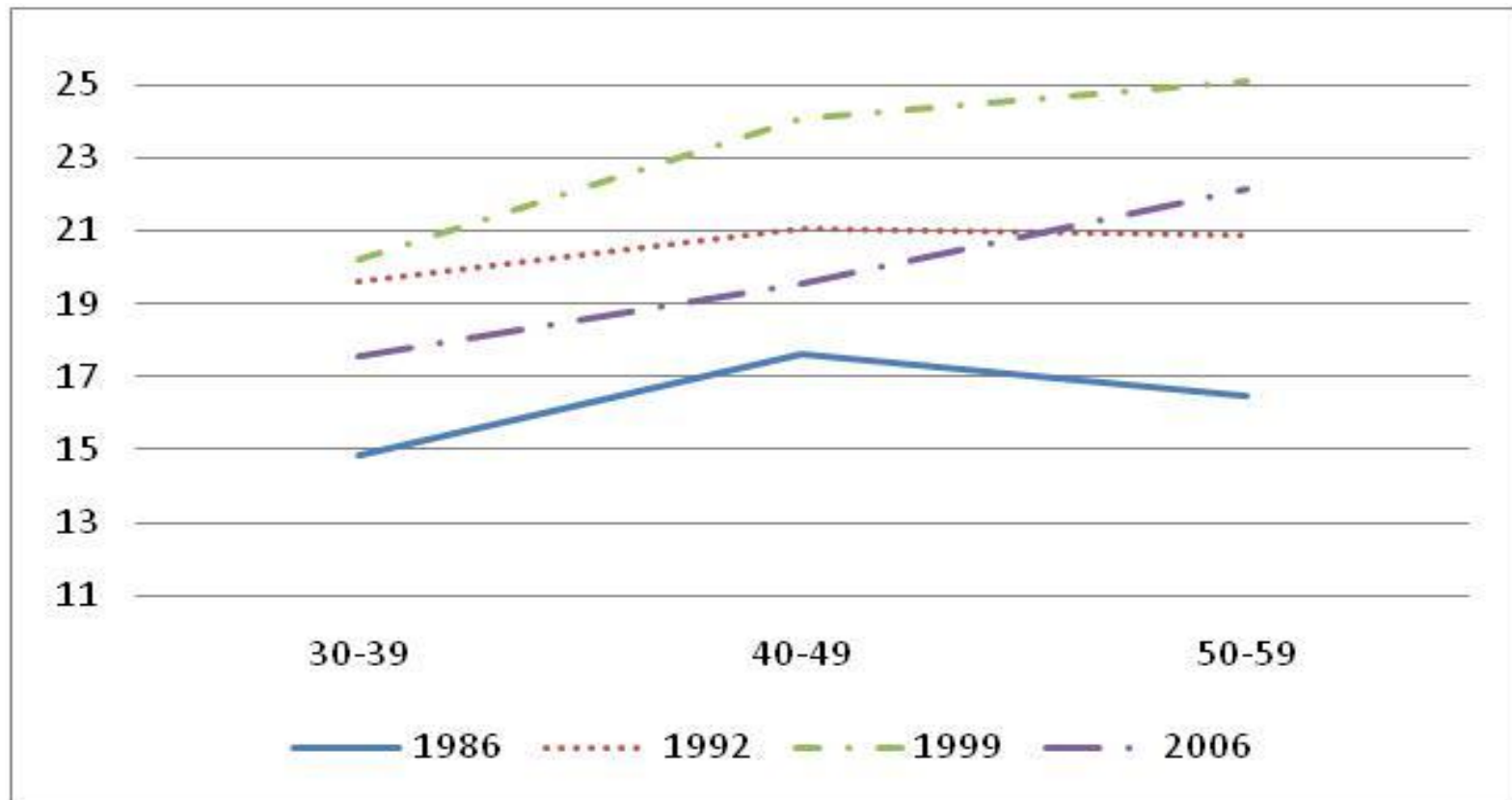
	1986	1992	1999	2006	1986	1992	1999	2006
	No vocational training				Apprenticeship / Basic voc. training			
<b>Age group 30-39</b>								
Tasks with intense use of fluid abilities	2.2	6.2	10.9	20.5	10.3	10.2	12.5	26.1
Tasks with intense use of crystallized abilities	6.5	9.1	17.9	24.0	18.0	16.3	28.4	32.0
Physical demanding tasks	22.5	19.9	25.0	37.4	29.3	30.1	35.5	40.3
<b>Age group 40-49</b>								
Tasks with intense use of fluid abilities	2.7	6.3	8.8	21.3	10.7	7.4	13.3	24.9
Tasks with intense use of crystallized abilities	6.5	10.0	18.2	26.4	17.5	17.3	29.0	30.0
Physical demanding tasks	32.1	20.1	27.8	34.8	30.1	25.1	32.1	39.1
<b>Age group 50-59</b>								
Tasks with intense use of fluid abilities	4.3	1.8	8.0	15.9	8.7	5.7	14.8	25.3
Tasks with intense use of crystallized abilities	7.2	6.3	19.0	21.0	17.1	14.5	29.7	28.2
Physical demanding tasks	33.0	26.4	28.0	33.1	28.0	24.6	29.7	35.8
	Trade or technical advanced voc. training				College education			
<b>Age group 30-39</b>								
Tasks with intense use of fluid abilities	18.7	22.5	24.4	35.2	30.5	30.6	46.2	55.1
Tasks with intense use of crystallized abilities	28.8	33.6	44.2	39.9	33.5	35.8	43.0	37.7
Physical demanding tasks	25.1	23.1	38.0	33.1	6.9	6.0	11.4	13.8
<b>Age group 40-49</b>								
Tasks with intense use of fluid abilities	19.5	18.3	26.4	37.3	37.4	27.9	41.8	53.8
Tasks with intense use of crystallized abilities	31.6	32.3	44.2	39.0	36.9	37.1	47.5	39.0
Physical demanding tasks	24.1	19.3	31.2	31.9	6.0	3.8	11.4	12.3
<b>Age group 50-59</b>								
Tasks with intense use of fluid abilities	19.0	17.2	28.4	36.6	38.1	29.2	39.5	52.9
Tasks with intense use of crystallized abilities	30.9	30.1	46.1	35.9	37.1	37.5	46.0	42.8
Physical demanding tasks	26.4	19.9	28.1	31.9	6.6	2.8	7.7	12.1

## Computer use

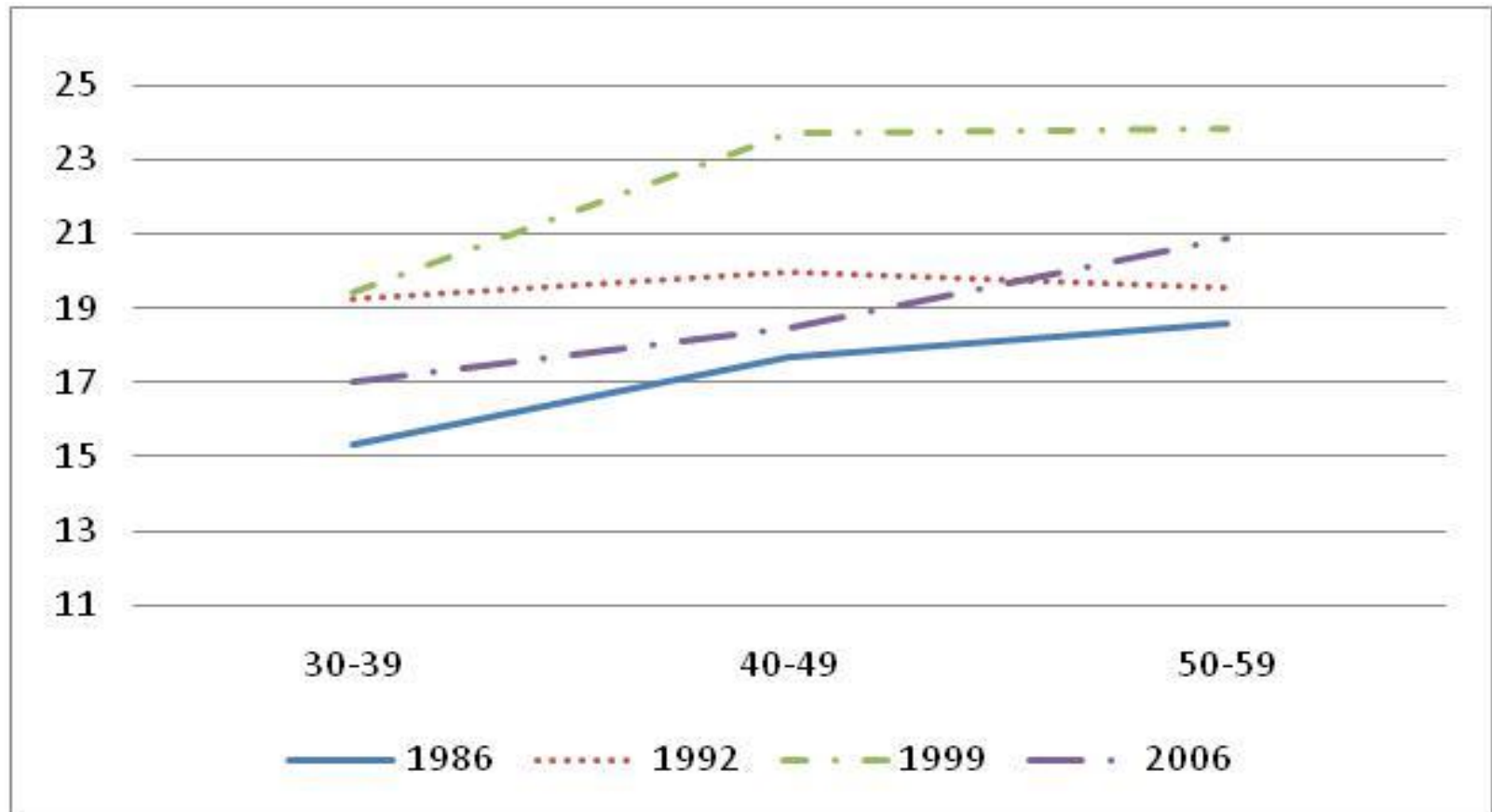




## Hourly wages – Fluid abilities, West Germany, Male workers



## Hourly wages – Crystallized abilities, West Germany, Male workers



## Hourly wages – Physical abilities, West Germany, Male workers

