The Intergenerational Elasticity of Earnings: Exploring the Mechanisms

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Fact: In UK, elasticity of child's income with respect to parent's income $\approx .3$

Question: Why do high income parents have high income children?

Potential explanations: Children of high income families ...

- ... attain more years of schooling
- ... have higher cognitive skills
- ... receive more investments: parental time & school quality
- ... face different family environment: more educated parents, fewer siblings

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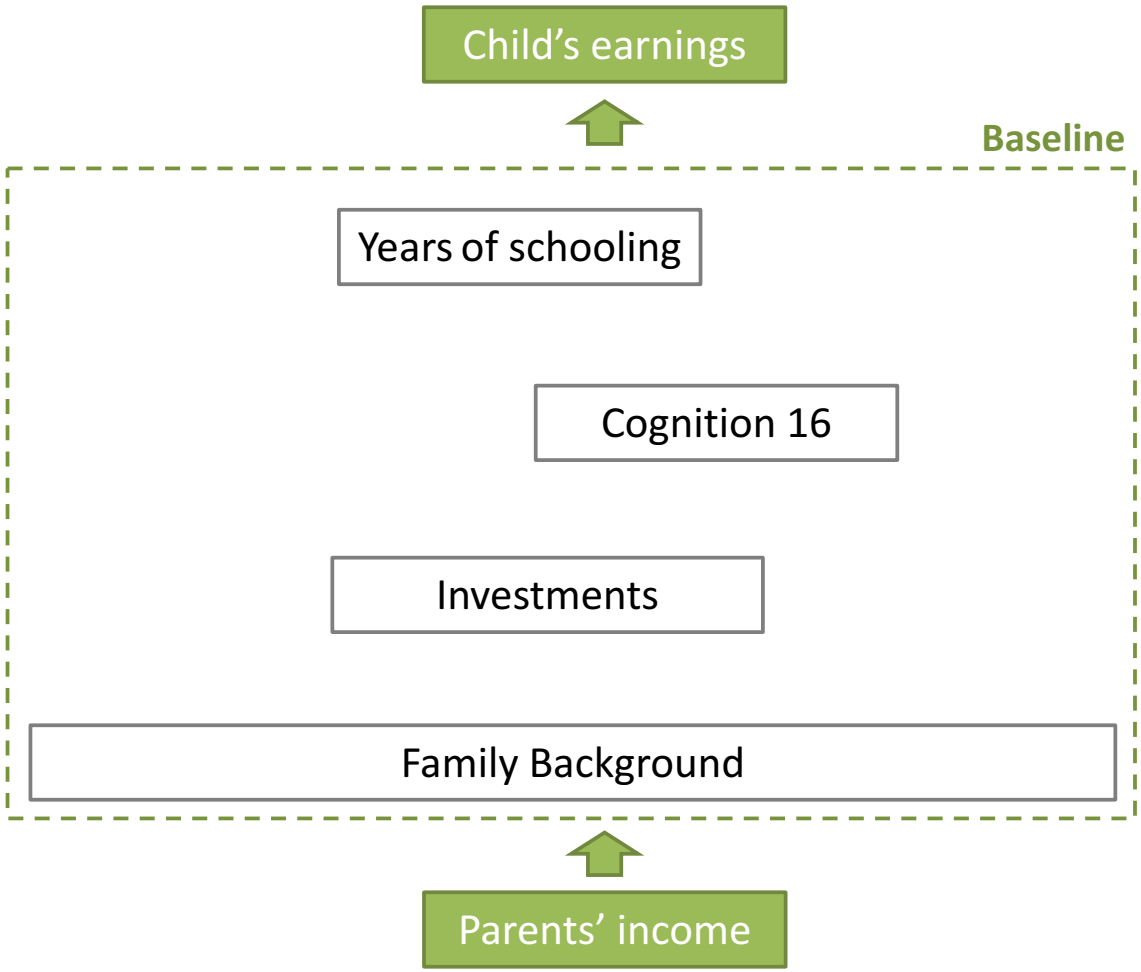
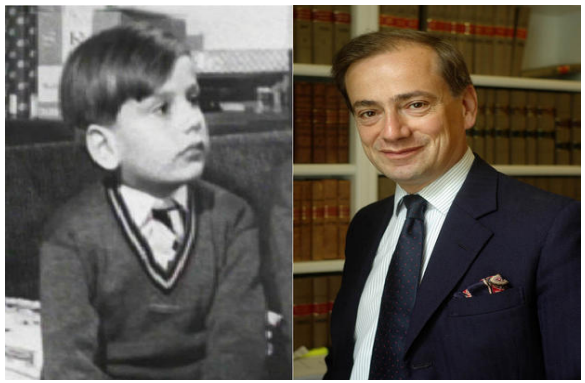
Baseline - Decomposition of IGE



Data - National Child Development Study (NCDS)

Timing of interviews similar to the "Up" documentary series

John



Tony

- Population born in one week in Britain in 1958
- Followed at ages 0, 7, 11, 16, 23, 26, 33, 37, 42, 49, 55
- Data on:
  - Parental income
  - Individual's earnings over the lifecycle
  - Potential drivers of the Intergenerational Elasticity of Earnings (IGE)

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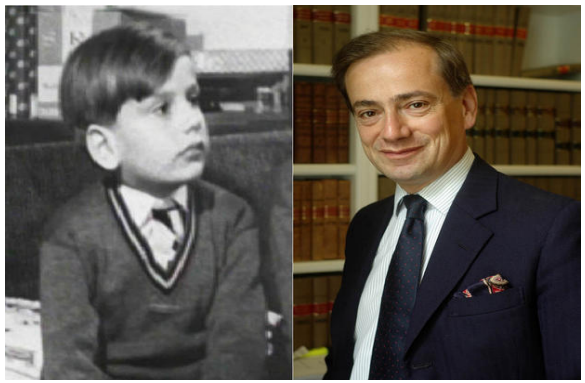

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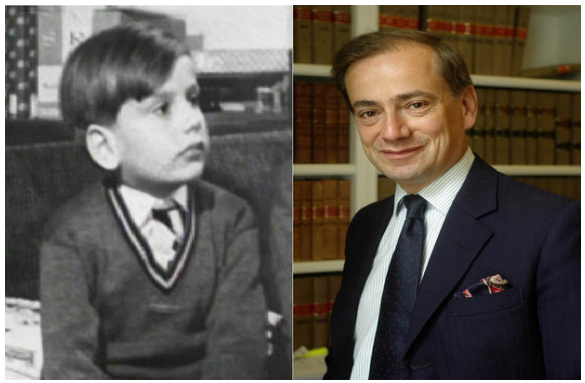

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Key Facts: Children from high income families ...

1. ... grow up in a different family environment: Details
   - More educated parents, less siblings
2. ... receive more time investments: Details
   - e.g. reading to child, outings with child, interest in child's education
3. ... go to better quality schools: Details
   - e.g. student-teacher ratios, PTA, fraction that continues education
4. ... have better cognitive skills at age 16: Details
   - e.g. Reading score, maths score, teacher-assessed ability
5. ... attain more years of schooling: Details

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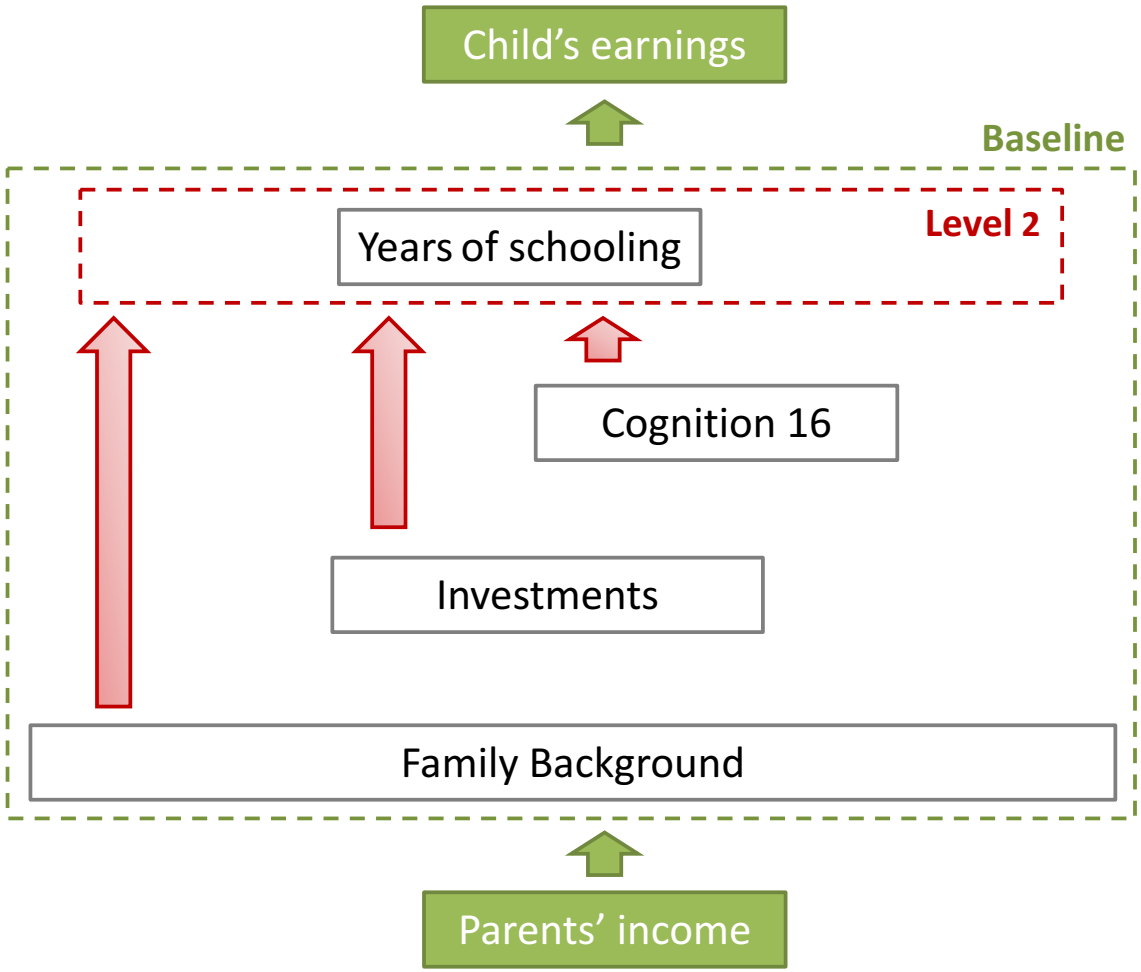
Latent Factors and Measurement Error

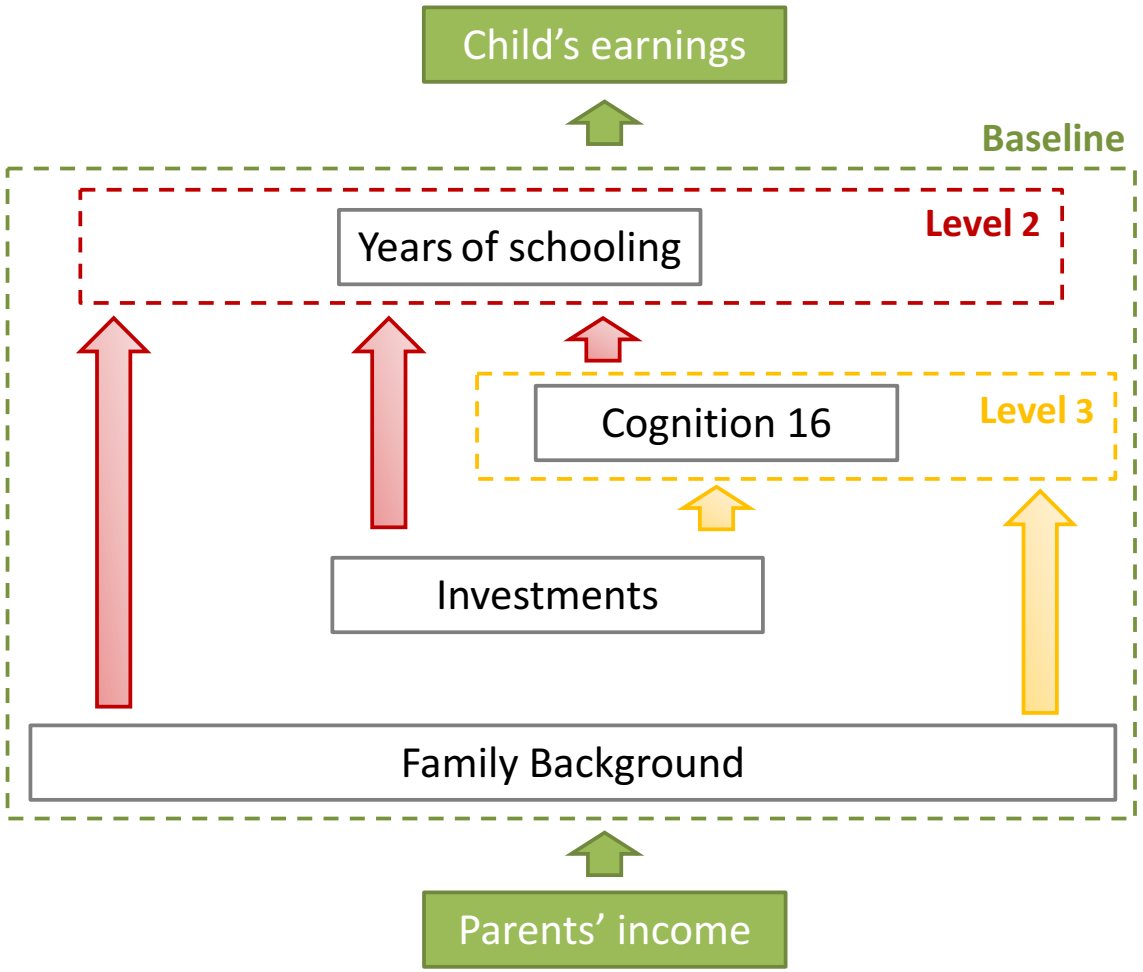
- We do not directly observe cognition, time investments, and school quality
- Instead, we observe multiple noisy measures, e.g. test scores
  - $\Rightarrow$ Combine measures using recent latent factor methods
  - $\Rightarrow$ Correct for measurement error in analysis using errors-in-variables (Heckman et al 2013)

Signal-Noise

Level 2 - Indirect effects via years of schooling

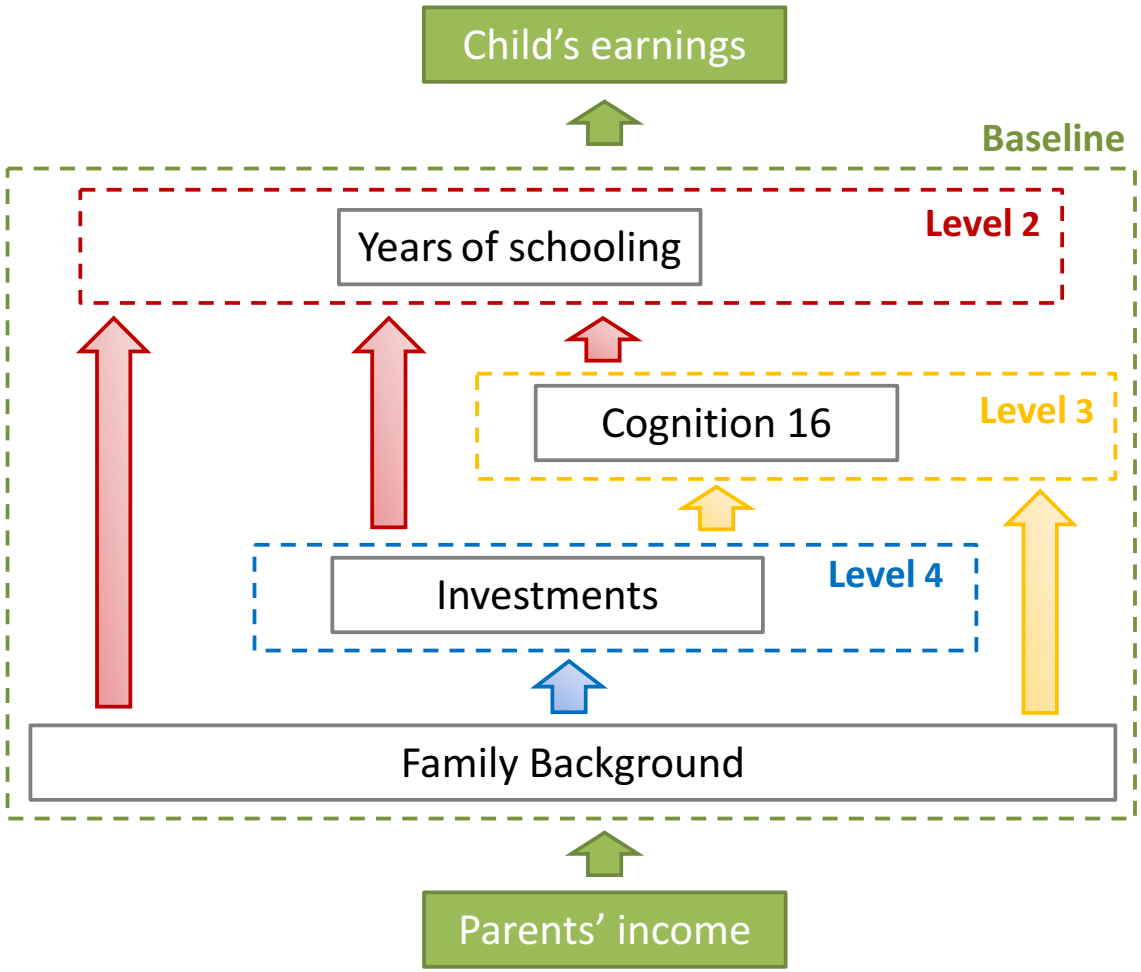


Level 3 - Indirect effects via years of schooling



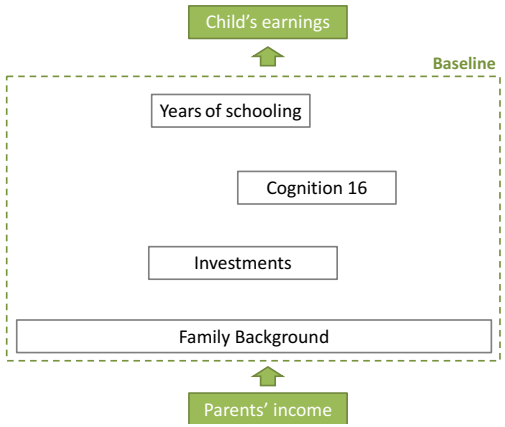
Details

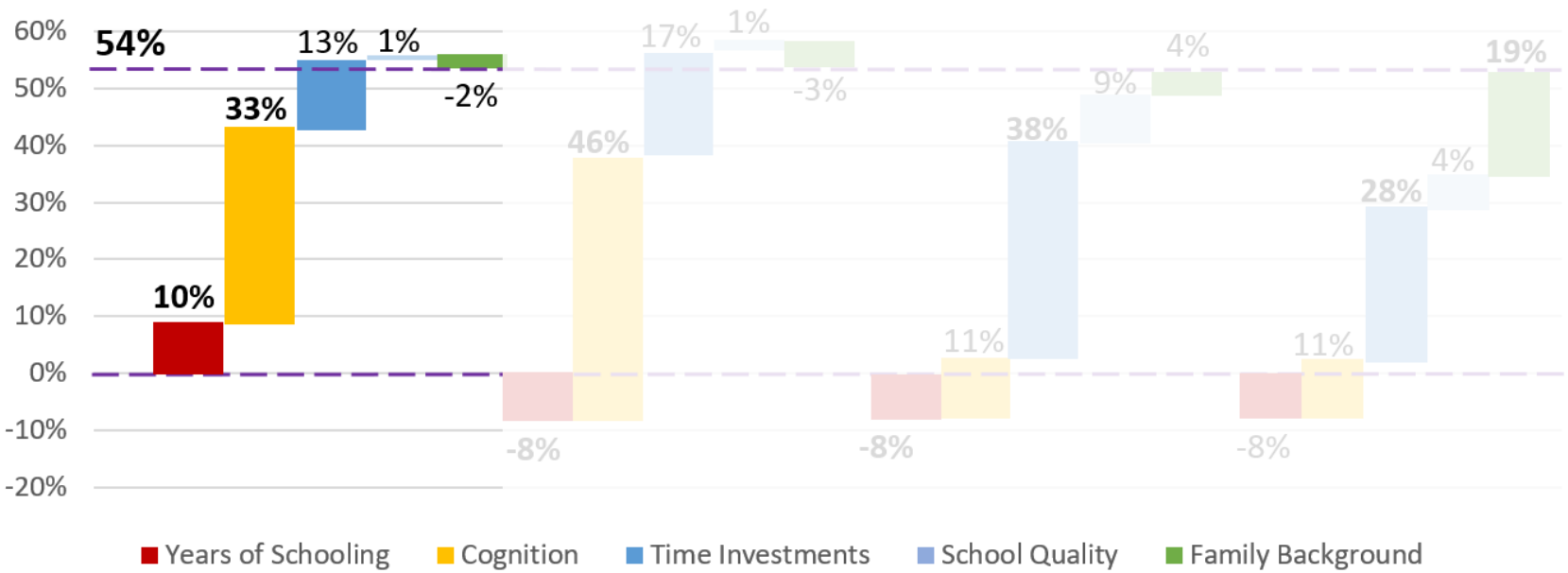
Level 4- Indirect effects via years of schooling



Details

Results: Mediation Analysis - Males





⇒ 54% of IGE is explained by our channels. Cognitive skills and schooling significantly affect IGE.

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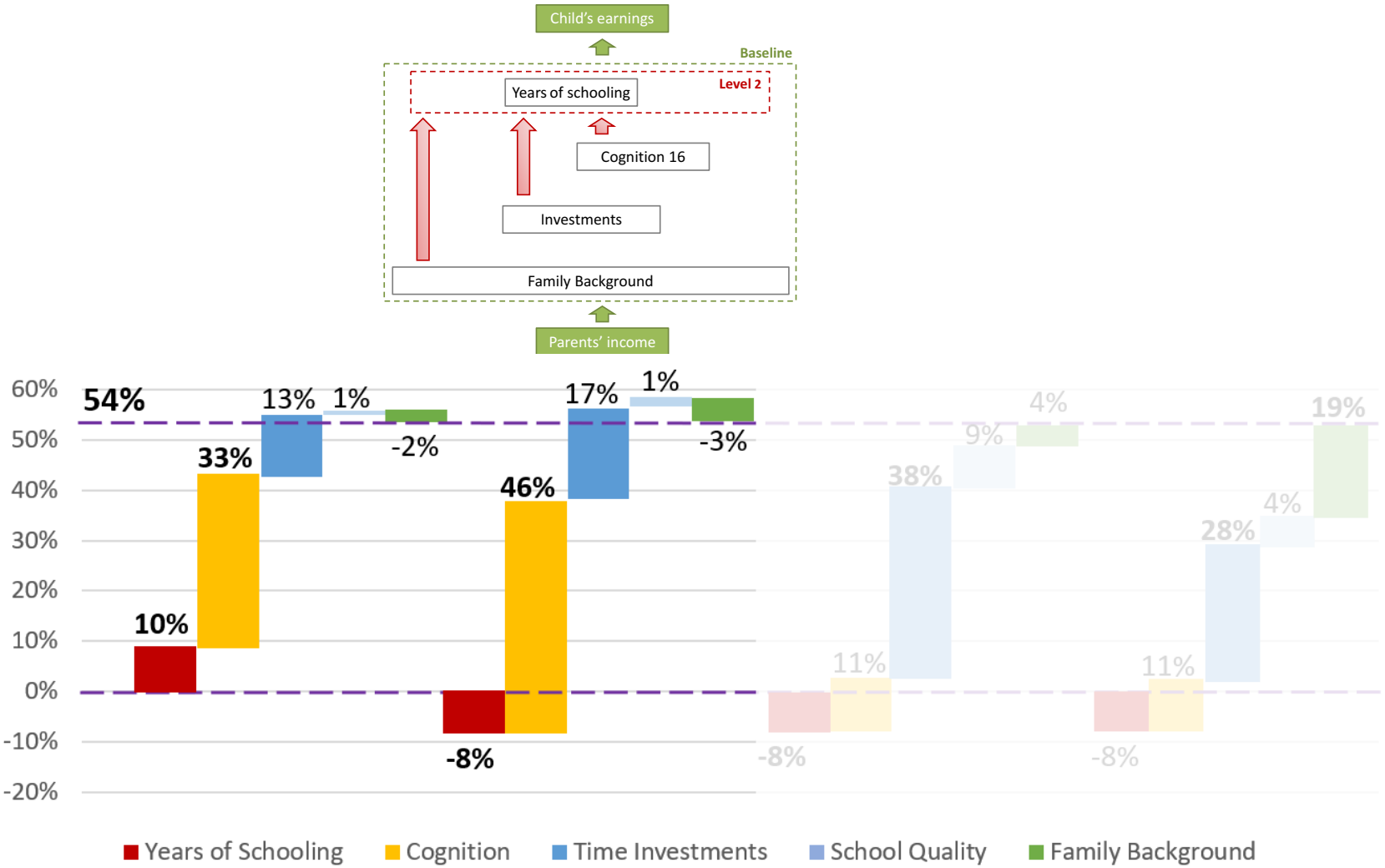

⇒ Effect of schooling is completely mediated by cognitive skills

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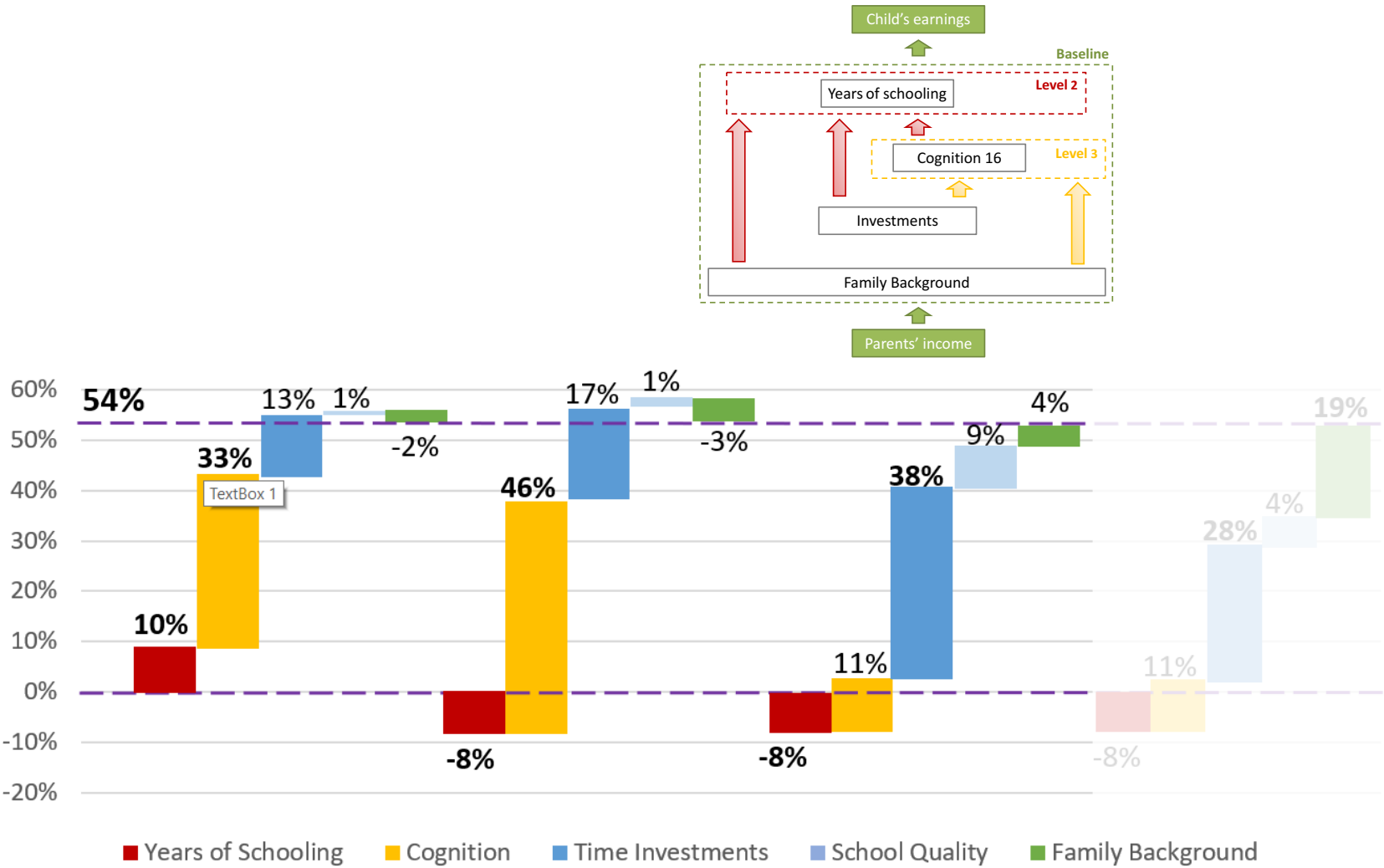

⇒ Most differences in cognition are explained by differences in time investments and school quality

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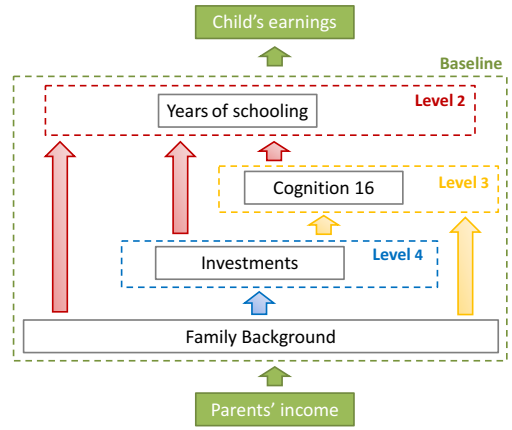

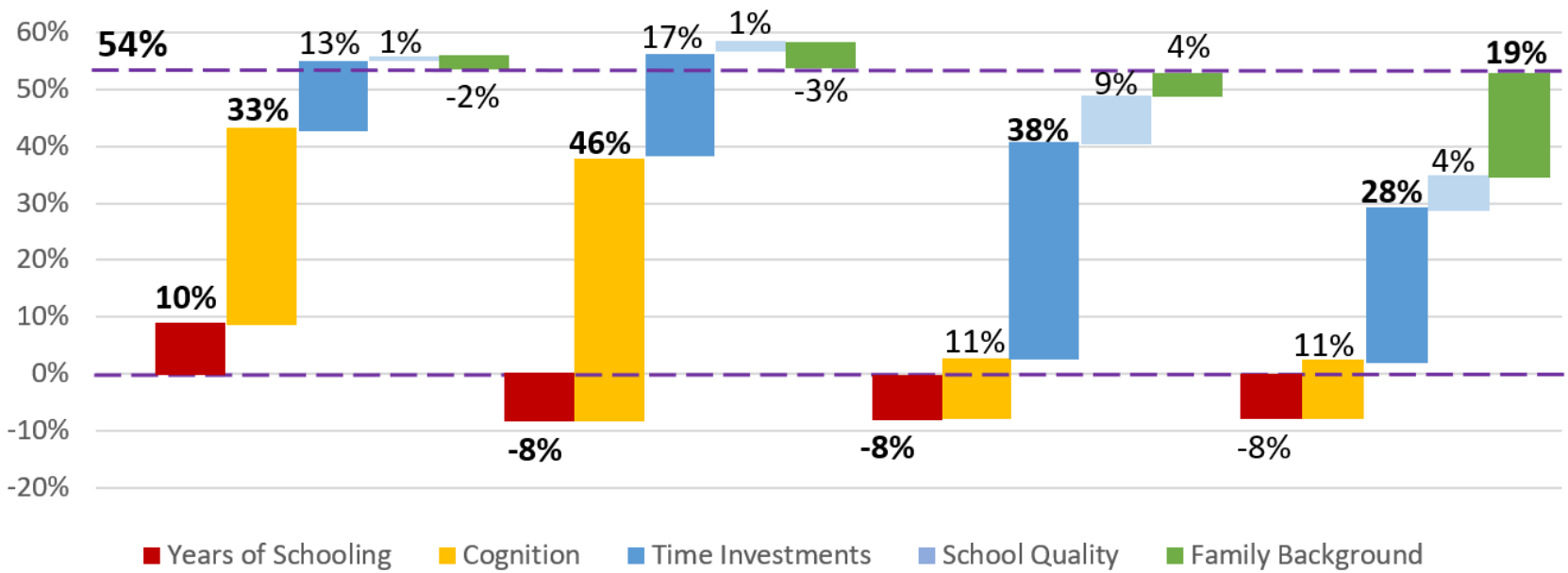

⇒ Even if we control for family background, the income gradient in investments persists

Conclusion

For both, men and women:

- Years of schooling and cognition explain the largest shares of the IGE
- But: Effect of years of schooling is entirely mediated by cognition ...

  ... and cognition is largely mediated by investments

$\Rightarrow$ Differences in investments between rich and poor families really matter for the IGE...

... and not all of them can be explained by family background

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Robustness

Our results are robust to:

- Accounting for non-cognitive skills see table
- Complementarity between schools and cognition see table
- Including other common family background variables see table

Back to Level 4

Robustness Check 1

Accounting for non-cognitive skills

	Males				Females			
	Level 1	Level 2	Level 3	Level 4	Level 1	Level 2	Level 3	Level 4
Years of Schooling	**0.104**	**-0.078**	**-0.078**	**-0.078**	**0.420**	0.039	0.039	0.039
	[0.031, 0.266]	[-0.274, -0.012]	[-0.274, -0.012]	[-0.274, -0.012]	[0.194, 1.127]	[-0.171, 0.329]	[-0.171, 0.329]	[-0.171, 0.329]
Cognition	**0.338**	**0.474**	0.107	0.107	0.135	**0.394**	0.012	0.012
	[0.181, 0.759]	[0.296, 1.007]	[-0.096, 0.378]	[-0.096, 0.378]	[-0.016, 0.400]	[0.161, 1.071]	[-0.297, 0.212]	[-0.297, 0.212]
Non-cognitive skills	-0.004	-0.005	- 0.046	- 0.046	0.000	0.000	- 0.022	-0.022
	[-0.079, 0.042]	[-0.082, 0.043]	[-0.169, 0.007]	[-0.169, 0.007]	[-0.047, 0.039]	[-0.073, 0.061]	[-0.151, 0.022]	[-0.151, 0.022]
Investments	0.123	0.178	**0.517**	**0.354**	0.033	0.128	**0.444**	0.239
	[-0.133, 0.454]	[-0.063, 0.623]	[0.212, 1.346]	[0.112, 0.974]	[-0.306, 0.351]	[-0.142, 0.525]	[0.158, 1.278]	[-0.038, 0.745]
Family Background	-0.008	-0.018	0.051	0.214	-0.006	0.020	0.108	0.314
	[-0.173, 0.109]	[-0.194, 0.103]	[-0.093, 0.188]	[0.092, 0.558]	[-0.238, 0.215]	[-0.189, 0.303]	[-0.066, 0.504]	[0.089, 0.997]
N	1339	1339	1339	1339	1336	1336	1336	1336

Notes: 95% Confidence intervals in brackets. Coefficients that are significant at the 5% level are **bold**.

Back

Robustness Check 2

Complementarity between schools and cognition

	Males			Females		
	EIV	GMM	GMM	EIV	GMM	GMM
Years of Schooling	**0.093**	**0.165**	**0.162**	**0.425**	**0.452**	**0.487**
	[0.019, 0.228]	[0.073, 0.325]	[0.066, 0.310]	[0.158, 1.337]	[0.231, 1.083]	[0.265, 1.206]
Cognition	**0.333**	**0.368**	**0.365**	0.135	0.094	0.078
	[0.193, 0.729]	[0.173, 0.646]	[0.184, 0.625]	[-0.008, 0.502]	[-0.058, 0.268]	[-0.081, 0.229]
Years of Schooling × Cognition			-0.016			0.003
			[-0.066, 0.017]			[-0.054, 0.070]
Investments	0.163	0.137	0.122	0.057	0.149	0.122
	[-0.060, 0.456]	[-0.112, 0.428]	[-0.119, 0.392]	[-0.266, 0.437]	[-0.140, 0.554]	[-0.124, 0.513]
Family Background	-0.012	-0.055	-0.053	0.022	0.055	0.102
	[-0.150, 0.112]	[-0.232, 0.074]	[-0.215, 0.077]	[-0.233, 0.302]	[-0.164, 0.297]	[-0.136, 0.374]

Notes: 95% Confidence intervals in brackets. Coefficients that are significant at the 5% level are **bold**.

Back

Robustness Check 3

Including other common family background variables

	Males				Females			
	Level 1	Level 2	Level 3	Level 4	Level 1	Level 2	Level 3	Level 4
Years of Schooling	**0.095**	-0.096	-0.096	-0.096	**0.423**	0.093	0.093	0.093
Cognition	**0.323**	**0.454**	0.149	0.149	0.129	**0.396**	-0.021	-0.021
Investments	0.134	0.187	**0.469**	0.306	0.049	0.150	**0.449**	0.277
Time Investments	0.132	0.178	**0.388**	**0.281**	-0.093	-0.038	0.116	-0.070
Age 7	0.135	0.156	0.152	0.084	0.149	0.167	0.181	-0.018
Age 11	-0.057	-0.030	0.075	0.066	-0.180	-0.176	-0.133	-0.053
Age 16	0.054	0.052	**0.162**	**0.131**	-0.062	-0.028	0.067	0.002
School Quality	0.002	0.010	0.081	0.024	**0.142**	**0.188**	**0.333**	**0.347**
Age 7	-0.001	-0.001	0.000	0.001	0.047	0.044	0.047	0.062
Age 11	-0.030	-0.028	-0.051	-0.056	0.017	0.019	0.012	0.005
Age 16	0.033	0.038	**0.132**	0.080	0.078	0.125	**0.274**	**0.280**
Family Background	-0.205	-0.197	-0.174	-0.011	-0.264	-0.302	-0.183	-0.012
Mother's education	-0.045	-0.044	-0.021	0.031	-0.027	-0.009	0.043	0.147
Father's education	0.012	0.004	0.032	0.084	0.055	0.066	0.113	0.209
Number of Siblings	0.013	0.012	0.028	0.077	-0.020	-0.021	-0.011	0.004
Stable	-0.145	-0.133	-0.150	-0.103	-0.189	-0.243	-0.178	-0.155
Mum's age	-0.032	-0.028	-0.038	-0.037	-0.099	-0.087	-0.155	-0.213
Dad's age	-0.008	-0.007	-0.025	-0.063	0.017	-0.008	0.004	-0.004
N	1350	1350	1350	1350	1347	1347	1347	1347

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Back

Mediation Analysis: Share of IGE Explained

	Males				Females			
	Level 1	Level 2	Level 3	Level 4	Level 1	Level 2	Level 3	Level 4
Years of Schooling	**0.095**	**-0.079**	**-0.079**	**-0.079**	**0.425**	0.024	0.024	0.024
Cognition	**0.327**	**0.456**	0.106	0.106	**0.135**	**0.402**	0.002	0.002
Investments	0.135	0.187	**0.473**	**0.325**	0.050	0.151	**0.463**	0.251
Time Investments	0.127	0.173	**0.384**	**0.284**	-0.100	-0.046	0.114	0.039
... Age 7	0.126	0.147	0.143	0.111	0.143	0.157	**0.176**	0.105
... Age 11	-0.054	-0.027	0.076	0.066	**-0.180**	**-0.175**	-0.133	-0.083
... Age 16	0.056	0.053	**0.166**	**0.108**	-0.062	-0.029	**0.070**	0.016
School Quality	0.008	0.014	0.089	0.041	**0.150**	**0.198**	**0.349**	**0.212**
... Age 7	-0.001	-0.001	0.000	-0.000	0.047	0.044	0.046	0.032
... Age 11	-0.024	-0.023	-0.044	-0.030	0.019	0.022	0.016	-0.010
... Age 16	0.033	0.038	**0.133**	0.072	0.084	**0.132**	**0.287**	**0.191**
Family Background	-0.019	-0.027	0.037	**0.185**	0.006	0.039	0.128	**0.340**
Mother's education	-0.051	-0.049	-0.029	0.020	-0.043	-0.024	0.010	0.104
Father's education	0.016	0.008	0.035	0.084	0.068	0.081	0.126	**0.227**
Number of Siblings	0.016	0.014	0.031	**0.081**	-0.019	-0.019	-0.008	0.009
Total	0.538	0.538	0.538	0.538	0.616	0.616	0.616	0.616
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... Age 7	0.126	0.147	0.143	0.111	0.143	0.157	**0.176**	0.105
... Age 11	-0.054	-0.027	0.076	0.066	**-0.180**	**-0.175**	-0.133	-0.083
... Age 16	0.056	0.053	**0.166**	**0.108**	-0.062	-0.029	**0.070**	0.016
School Quality	0.008	0.014	0.089	0.041	**0.150**	**0.198**	**0.349**	**0.212**
... Age 7	-0.001	-0.001	0.000	-0.000	0.047	0.044	0.046	0.032
... Age 11	-0.024	-0.023	-0.044	-0.030	0.019	0.022	0.016	-0.010
... Age 16	0.033	0.038	**0.133**	0.072	0.084	**0.132**	**0.287**	**0.191**
Family Background	-0.019	-0.027	0.037	**0.185**	0.006	0.039	0.128	**0.340**
Mother's education	-0.051	-0.049	-0.029	0.020	-0.043	-0.024	0.010	0.104
Father's education	0.016	0.008	0.035	0.084	0.068	0.081	0.126	**0.227**
Number of Siblings	0.016	0.014	0.031	**0.081**	-0.019	-0.019	-0.008	0.009
Total	0.538	0.538	0.538	0.538	0.616	0.616	0.616	0.616
N	1350	1350	1350	1350	1347	1347	1347	1347

Back to Level 4

Importance of Correcting for Measurement Error

Ignoring measurement error:

- under-estimates the importance of cognition by up to 35%
- attenuates fraction explained by parental investment by 45%

Table: Decomposition without Measurement Error Corrections

	Males				**Females**			
	Level 1	Level 2	Level 3	Level 4	Level 1	Level 2	Level 3	Level 4
Years of School	**0.177**	0.007	0.007	0.007	**0.530**	0.104	0.104	0.104
Cognition	**0.175**	**0.294**	0.123	0.123	0.042	**0.282**	**0.132**	**0.132**
Investments	**0.132**	**0.175**	**0.287**	**0.178**	0.044	**0.153**	**0.243**	**0.136**
Family Background	0.018	0.027	0.085	**0.194**	0.009	0.087	0.146	**0.254**
Total	0.502	0.502	0.502	0.502	0.626	0.626	0.626	0.626
N	1092	1092	1092	1092	1127	1127	1127	1127

Level 4 - Indirect effects via investments

Determinants of cognition:

$$inv_{16,i} = \boldsymbol{\delta}_F \boldsymbol{F}_i + \delta_{Y_P} \ln Y_{Parent,i} + u_i^{inv_{16}}$$

Share of the IGE explained by maternal education:

$$\{ \underbrace{\alpha_{ed_m}}_{\substack{\text{Direct Effect} \\ \text{of mum ed on Earnings}}} + \underbrace{\alpha_S \beta_{ed_m}}_{\substack{\text{Indirect Effect} \\ \text{of mum ed via Schooling}}} + \underbrace{(\alpha_C + \beta_C \alpha_S)\gamma_{ed_m}}_{\substack{\text{Indirect Effect} \\ \text{of mum ed via Cognition}}} +$$

$$[\underbrace{\alpha_{inv_{16}}}_{\substack{\text{Direct Effect of} \\ inv_{16} \text{ on Earnings}}} + \underbrace{\beta_{inv_{16}} \alpha_S}_{\substack{\text{Indirect Effect of} \\ inv_{16} \text{ via schooling}}} + \underbrace{(\underbrace{\alpha_C}_{\substack{\text{Direct Effect of} \\ \text{cognition on Earnings}}} + \underbrace{\beta_C \alpha_S}_{\substack{\text{Indirect Effect of} \\ \text{cognition via schooling}}}) \gamma_{inv_{16}}}_{\text{Indirect Effect of } inv_{16} \text{ via cognition}}] \delta_{ed_m, inv_{16}} \} \cdot \kappa_{ed_m} / \rho$$

$$\underbrace{\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad}_{\substack{\text{Indirect effect} \\ \text{via } inv_{16}}}$$

Back

Level 4 - Indirect effects via investments

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$$inv_{16,i} = \boldsymbol{\delta}_F \boldsymbol{F}_i + \delta_{Y_P} \ln Y_{Parent,i} + u_i^{inv_{16}}$$

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$$\underbrace{[\underbrace{\alpha_{inv_{16}}}_{\substack{\text{Direct Effect of} \\ inv_{16} \text{ on Earnings}}} + \underbrace{\beta_{inv_{16}} \alpha_S}_{\substack{\text{Indirect Effect of} \\ inv_{16} \text{ via schooling}}} + (\underbrace{\alpha_C}_{\substack{\text{Direct Effect of} \\ \text{cognition on Earnings}}} + \underbrace{\beta_C \alpha_S}_{\substack{\text{Indirect Effect of} \\ \text{cognition via schooling}}}) \gamma_{inv_{16}}]}_{\text{Indirect Effect of } inv_{16} \text{ via cognition}} \delta_{ed_m, inv_{16}} \}}_{\substack{\text{Indirect effect} \\ \text{via } inv_{16}}} \cdot \kappa_{ed_m} / \rho$$

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Level 3- Indirect effects via cognition

Determinants of cognition:

$$C_i = \gamma_I \boldsymbol{I}_i + \gamma_F \boldsymbol{F}_i + \gamma_{Y_P} \ln Y_{Parent,i} + u_i^C$$

Share of the IGE explained by age 16 investments:

$$[\underbrace{\alpha_{inv_{16}}}_{\substack{\text{Direct Effect} \\ \text{of } inv_{16} \text{ on Earnings}}} + \underbrace{\beta_{inv_{16}}\alpha_S}_{\substack{\text{Indirect Effect} \\ \text{of } inv_{16} \text{ via schooling}}} + \underbrace{(\underbrace{\alpha_C}_{\substack{\text{Direct Effect} \\ \text{of cognition on Earnings}}} + \underbrace{\beta_C\alpha_S}_{\substack{\text{Indirect Effect} \\ \text{of cognition via schooling}}})\gamma_{inv_{16}}}_{\text{Indirect Effect of } inv_{16} \text{ via cognition}}] \cdot \kappa_{inv_{16}}/\rho$$

Back

Level 3- Indirect effects via cognition

Determinants of cognition:

$$C_i = \gamma_I \boldsymbol{I}_i + \gamma_F \boldsymbol{F}_i + \gamma_{Y_P} \ln Y_{Parent,i} + u_i^C$$

Share of the IGE explained by age 16 investments:

$$\Big[\underbrace{\alpha_{inv_{16}}}_{\substack{\text{Direct Effect} \\ \text{of } inv_{16} \text{ on Earnings}}} + \underbrace{\beta_{inv_{16}}\alpha_S}_{\substack{\text{Indirect Effect} \\ \text{of } inv_{16} \text{ via schooling}}} + \Big(\underbrace{\alpha_C}_{\substack{\text{Direct Effect} \\ \text{of cognition on Earnings}}} + \underbrace{\beta_C\alpha_S}_{\substack{\text{Indirect Effect} \\ \text{of cognition via schooling}}} \Big)\gamma_{inv_{16}} \Big] \cdot \kappa_{inv_{16}}/\rho$$

$\Big(\quad \Big)\gamma_{inv_{16}}$: Indirect Effect of inv_{16} via cognition

Back

1. Family environment differs by parental income

	Parental Income Tertile			
Variable	Bottom	Middle	Top	P-val
Family Background				
Number of siblings	2.13	1.93	2.05	0.01
Father's age left school	14.9	14.8	15.2	0.00
Mother's age left school	15.0	15.1	15.3	0.00

Back

2. Parental investments differ by parental income

	Parental Income Tertile			
Variable	Bottom	Middle	Top	P-val
Time investment				
% of mothers very interested at age 7	31.5	34.1	37.4	0.03
% of mothers very interested at age 11	29.8	34.3	36.1	0.02
% of mothers very interested at age 16	31.5	32.8	35.6	0.19
School quality				
% whose PTA holds meetings at age 7	56.8	57.6	58.7	0.71
Student-teacher ratio age 11	24.8	24.7	24.3	0.06
% from child's class studying for GCEs age 16	44.0	44.4	50.5	0.00

Back

3. Child outcomes differ by parental income

	Parental Income Tertile			
Variable	Bottom	Middle	Top	P-values
Cognition				
Reading at age 16	-0.11	0.01	0.10	0.00
Math at age 16	-0.08	-0.02	0.10	0.00
Education				
Age left education	17.9	17.9	18.1	0.02
Income				
Children's average annual earnings	17,293	19,019	20,386	0.00

Back

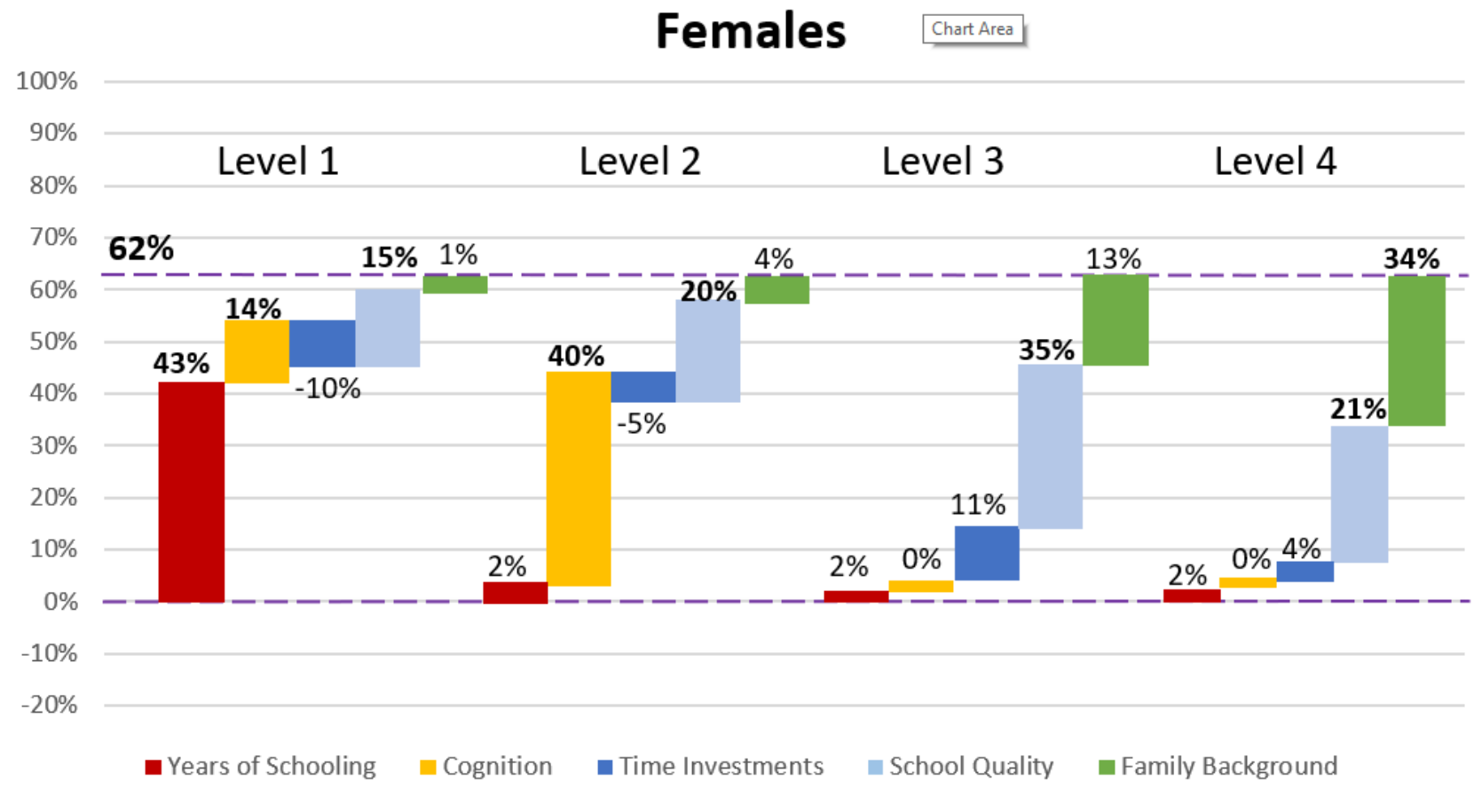
Signal-to-Noise Ratios

Table: Signal-to-Noise Ratio for some of our measures

Cognition at 16		**Time Inv 16**		**School Quality 16**	
Reading Score	0.56	P:Supportive	0.32	School Type	0.08
Math Score	0.62	M:Interest in ed	0.90	%Cnt School	0.35
Teacher: Math	0.80	F: Interest in ed	0.75	%FT degree	0.82
Teacher: English	0.72			%Passed A-levels	0.93
				%Studying towards A-levels	0.45
				Teacher Student Ratio	0.20

Back

Results: Mediation Analysis - Females



Full Table Robustness

Back: Males

Literature

How can we explain intergenerational earnings persistence?

1. Potential mechanisms:
   - Schooling: Carneiro & Heckman (2002), Caucutt & Lochner (2020)
   - Cognition: Dahl & Lochner (2012), Agostinelli & Sorrenti (2018)
   - Parental Investments: Cunha & Heckman (2008), Cunha et al. (2010), Attanasio et al. (2020), Dearden et. al (2002)
   - Family background: Meghir & Palme (2005), Bhalotra & Clarke (2020)
   - Decomposition: Blanden, Gregg, Macmillan (2007)
2. Dynamic lifecycle models: Gayle, Golan, Soytas (2018), Lee & Seshadri (2019), Daruich (2020)

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