

# Income Inequality Trends of Knowledge Societies: Evidence from 19 OECD Countries, 1970 to 2002

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## The knowledge society debate:

- ▶ **Content:** Rising importance of knowledge - developmental and causal (contextual) hypotheses
- ▶ **Scope:** Always and ever - just now in most advanced societies
- ▶ **Empirical testing:** Unquestioned template - (few) tests of falsification

## Aims of the doctoral project:

- ▶ Cross-national reliable and valid **conceptualization** of the "knowledge society"
- ▶ **Descriptive analyses** on the longitudinal and cross-national development of knowledge societies
- ▶ **Analyses on causation** between the development of knowledge societies and stratification.

## Introduction

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## Conceptualization of the Knowledge Society

As the hypotheses explaining the emergence and main characteristics of the knowledge society differ, the approaches to empirically grasp the concept of the knowledge society are manifold:

- ▶ Technical infrastructure and social indicators approaches
- ▶ Occupational approaches
- ▶ **Industry approaches**

Knowledge society from the industry perspective can be defined as (=def.) **a society in which the knowledge sector (KS) represents the most significant share of the economy** (Deutsch, 1984, pg. 33).

Based on a knowledge functional heuristic<sup>1</sup> the **KS** can be defined as (=def.) **the aggregate of industries whose main function is to produce the goods or services within the value-added chain of knowledge.**

1. '**Knowledge creation**', i.e. activities in order to produce new knowledge
2. '**knowledge infrastructure**', i.e. activities in order to manufacture the knowledge processing instruments and to provide their services
3. '**knowledge management**', i.e. activities in order to acquire, prepare and apply knowledge
4. '**knowledge mediation**', i.e. activities in order to transfer or impart knowledge

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<sup>1</sup>See Spinner (1998); Stock (2000). For details see Rohrbach (2007).

The final classification of the KS, i.e. the knowledge industries, separated by functional groups is as follows (expressed in terms of ISIC Rev.3):

1. **Knowledge creation:** Research and development
2. **Knowledge infrastructure:** Manufacture of paper and paper products; Manufacture and renting of computer machinery, radio, television and communication equipment and other electrical machinery and instruments; Computer and related activities; Post and Telecommunications
3. **Knowledge management:** Legal, accounting, book-keeping and auditing activities, Tax consultancy, market research and public opinion polling, business and management consultancy; Advertising
4. **Knowledge mediation:** Education; Publishing, printing and reproduction of recorded media; Motion picture, radio, television and other entertainment activities; News agency activities; Library, archives, museums and other cultural activities

## Inequality in the Knowledge Society

The classical theory predicts that:

- ▶ educational expansion would lead to more equality of educational opportunity (Bell, 1973, pg. 242),
- ▶ the direct origin effect on social status would decline through the drop in agrarian family business (ibid.: 361),
- ▶ for normative and functional reasons firms increasingly honor individuals' educational achievement, so that, overall

firstly, **education becomes more rewarded in the labor market in absolute terms** (ibid.: 453).



Moreover, the more efficient use of human capital in the production process

- ▶ would enhance the overall productivity, shift upward the occupational structure and improve the working conditions, so that
- ▶ knowledge societies would be more wealthy than industrial societies, resulting in redistribution policies and social security systems, so that, overall

secondly, **inequality is a less severe problem in knowledge societies** (Bell, 1973, pg.451-5).

However, from comparative, longitudinal research on stratification we are confronted with the findings that

- ▶ there is **no "strengthening bond"** between education and rewards at the individual level in most Western societies<sup>2</sup>,
- ▶ **nor does the distribution of rewards constantly become more equal** since the 1970s in most Western societies<sup>3</sup>.

The scenario of a more meritocratic and less unequal society has to be challenged.

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<sup>2</sup>Breen and Luijkx (2004); Jonsson (1996); Psacharopoulos and Patrinos (2002); Trostel et al. (2002).

<sup>3</sup>See e.g. Alderson and Nielsen (2002); Lee (2005).

There are several **explanations for the inequality upswing** at the aggregate level in the literature<sup>4</sup>:

- ▶ rising **globalization** (increase in foreign direct investment, rising "North-South-trade");
- ▶ re-structuring of the **institutional structure** of the nation states (e.g. towards less corporatism, de-unionization);
- ▶ **demographic shifts** (especially female labour force participation);
- ▶ changes in the **educational distribution**;
- ▶ **sectoral change** (de-industrialisation).

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<sup>4</sup>See e.g. deGregorio and Lee (2002); Aghion et al. (1999); Morris and Western (1999); Gustafsson and Johansson (1999); Alderson and Nielsen (2002); Bornschieer (2002).

Firstly, following Kuznets (1955), knowledge sector expansion may cause inequality if

- ▶ this sector is characterized by relatively higher earnings (**sector dualism effects**);
- ▶ and/or higher inequality of earnings (and skills) than the remainder of the economy (**sector bias effects**);

The structure of **changes in the demand for skills** is in fact an object of controversial discussion<sup>5</sup>.

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<sup>5</sup> Autor et al. (2006); DiPetre (2005).

Secondly, one may consider changes in the **supply of skills**.

- ▶ The usual expectation is that the greater supply of skills lowers the skill premium, which in turn reduces inequality;
- ▶ Contrary, for reasons of **rising inequality** in the distribution of education or **changing skill premia** at higher levels of educational expansion the negative relationship between greater supply of skills and inequality may reverse and become positive<sup>6</sup>.

However, studies exploiting data from advanced industrial societies until the early 1990s do not find such a curvilinear relationship.

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<sup>6</sup>See e.g. Creshaw and Ameen (1994); Bornschieer (2002); deGregorio and Lee (2002). 

## Hypotheses

**Growth Hypothesis:** There is a continuous rise of the share of gross value added and of persons employed in the knowledge sector since the 1970s in advanced industrial societies.

**Polarization Hypothesis:** Within the knowledge sector there is an increasing share of high-skilled and low-skilled non-routine employment to the disadvantage of medium skilled routine employment.

**Wage Differential Hypothesis:** There is a wage differential between the KS and the remainder of the economy.

**Sector Bias Hypothesis:** The higher is the employment in the knowledge sector, the higher is the income inequality.

**Sector Dualism Hypothesis:** The higher is the wage differential between the KS and the remainder of the economy, the higher is the income inequality.

**Skill Supply Hypothesis:** At lower levels of the educational expansion, the higher the supply of skills, the lower is the income inequality. At later stages of the educational expansion, the higher the supply of skills, the higher is the income inequality.

## Data

**Dependent variable:** Gini income inequality ("Estimated Household Income Inequality Data Set (EHII)"<sup>7</sup>)

**Countries:** Australia (AUS), Austria (AUT), Canada (CAN), Denmark (DNK), Finland (FIN), France (FR), Germany (GER), Greece (GRC), Italy (ITA), Japan (JAP), Luxembourg (LUX), the Netherlands (NL), New Zealand (NZ), Norway (NOR), Portugal (PRT), Spain (ESP), Sweden (SWE), United Kingdom (UK) and the United States (USA)

**Time span:** 1970-2002

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<sup>7</sup>See <http://utip.gov.utexas.edu/data.html>.



**Industrial sectors:** Percentage shares of employment and basic, constant gross value added by aggregated industries (OECD Structural Analysis (STAN) database (OECD, 2003) and OECD services database (OECD, 2001))

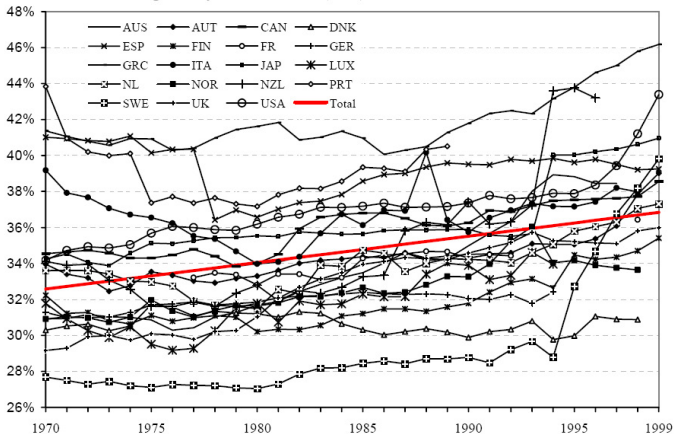
**Sector dualism:** Percentage of KS employment minus its value added share (STAN data)

**Sector bias:** Ratio between percentage share in nonroutine and routine employment in the KS (OECD "Employment by industry and occupation" database (OECD, 1998)), percentage share of employment in industry and the KS

**Skill supply:** Average years of schooling for the overall population over age 25 ("Barro-Lee educational database" (Barro and Lee, 2000))

**Control variables:** Natural population increase (UN); economic globalisation (direct investment outflow as a percentage of current GDP (Huber et al., 2004; OECD, 2006)); union density ((Visser, 2006) and OECD Labor Force Statistics (Online Database))

Figure 1 *Gini Coefficients (\*100) for Estimated Household Income by Country (actual values) and regressed for all countries (total), 1970-1999*



Source: EHII, own calculations.

## Method

An adequate method is to **estimate error component models** relying on random effects models (Gustafsson and Johansson, 1999; Alderson and Nielsen, 2002; Lee, 2005; Hox, 2002; Verbeke and Molenberghs, 2000).

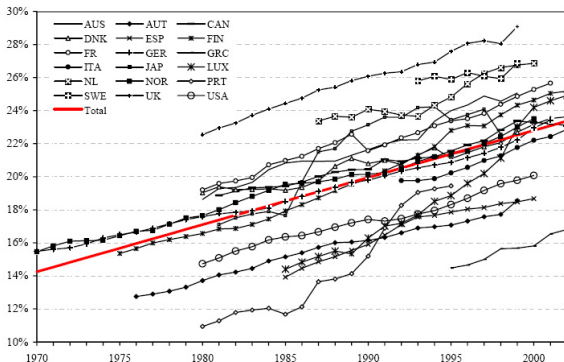
The equation for the model is as follows:

$$Y_{ij} = \beta_{00} + \sum (\beta_k * X_{kij}) + u_{0i} + \epsilon_{ij} \quad (1)$$

where **i** denotes the **countries** and **j** denotes the **year**,  $u_{0i}$  is the error term of the country level and  $\epsilon_{ij}$  the error term of the repeated measure level.

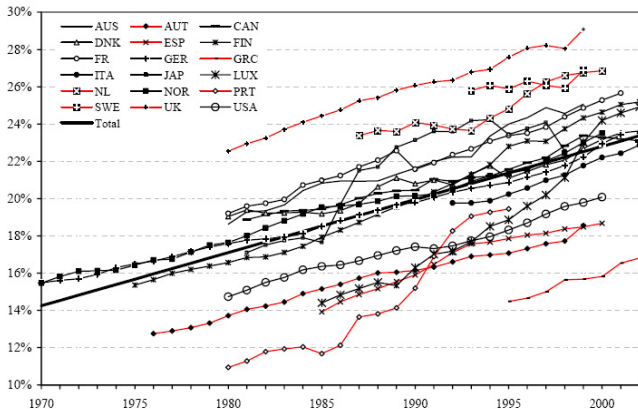
## Knowledge Sector Growth

Figure 2 Percentage share of knowledge sector employment (headcounts) by country (actual values) and regressed for all countries (total), 1970-2002



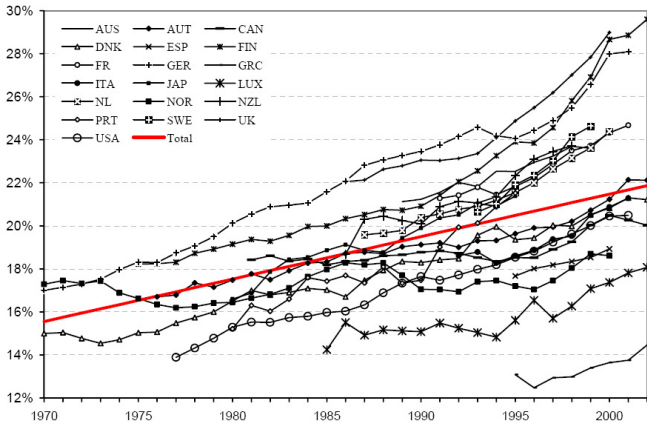
Notes: AUT, CAN, JAP, NZ, UK: Number of jobs; GB: Number of Employees. Source: OECD, own calculations.

Figure 2 Percentage share of knowledge sector employment (headcounts) by country (actual values) and regressed for all countries (total), 1970-2002



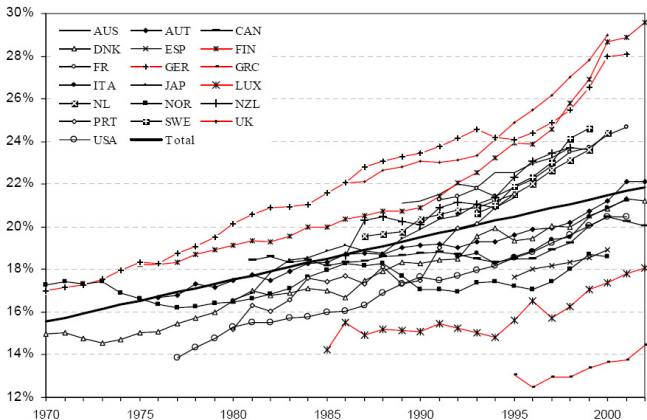
Notes: AUT, CAN, JAP, NZ, UK: Number of jobs; GB: Number of Employees. Source: OECD, own calculations.

Figure 3 *Percentage share of knowledge sector value added by country (actual values) and regressed for all countries (total), 1970-2002*



Notes: AUS, FR, GRC, NL, NOR, NZ, SWE, USA: annually re-weighted chained Laspeyres, other: fixed-weight Laspeyres; AUS, BZ, PRT, SWE: current prices, CAN: 1997=100, FIN: 2000=100. Source: OECD, own calculations.

Figure 3 *Percentage share of knowledge sector value added by country (actual values) and regressed for all countries (total), 1970-2002*

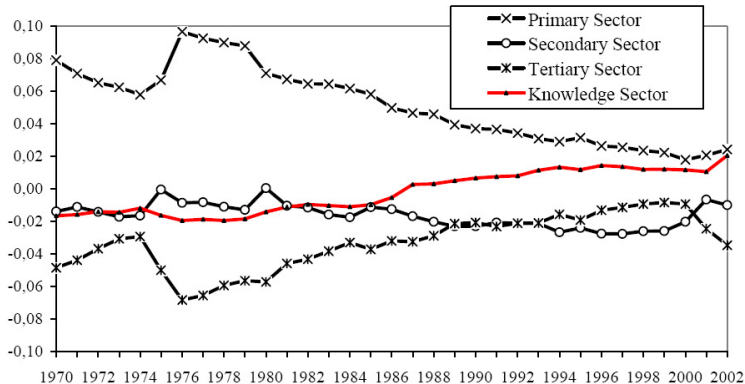


Notes: AUS, FR, GRC, NL, NOR, NZ, SWE, USA: annually re-weighted chained Laspeyres, other: fixed-weight Laspeyres; AUS, BZ, PRT, SWE: current prices, CAN: 1997=100, FIN: 2000=100. Source: OECD, own calculations.



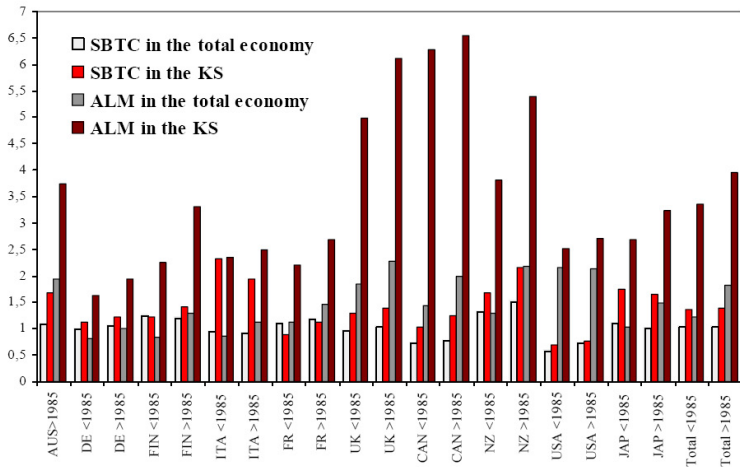
## Skill Demand, Skill Supply, and Inequality

Figure 4 Sector dualism: Employment shares minus value added shares, by sectors, 1970-2002



Notes: N=311; Source: OECD, own calculations.

Figure 5 Sector bias: SBTC versus ALM, total economy and by broad economic sectors, 1970-1995



Notes: N=39; SBTC=%skilled/%unskilled, ALM=%nonroutine/%routine. Source OECD, own calculations.

Table 2 *Unstandardized Coefficients from the Random-Effects GLS Regression of Income Inequality (the Gini) on Selected Independent Variables: 19 Countries, 1970-2002*

	Empty model	Model (0)	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
Occasion (years).....		0.151*** (0.008)	0.204*** (0.012)	0.051 (0.031)	0.055 (0.036)	0.046 (0.037)	0.013 (0.035)	0.008 (0.036)
Aver. years of schooling.....			<b>-3.292***</b> (0.430)	<b>-3.488***</b> (0.854)	<b>-2.324*</b> (0.958)	<b>-2.908**</b> (1.048)	<b>-2.852**</b> (0.871)	<b>-2.800**</b> (0.983)
Aver. years of schooling <sup>2</sup> .....			<b>0.157***</b> (0.024)	<b>0.168**</b> (0.047)	<b>0.124*</b> (0.052)	<b>0.158**</b> (0.057)	<b>0.168**</b> (0.048)	<b>0.167**</b> (0.054)
% employed in Industry.....				-0.087* (0.041)	-0.088 (0.045)	-0.087 (0.046)	-0.089* (0.043)	-0.091* (0.044)
<b>KS Sector Bias (% employed in KS)....</b>				<b>0.495***</b> (0.099)	<b>0.223</b> (0.122)	<b>0.258*</b> (0.131)	<b>0.248*</b> (0.114)	<b>0.244*</b> (0.124)
<b>KS Sector Dualism.....</b>					<b>0.040</b> (0.096)	<b>0.077</b> (0.104)	<b>0.145</b> (0.094)	<b>0.169</b> (0.101)
Nat. rate of pop. increase.....				-0.004 (0.064)	-0.145* (0.073)	-0.142 (0.083)	-0.236** (0.072)	-0.273** (0.083)
DI						-0.033 (0.061)		0.016 (0.060)
Outflow.....							-0.078*** (0.014)	-0.081*** (0.016)
Union Density.....								
Constant...	34.622*** (0.713)	32.542*** (0.726)	47.570*** (1.960)	43.327*** (4.027)	42.647*** (4.450)	44.547*** (4.695)	47.780*** (4.113)	47.836*** (4.434)
$\sigma_e^2$	3.770	2.174	1.965	1.110	0.963	1.006	0.887	0.926
$\sigma_{\omega}^2$	9.524	9.712	6.062	6.423	6.035	5.652	3.915	4.158
$\sigma_{\text{spatial}}$	13.293	11.886	8.027	7.533	6.998	6.658	4.802	5.084
<b>R<sup>2</sup> L1</b>		0.423	<b>0.479</b>	<b>0.706</b>	<b>0.744</b>	<b>0.733</b>	<b>0.765</b>	<b>0.754</b>
<b>R<sup>2</sup> L2</b>			<b>0.376</b>	<b>0.339</b>	<b>0.379</b>	<b>0.418</b>	<b>0.597</b>	<b>0.572</b>
R <sup>2</sup> total		0.106	0.396	0.433	0.474	0.499	0.639	0.618
Deviance	2282.246	2001.850	1941.278	890.796	707.566	672.155	671.576	639.512

Notes: Standard errors in parentheses.

\*p<0.05, \*\*p<0.01; \*\*\*p<0.001 (two-tailed tests).

## Summary of Results and Future Prospects

### Summary of results:

- ▶ In all the 19 OECD countries studied, a clear **knowledge society trend** from the 1970s on is observable;
- ▶ These changes are accompanied by **changes in the supply of and demand for skills**, which in turn have significant effects on **inequality** in the countries studied;

- ▶ The results seem to support the *skill supply hypothesis*, i.e. that at later stages of the educational expansion, the higher the supply of skills, the higher is the income inequality;
- ▶ There is empirical support for the assumption that the KS is more than the rest of the economy **skill biased** and that the **expansion of the KS effects inequality by sector bias**;
- ▶ There is no statistically significant positive sector dualism effect on income inequality.

## Future prospects:

- ▶ The development towards the **knowledge society** may also **moderate the patterns of movement from origins to destinations and rewards** in the stratification systems.
- ▶ Consequently, that identified macro-level variation must be related to micro-level processes, questioning if, in fact, **knowledge societies** at large, or at least the knowledge sector, operate on **meritocratic principles**.

## First results of multilevel analyses of the ISSP data 1985-2002 show:

- ▶ There are marked **differences between countries** in the strength of the association between education and rewards, but there is **no increase in the returns to education** in nearly all 19 countries.
- ▶ There is a statistically significant **negative (cross-level) interaction** between knowledge sector employment on the association between education and rewards, i.e. the higher the knowledge sector the lower is the effect of education on income.

*Table 3 Unst. Coefficients, Random-Effects GLS Regression of Individual Income (Log hourly, in PPP \$) on Selected Independent Variables, 18 Countries, 1985-2002*

	Empty model	Model 1: Mincer	Model 2: +Controls	Model 3: +KS Intcpt.	Model 4: + KS Slpe.	Model 5: +EY Intcpt.	Model 6: +ES Slpe.
<b>LEVEL 1</b>							
Sex:		0.190***	0.179***	0.179***	0.177**	0.177**	0.177**
Male.....		(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
Years of		0.023***	0.022***	0.022***	0.022***	0.022***	0.022***
Experience.....		(0.0021)	(0.0020)	(0.0019)	(0.0018)	(0.0018)	(0.0018)
Years of		-.0003***	-.0003***	-.0003***	-.0003***	-.0003***	-.0003***
Experience <sup>2</sup> .....		(0.00004)	(0.00004)	(0.00004)	(0.00004)	(0.00004)	(0.00004)
Years of		<b>0.0537***</b>	<b>0.0294***</b>	<b>0.0294***</b>	<b>0.0898***</b>	<b>0.0889***</b>	<b>0.108***</b>
Education.....		( <b>0.0032</b> )	( <b>0.0024</b> )	( <b>0.0024</b> )	( <b>0.0188</b> )	( <b>0.0188</b> )	( <b>0.0278</b> )
Place of Residence:		0.082***	0.082***	0.082***	0.079***	0.079***	0.079***
Urban.....		(0.0089)	(0.0089)	(0.0089)	(0.0087)	(0.0087)	(0.0087)
Employment Status:		-0.163***	-0.162***	-0.162***	-0.164***	-0.164***	-0.165***
Selfemployed.....		(0.0233)	(0.0233)	(0.0233)	(0.0233)	(0.0233)	(0.0233)
Work Status:		0.0796***	0.0796***	0.0796***	0.0797***	0.0797***	0.0799***
Supervises others.....		(0.0081)	(0.0081)	(0.0081)	(0.0081)	(0.0081)	(0.0080)
ISEI		0.0073***	0.0073***	0.0073***	0.0073***	0.0073***	0.0073***
Respondent.....		(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)
<b>LEVEL 2</b>							
<i>Random intercept effect</i>				0.0385***	<b>0.0721***</b>	<b>0.0820***</b>	<b>0.0835***</b>
% KS Employment.....				(0.0078)	(0.0108)	(0.0117)	(0.0117)
<i>Random slope effect</i>					<b>-0.0028***</b>	<b>-0.0027***</b>	<b>-0.0029***</b>
% KS Empl.*Years of Education.....					(0.0008)	(0.0008)	(0.0008)
<i>Random intercept effect</i>						0.1067***	0.1262***
Average Years of Schooling.....						(0.0154)	(0.0327)
<i>Random slope effect</i>							-.0015
Average Years of Schooling.....							(0.0022)
Constant.....	3.673***	2.576***	2.495***	1.677***	0.944***	-0.332	-0.560
	(0.0410)	(0.0753)	(0.0781)	(0.1791)	(0.2367)	(0.322)	(0.395)
R <sup>2</sup> total L1	0.110	0.168	0.168	0.172	0.172	0.172	0.172
R <sup>2</sup> total L2	<i>ICC: .244</i>	0.240	0.240	0.390	0.410	0.600	0.600
R <sup>2</sup> total		0.142	0.186	0.222	0.230	0.276	0.276
Deviance	55932.65	52033.88	49862.51	49854.89	49782.62	49763.73	49773.49
No. of Contextes/Individ.	58	58/33506	58/33506	58/33506	58/33506	58/33506	58/33506

Notes: Robust standard errors in parentheses. \*p<0.05, \*\*p<0.01; \*\*\*p<0.001 (two-tailed tests). Source: ISSP Data 1985-2002 and OECD (diverse).



Thank you very much for your attention!

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