# Education and equality of opportunity in health

November 2013

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# Schooling and Health Inequity

- Large literature on the positive gradient in health by years of schooling/academic qualifications and some evidence that this may be causal. But less is known about whether the type/quality of school also affects health and how it interacts with attainment.

"Improvements in education may be the single most important cause of better health in lower-income countries today"

Angus Deaton (2013) The Great Escape. Princeton University Press, p.105.

- Interest in inequality of opportunity in health rather than inequality of outcomes *per se.* This adds a normative dimension to evaluating the relationship between quality of schooling and health.

# Comprehensive education reform

- Exploit a **major education policy reform**, as often done in the recent literature (e.g. Lleras-Muney 2005; Arendt 2005, 2008; Oreopoulos 2006; Silles 2009; and Van Kippersluis et al. 2009).
- The ***comprehensive education reform***, implemented in England and Wales in the 1960s and 1970s, replaced an education system that used early selection, based on academic performance measured at age 11, by a unified system of mixed-ability secondary schools.
- The reform was intended to reduce the **inequality of opportunity** induced by early selection.

# QUALITY OF SCHOOLING AND INEQUALITY OF OPPORTUNITY IN HEALTH

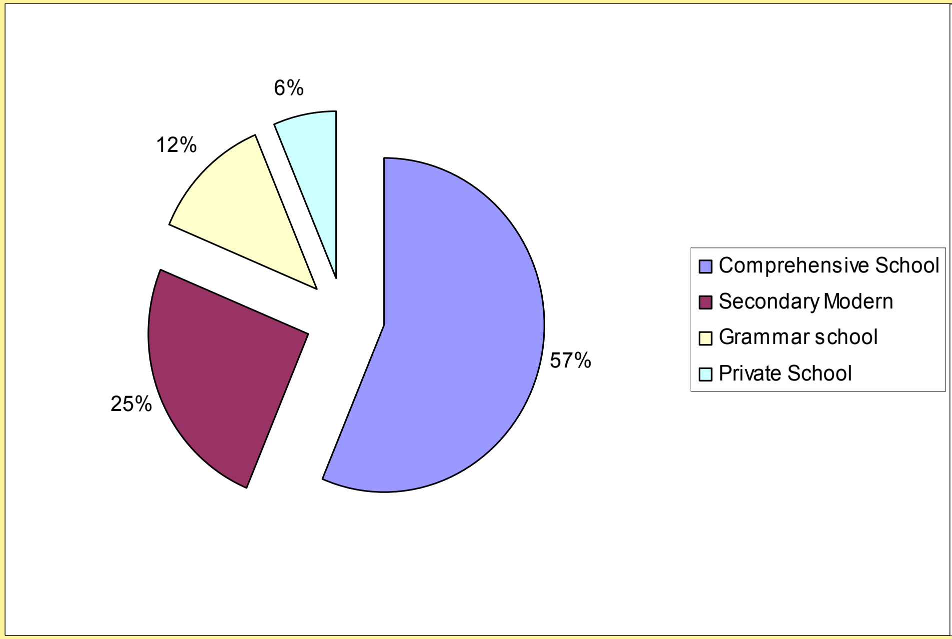
Andrew M. Jones, Nigel Rice & Pedro Rosa Dias

*Empirical Economics*, 42: 369-394, 2011.

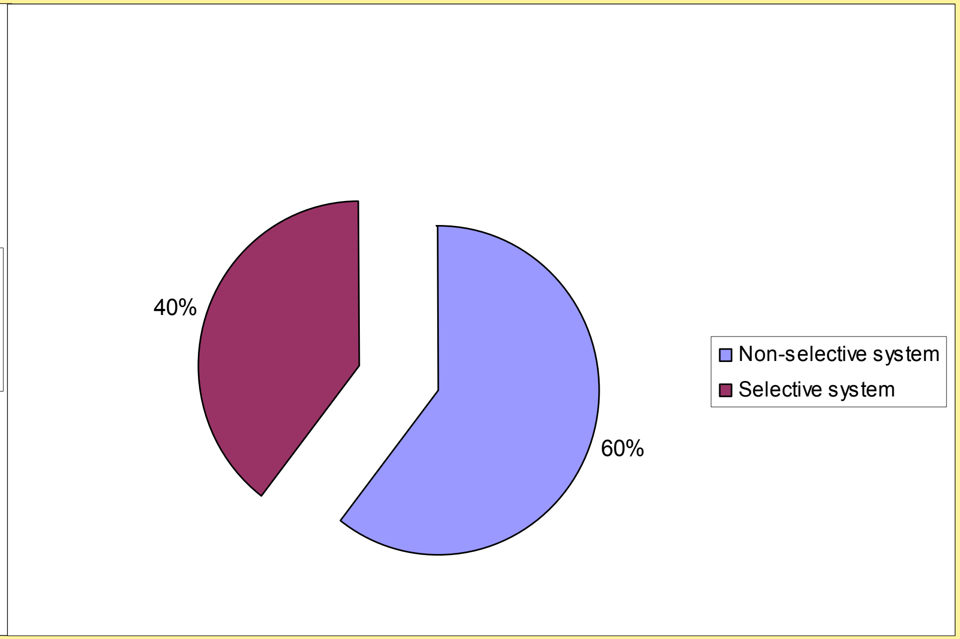
# Types of schools and educational system

(at age 16 in 1974, England & Wales)

**NCDS: cohort members by type of secondary school**




**NCDS: cohort members by type of educational system (state-schools only)**



- <u>Selective system</u>

**Grammar schools**: academically oriented state schools that provided teaching for the entire age range 11-18, included a sixth form for A-level studies and prepared pupils to go on to higher education. Admission into these schools was determined by an exam taken at age 11 (the 'Eleven Plus' exam).

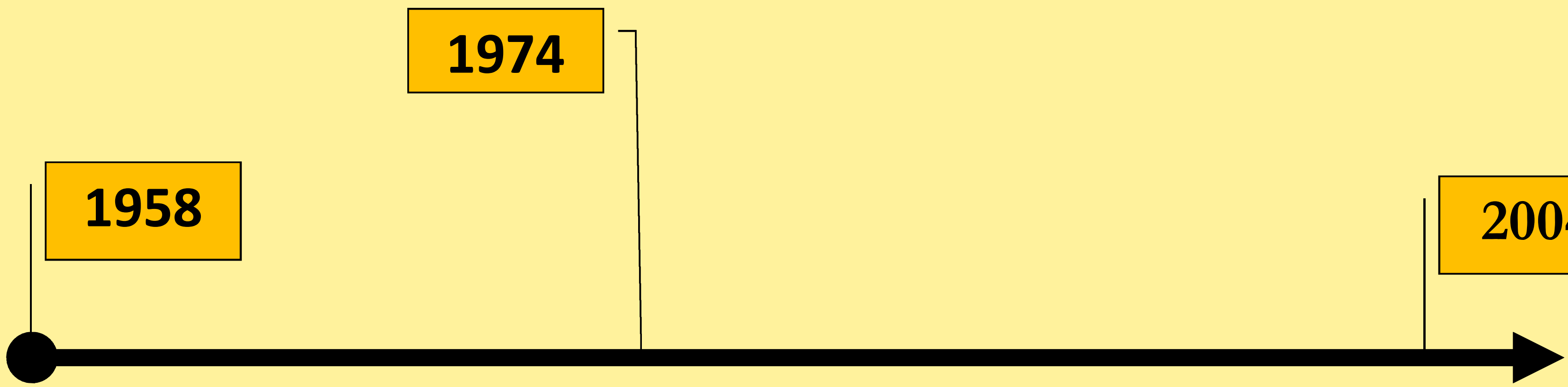
**Secondary modern schools**: vocationally oriented state schools; typically covered the ages 11-16. Limited chances for progressing to higher education.

- <u>Non-selective system</u>

**Comprehensive schools**: unified mixed ability secondary schools (often with ability streams).

## Data - National Child Development Study (NCDS)

Cohort of nearly 17000 individuals born in the week of March the 3rd 1958, from birth to age 46. Interviews conducted in 1965, 1969, 1974, 1981, 1991, 1999 / 2000 and 2004.



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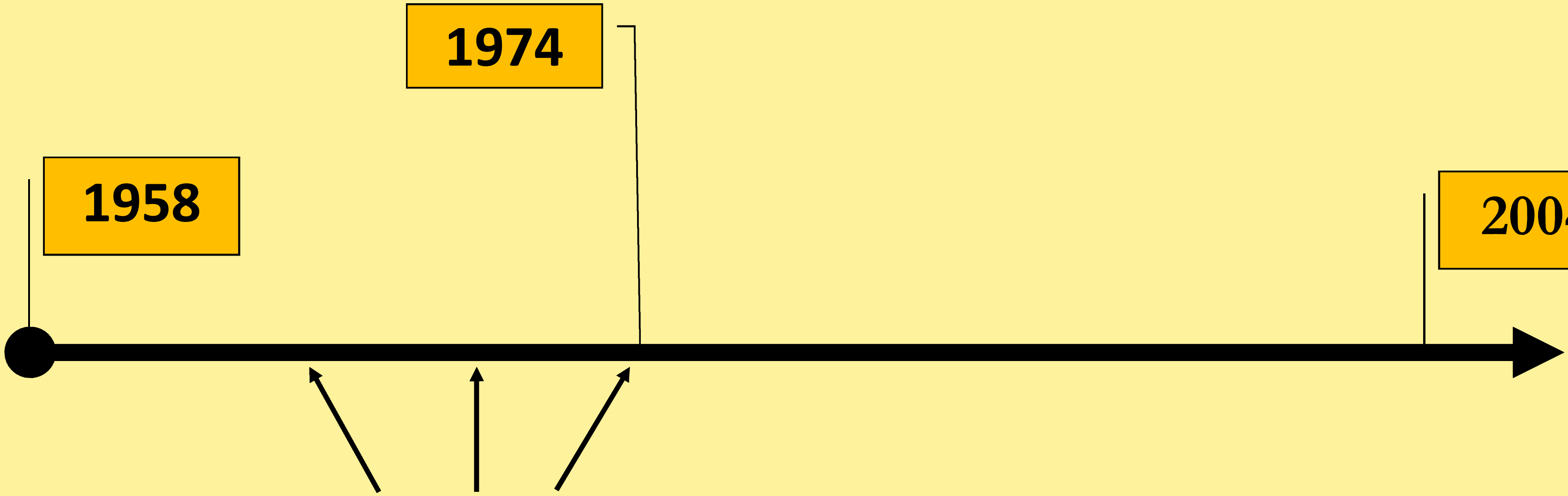



**<u>First 3 waves: childhood circumstances</u>**

<u>Socioeconomic background</u> : Parental social class; social class of both grandfathers; years of schooling of both parents; exposure of household to bad finances.

<u>Health endowment</u>: Birthweight; maternal smoking during pregnancy; wide range of childhood morbidities; hereditary conditions in the family; obesity in childhood and adolescence; parental smoking.

<u>Ability</u>: Cognitive and non-cognitive ability.

# Data - National Child Development Study (NCDS)

Cohort of nearly 17000 individuals born in the week of March the 3rd 1958, from birth to age 46. Interviews conducted in 1965, 1969, 1974, 1981, 1991, 1999 / 2000 and 2004.

**1958**

**1974**

**<u>Waves 4 -7: Adulthood lifestyle and health outcomes</u>**

<u>Socioeconomic status</u>: Social class and academic qualifications

<u>Lifestyles</u>: Cigarette smoking; diet (avoidance of fried food and chips, consumption of sweets, consumption of vegetables); alcohol consumption.

**2004**

**<u>First 3 waves: childhood circumstances</u>**

<u>Socioeconomic background</u> : Parental social class; social class of both grandfathers; years of schooling of both parents; exposure of household to bad finances.

<u>Health endowment</u>: Birthweight; maternal smoking during pregnancy; wide range of childhood morbidities; hereditary conditions in the family; obesity in childhood and adolescence; parental smoking.

<u>Ability</u>: Cognitive and non-cognitive ability.

**Family SES**

- Father's SC (3 groups)
- Mother & father's years of schooling
- Financial hardship (age 7)
- ED characteristics

**Family & childhood health**

- Gender
- Morbidity index (age 7)
- Hospitalisations (age 7)
- Obesity (age 16)
- Family illness (diabetes, epilepsy, heart disease)

**Ability: Cognitive**

- Tests at age 7 & 11

**Non-cognitive**

- BSAG at age 11

**Schooling**

- Primary school (size of class at 7, unhappy, parents' plans)
- School type (age 16)
- School characteristics
- Qualifications

**Adult SES & lifestyle**

- Own SC (age 42)
- Smoking (age 42)
- Drinking (age 33)
- Vegetables (age 33)
- Fried food (age 33)
- Smoking during pregnancy

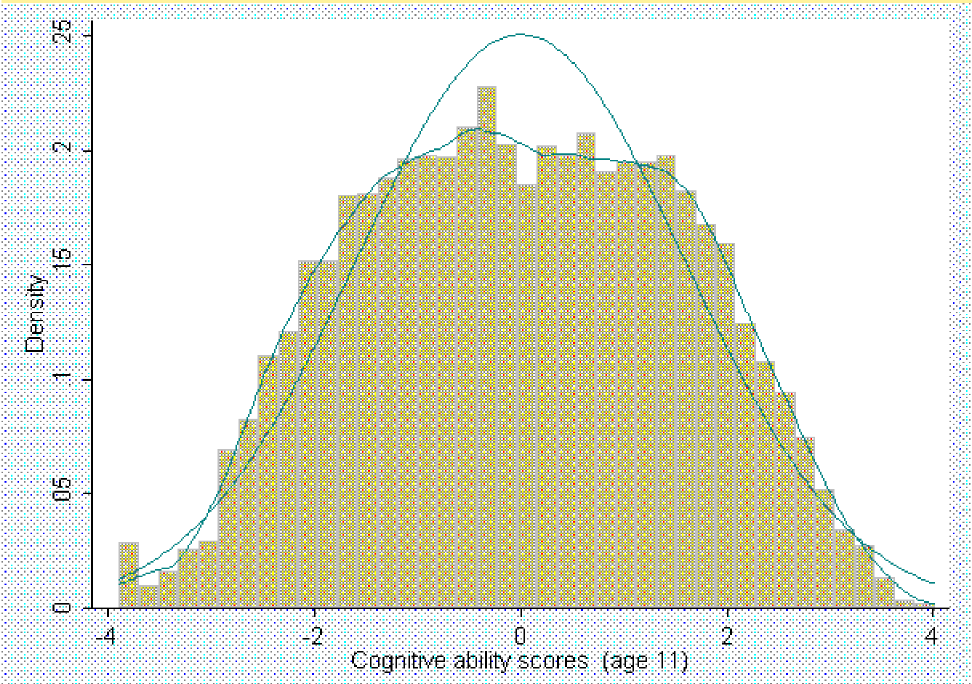
**Adult health**

- Self-assessed health (age 46)
- Long-standing illness (age 46)
- Malaise (age 46)

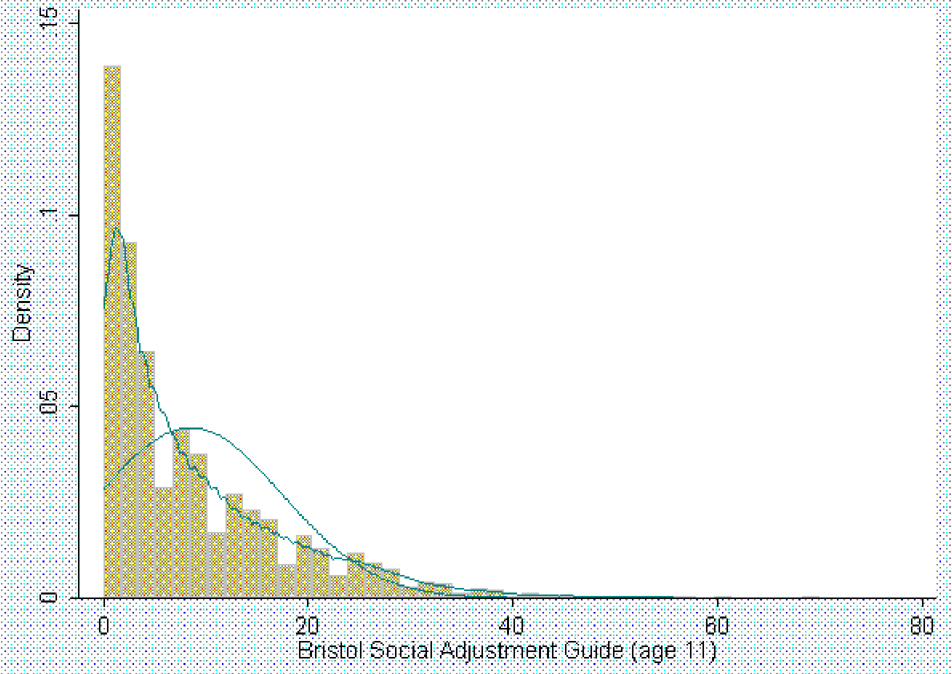
# Key control variables: cognitive ability and social adjustment

**(histogram, kernel density & normal curve)**

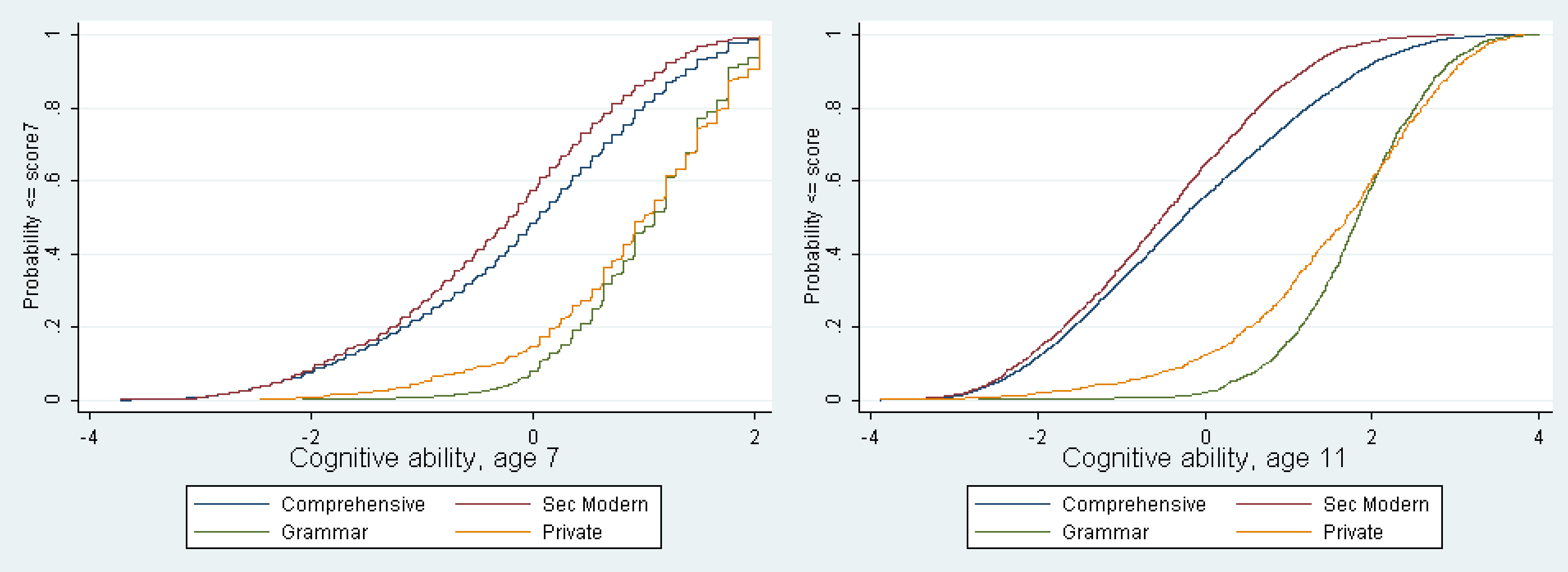
**Cognitive ability scores**




**BSAG scores**



# Empirical distributions of cognitive ability scores at ages 7 and 11



**Family SES**

- Father's SC (3 groups)
- Mother & father's years of schooling
- Financial h... (age 7)
- ED charact...

**Family & childhood health**

- Gender
- Morbidity index (age 7)

**Ability: Cognitive**

- •Tests at age7

**Non-cognitive**

...1

**Schooling**

1. <u>**Primary school characteristics**</u>:
   - **Private schools vs state schools**
   - **Pupil – teacher ratio**
   - **Pupil *happy at school***
2. <u>**Secondary school characteristics**</u>:
   - **School type (Grammar, sec. mod, comprehensive and private)**
   - **Ability streaming**
   - **Single sex school**
   - **Boarding school**
   - **Pupil–teacher ratio**
   - **Expulsion rate**

**Adult ...**

- Own SC
- •Smoking
- Drinking
- Vegetabl...
- Fried food (age 33)
- Smoking during pregnancy

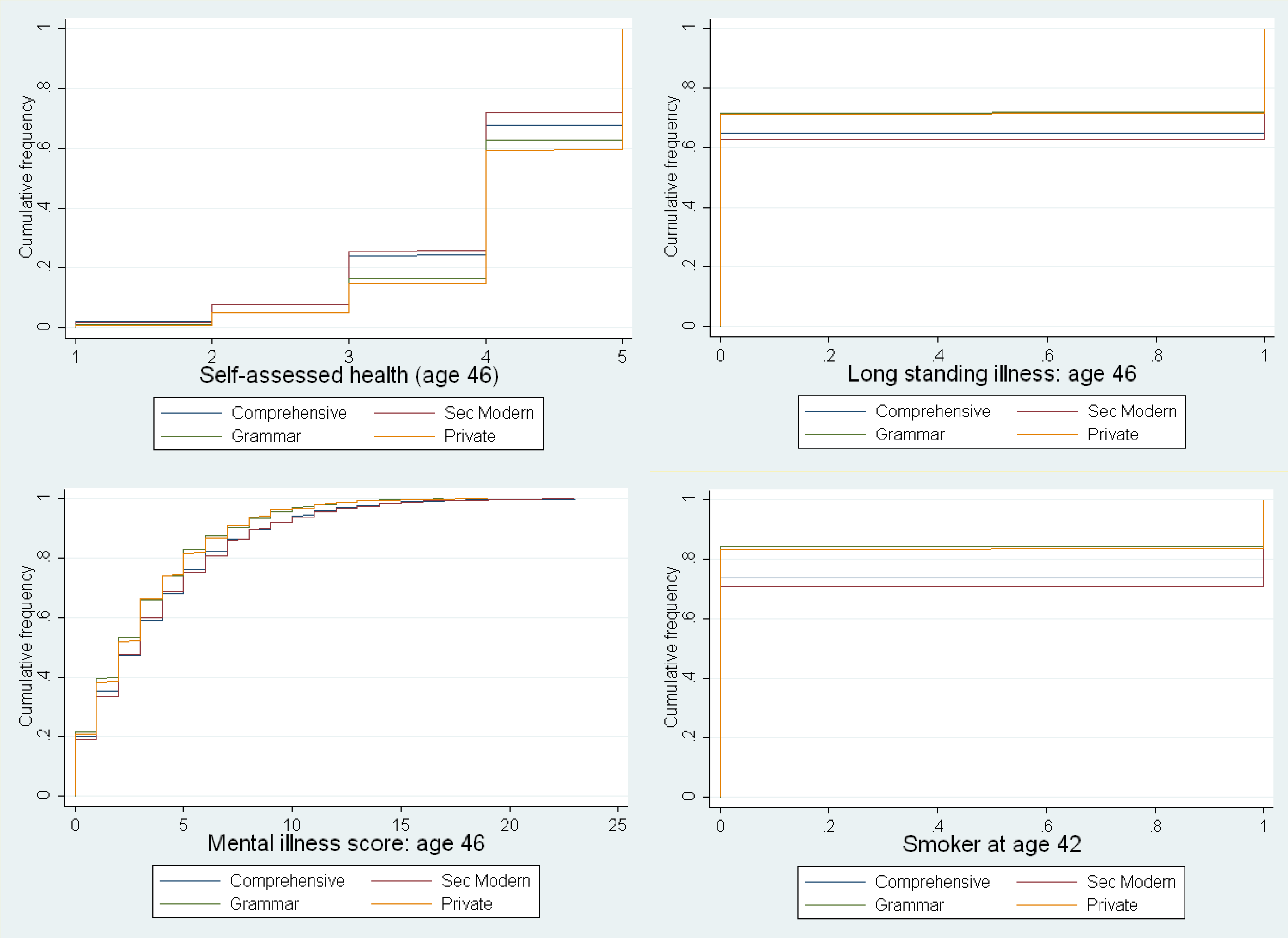
...ge 46)

...ge 46)

## The Roemer model and inequality of opportunity in health

- Health production function: H = H(C, E(C))
- **Circumstances**: **Illegit**imate sources of inequality (e.g. type of secondary school attended at age 16).
- **Effort**: **Legit**imate sources of inequality (e.g. cigarette smoking) .
- Social types 1 to T: exposed to identical circumstances
- **Equality of opportunity**: nullification of the impact of circumstances keeping inequalities solely due to differential effort untouched.
- LeFranc et al (2009) define equality of opportunity in terms of stochastic dominance in the context of the Roemer model. These are **testable conditions** (e.g., Davidson & Duclos, 2000).

# Stochastic dominance



# Stochastic dominance in parametric models – distributional regressions

- Parametric models used to see how results for first order dominance are influenced by conditioning the distribution on other factors.
- Use **distributional regressions** approach of Foresi and Peracchi (1995) .
- Estimate CDF 'step functions' as a sequence of probits/logits:

    1. Only school types (age 16)
    2. + pre-schooling individual characteristics and school variables
    3. + own qualifications
    4. + own socioeconomic status
    5. + own health-related behaviours

# Main Findings

• Association between adult health and different qualities of education, over and above the effects of measured ability, social development, years of schooling and academic qualifications.

•Attendance at some types of schools is associated with a much higher prevalence of chronic illness and disability in adulthood, than others.

•Statistically significant and economically relevant association between standard measures of poor quality of secondary schooling, such as the pupil expulsion rate, and poorer self-assessed health in adulthood.

•<u>However</u>, the association between different dimensions of quality of schooling is uneven across the set of outcomes of interest.

# EQUALISING OPPORTUNITIES IN HEALTH USING EDUCATIONAL POLICY

Andrew M. Jones[1] John E. Roemer[2]
& Pedro Rosa Dias[3]

**HEDG Working Paper 13/29, 2013**

[1] University of York, [2] Yale University, [3]University of Sussex

# Motivation

- A normative framework to assess the pathways through which differences in parental background, cognitive ability and educational achievement shape opportunities for health in adulthood.

- An evaluation of the distribution of health outcomes associated with such policies under different ethical criteria: equality of opportunity and utilitarianism.

- Use of NCDS data to simulate counterfactual distributions of health outcomes.

- A comparison of the relative importance of different pathways under alternative educational policy regimes (selective *vs.* non-selective education).

# Normative evaluation of policies

• The **equality-of-opportunity ethic** prescribes choosing the policy that makes the distribution function of the most disadvantaged type as favourable as possible. If there is FOSD, and letting 1 be the most disadvantaged type, the problem is to:

$$\max_r \int \left(1 - F_r^1(h)\right) dh$$

• More generally, it is necessary to compute the area above the left-hand envelope of the outcome distributions of all types (see Roemer, 2002).

• With self-assessed health the **equality-of-opportunity** principle chooses the policy that solves:

$$\max_r \sum_{h=1}^{5} (1 - F_r^1(h))$$

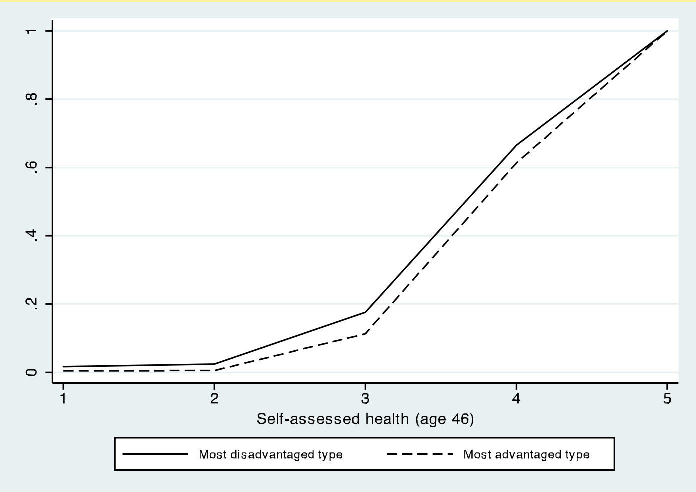
•In contrast, the **utilitarian** rule is:

$$\max_r \sum_{t=1} \sum_{h=1}^{5} g^t (1 - F_r^t(h))$$

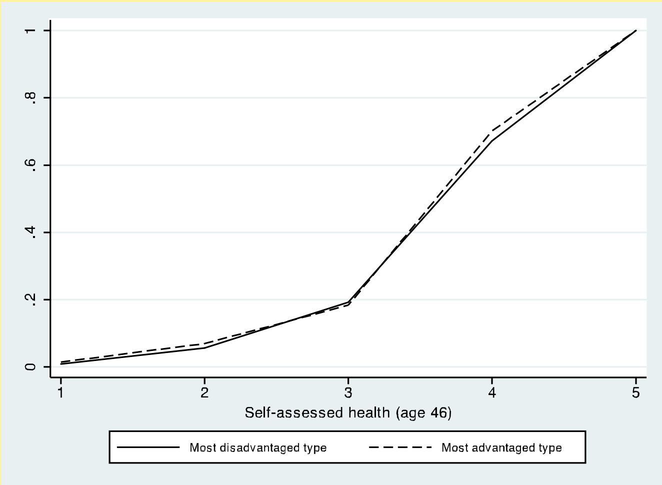
# Distributions of SAH by type

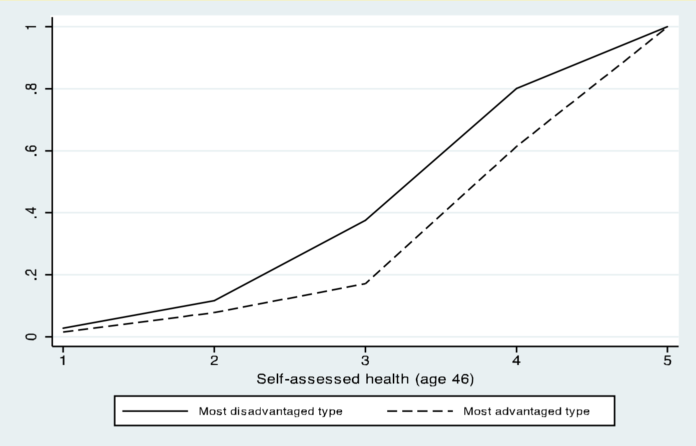
(by Conservative (top) & Labour (bottom) areas)

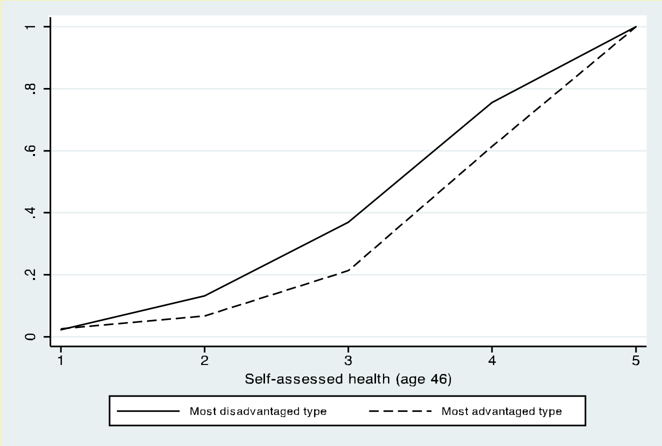
## Selective




## Comprehensive

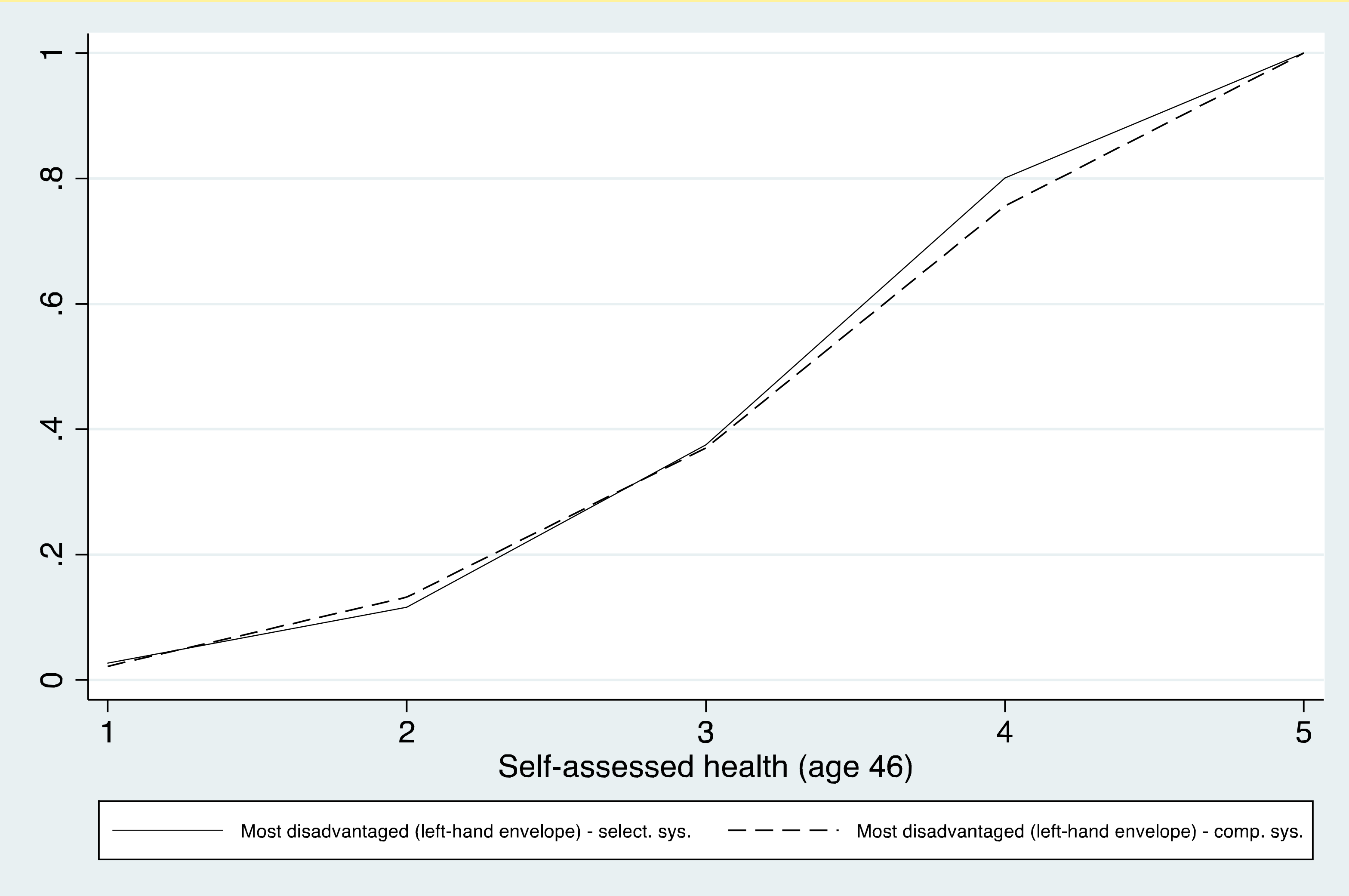


# Distributions of SAH

## Most disadvantaged type by system



# Long-term Effects of Cognitive Skills, Social Adjustment and Schooling on Health and Lifestyle: Evidence from a Reform of Selective Schooling

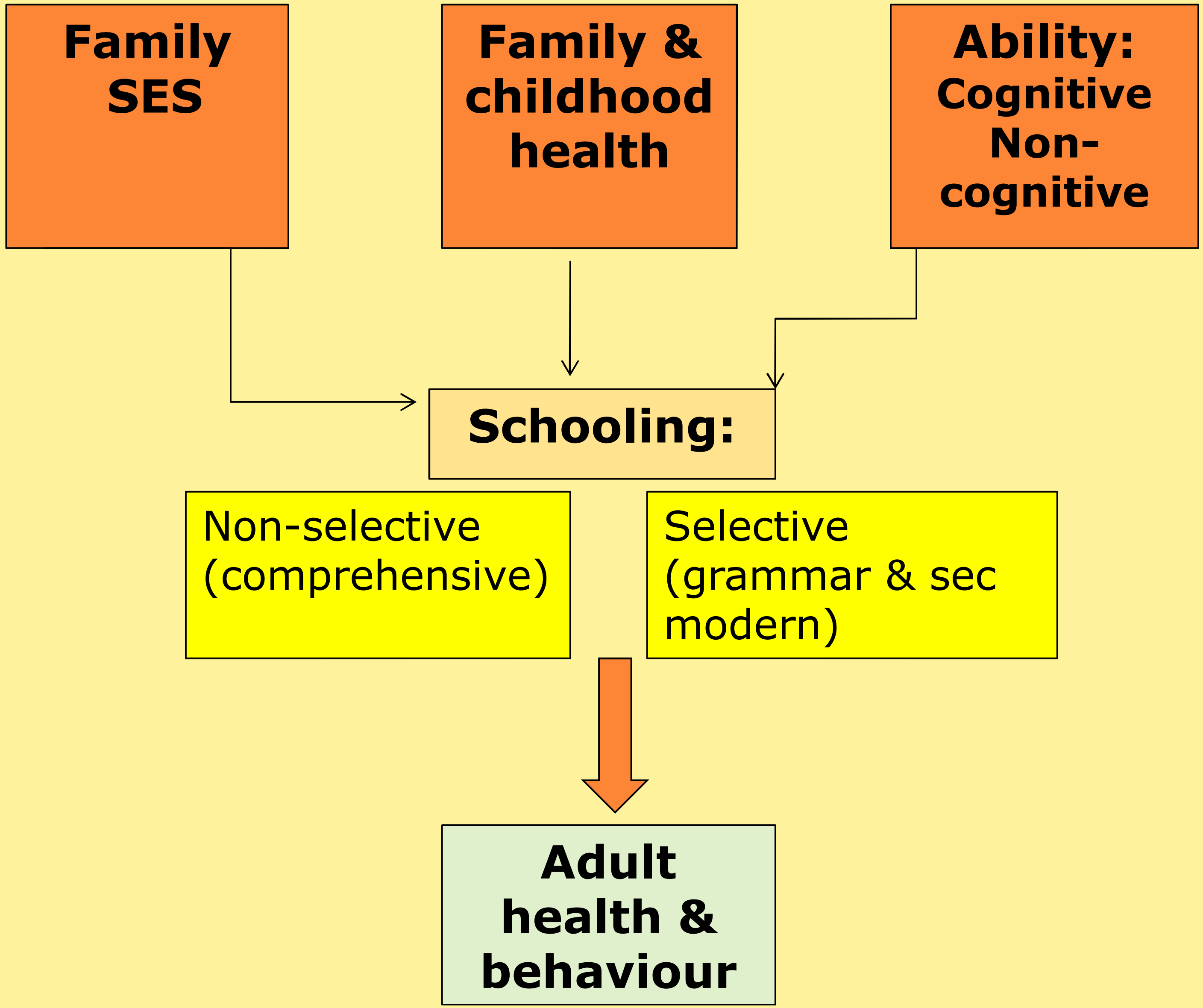
Andrew M. Jones, Nigel Rice & Pedro Rosa Dias

*Journal of Human Capital*, 5: 342-376, 2011

# Research questions: A sketch of our empirical strategy

• **On average, what is the overall impact of educational attainment, captured by a detailed measure of the highest qualification attained, and of the quality of schooling on adult health and health-related behaviour?** This comparison uses matching to balance the sample and controls for an extensive set of observed pre-schooling characteristics using linear and nonlinear regression methods.

• **Is there heterogeneity in the impacts, particularly according to the type of school attended?** This is explored by creating matched samples, linking those who actually went to grammar or secondary modern schools with comparable counterparts who went to comprehensive schools and then applying parametric models to these matched sub-samples.


Family SES
Family & childhood health
Ability: Cognitive Non-cognitive
Schooling:
Non-selective (comprehensive)
Selective (grammar & sec modern)
Adult health & behaviour

# Matched Samples

• Implement the matching in two steps:

• In the first step **coarsened exact matching** is applied to the key measures of cognitive and non-cognitive skills, the ability score at age 7 and the BSAG score at age 11 (Blackwell *et al.,* 2009). Then any observations that lie outside the common support of their joint distribution are excluded: this is only 34 cases in our data.

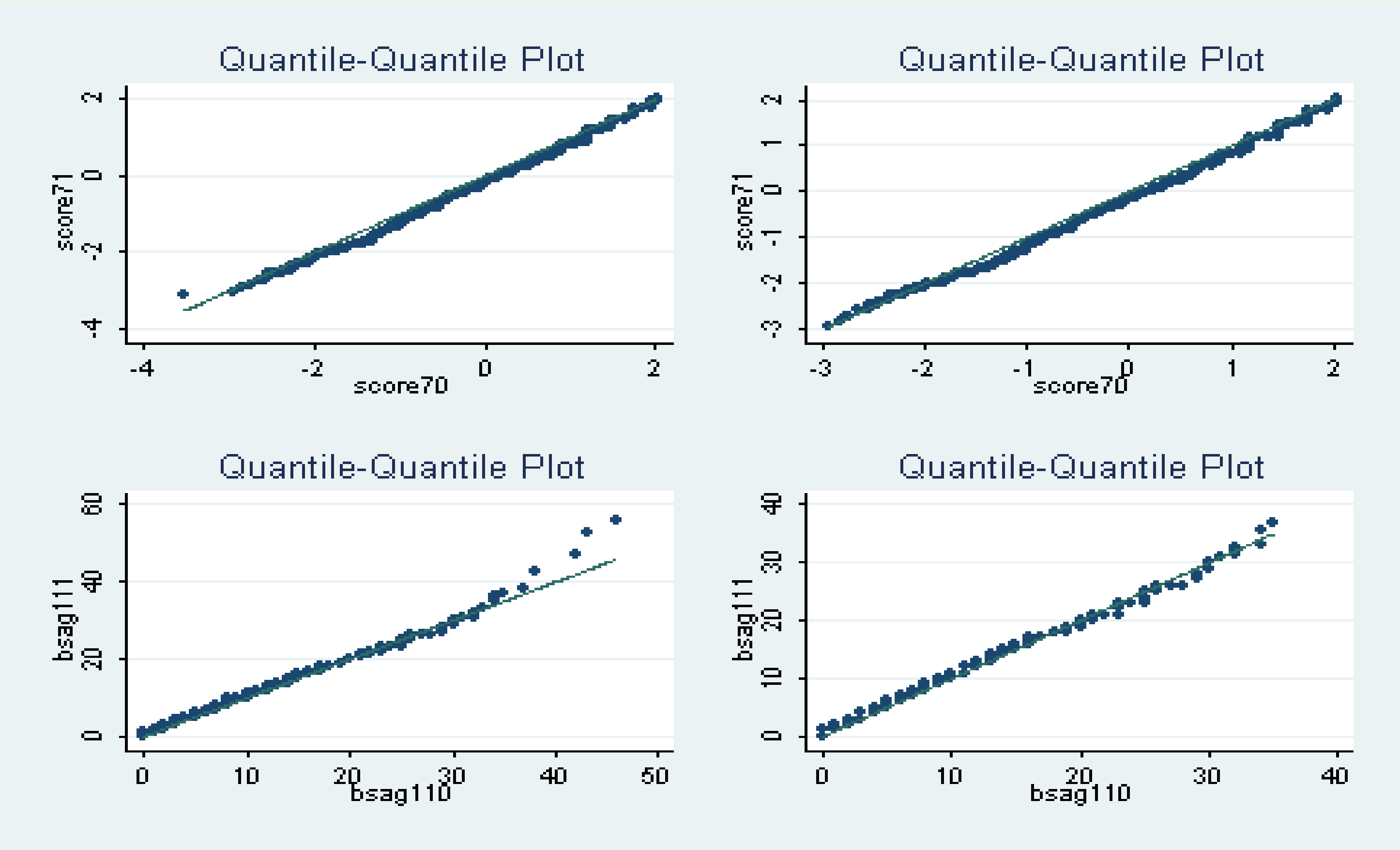
• The second step uses a combination of propensity score and Mahalanobis exact matching.

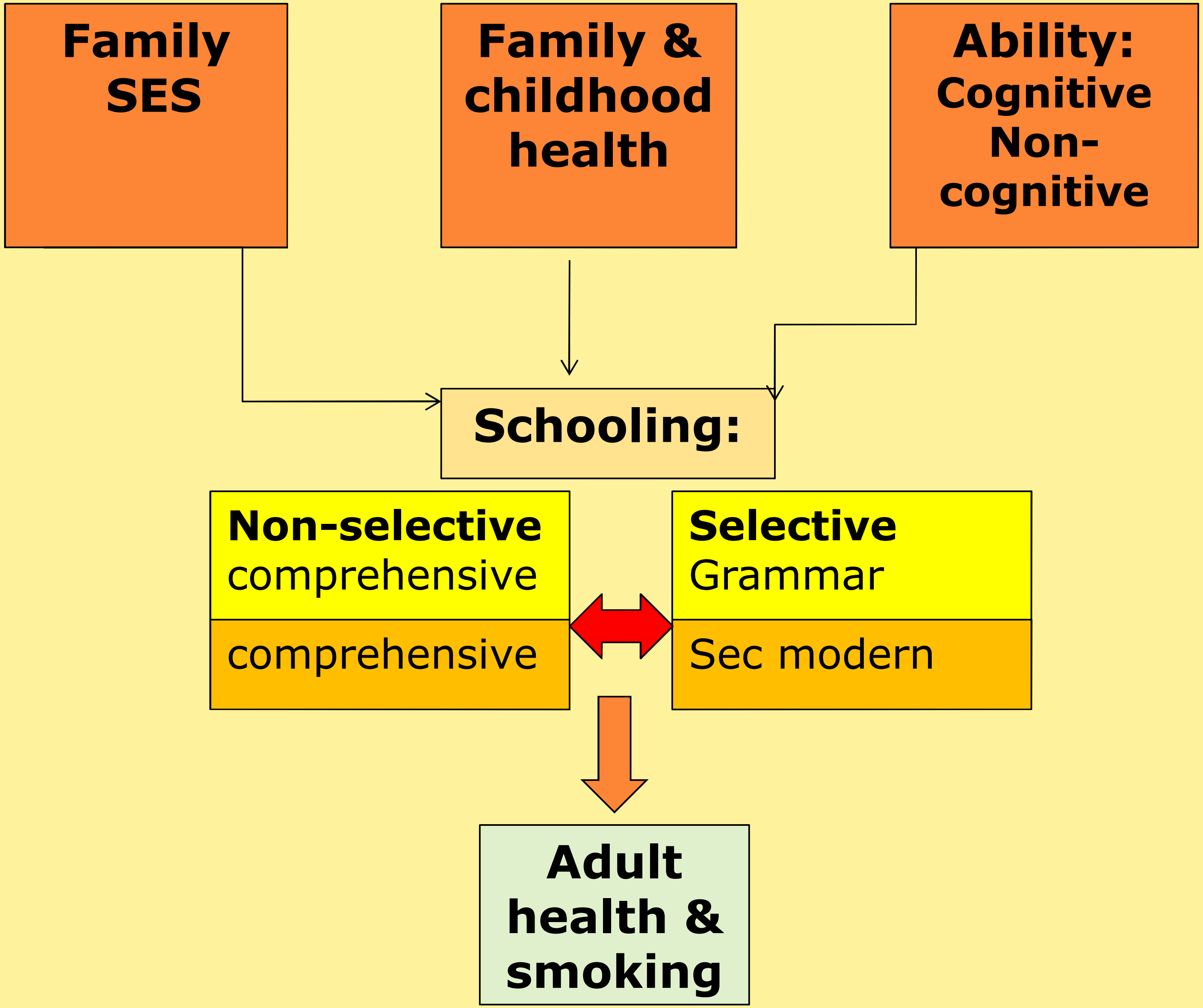
- The propensity score for attending a comprehensive school, as a function of all of the pre-schooling variables, is estimated using a logit model.

- Those who went to comprehensive schools are then matched with those who went to selective schools using the propensity score, within the common support and with a caliper of 0.1, combined with exact Mahalanobis matching for two key covariates, cognitive ability at age 7 and the BSAG score.

- The matching weights are then used in the subsequent regression analysis.

# Empirical QQ-plots for cognitive score at 7 and BSAG score: Before and after matching




Family SES
Family & childhood health
Ability: Cognitive Non-cognitive
Schooling:
Non-selective comprehensive
comprehensive
Selective Grammar
Sec modern
Adult health & smoking

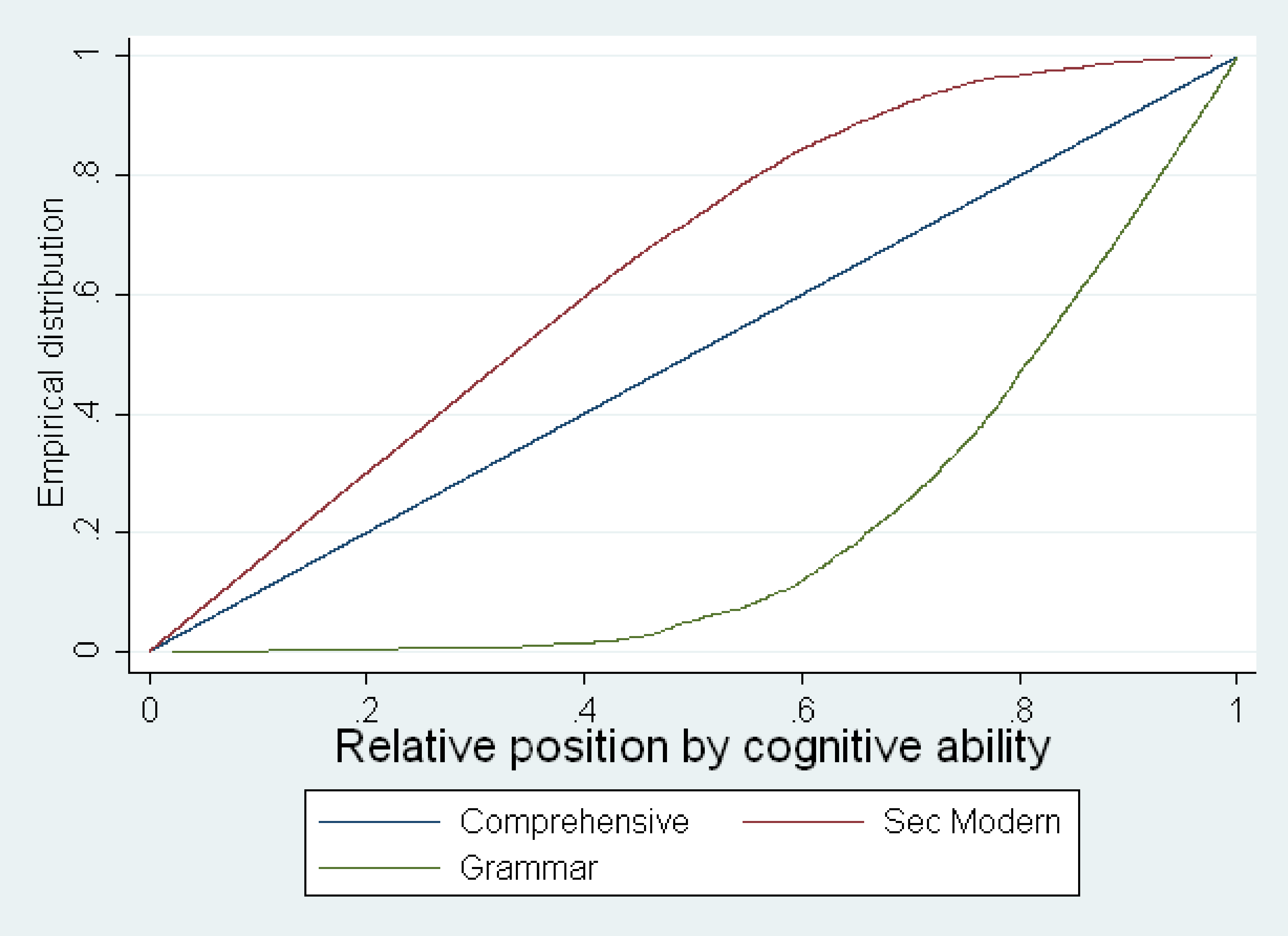
# Different impacts by type of school

- Individuals of the non-selective system are matched to cohort members **of the selective system school they would have attended** if not exposed to the reform.

- Propensity score controlling for set of pre-policy variables estimated on the sub-set of individuals who went to selective schools. Then whole sample matched on predicted propensity score.

- The matching is over the common support with a caliper of 0.1 and uses Mahalanobis matching on the propensity score and exact matching on relative ability at age 11, absolute ability at age 7, the BSAG score and father's social class.

# Empirical distributions of relative ability (rankings)



# Effect of educational attainment on health-related behaviours: matched sub-samples

| **Grammar** | Smoking (age 42) | Drinking (age 42) | Vegetables (age 33) | Fried food (age 33) | Smoking during pregnancy |
|---|---|---|---|---|---|
| Sample size | 713 | 629 | 690 | 690 | 162 |
| Attainment | **-0.010** | -0.355 | **0.036** | -0.011 | -0.016 |
| | **(-1.99)** | (-0.86) | **(2.12)** | (-0.81) | (-1.40) |

| **Sec Modern** | Smoking (age 42) | Drinking (age 42) | Vegetables (age 33) | Fried food (age 33) | Smoking during pregnancy |
|---|---|---|---|---|---|
| Sample size | 1063 | 873 | 1027 | 1027 | 125 |
| Attainment | **-0.038** | **0.959** | **0.064** | **-0.054** | -0.010 |
| | **(-5.00)** | **(2.06)** | **(2.68)** | **(-2.95)** | (-0.33) |

# Effect of educational attainment on health: matched sub-samples

| **Grammar** | LSI | | Malaise |
|---|---|---|---|
| | LPM | Probit | |
| Sample size | 743 | | 710 |
| Attainment | **-0.012** | **-0.012** | **-0.110** |
| | **(-1.82)** | **(-1.78)** | **(-2.39)** |

| **Sec. Modern** | LSI | | Malaise |
|---|---|---|---|
| | LPM | Probit | |
| Sample size | 1127 | | 1059 |
| Attainment | 0.006 | 0.006 | -0.012 |
| | (0.67) | (0.66) | (-0.19) |

# Long-Term Health Returns to Quality of Schooling: the Roles of Selection and Heterogeneity

Anirban Basu, University of Washington
Andrew Jones, University of York
Pedro Rosa Dias, University of Sussex

# Background: schooling and health

- Beyond years of schooling: recent evidence suggests that **type and quality of schooling** also affects health (e.g., Johnson, 2010; Jones et al, 2011).

- Beyond mean effects: is there heterogeneity in the effect of **type and quality of schooling** in the same way shown in Heckman and Conti, 2010 for **length of schooling**?

# METHODS

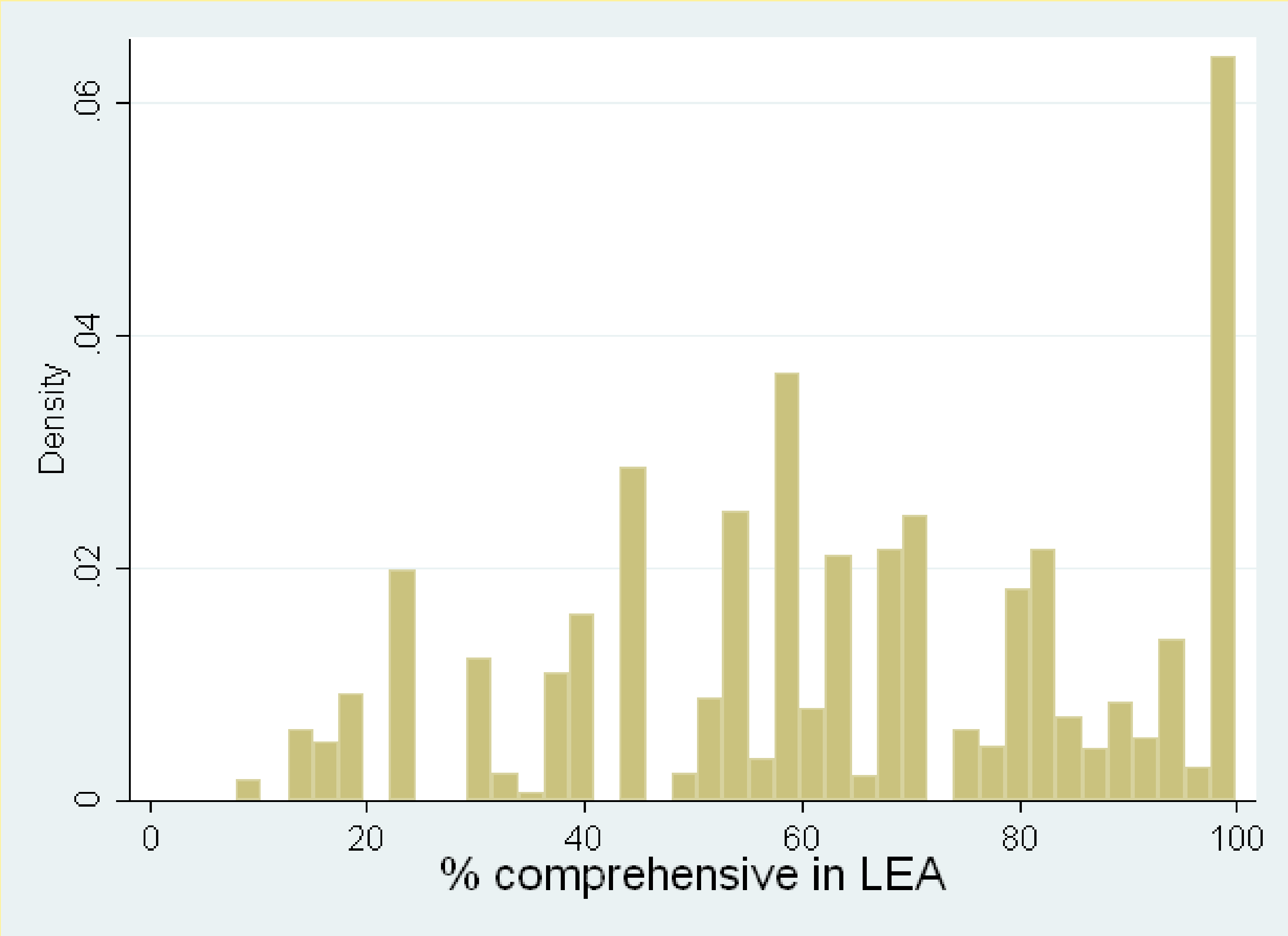
- Person-centered treatment (PeT) effects (Basu 2013)
  - Extension of local instrumental variables (pioneered by Heckman and colleagues)
  - conditions on the person's observed characteristics and averaged over the potential conditional distribution of unobserved characteristics that lead them to their observed treatment choices
  - Can be viewed as individualized treatment effects
  - Can be aggregated to form ATE, TT, TUT

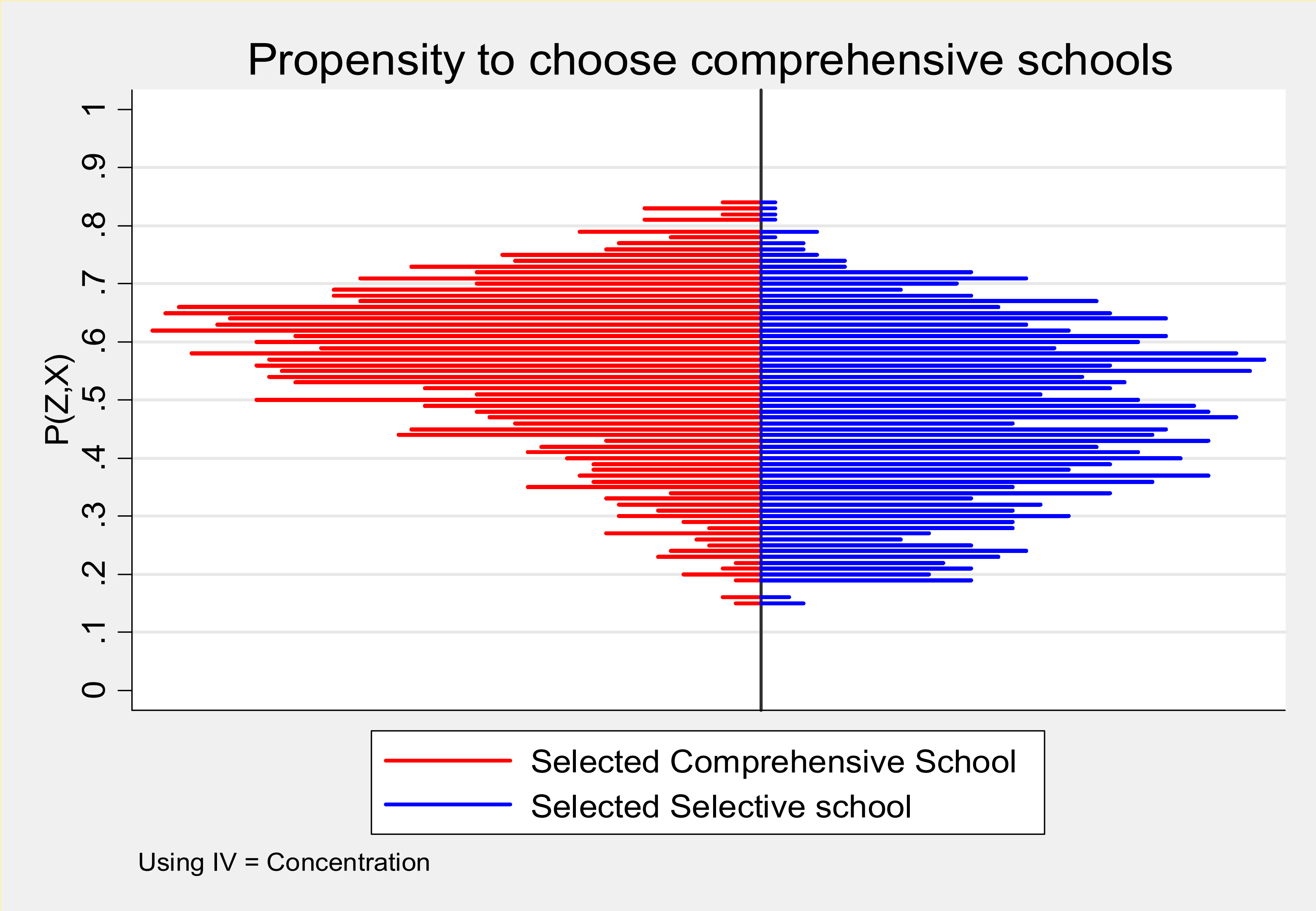
**Treatment**: Attendance at comprehensive school

**Instrument**: Concentration of comprehensive school pupils within each Local Education Authority (LEA).

# PeT/LIV approach

Percentage at comprehensives by LEA



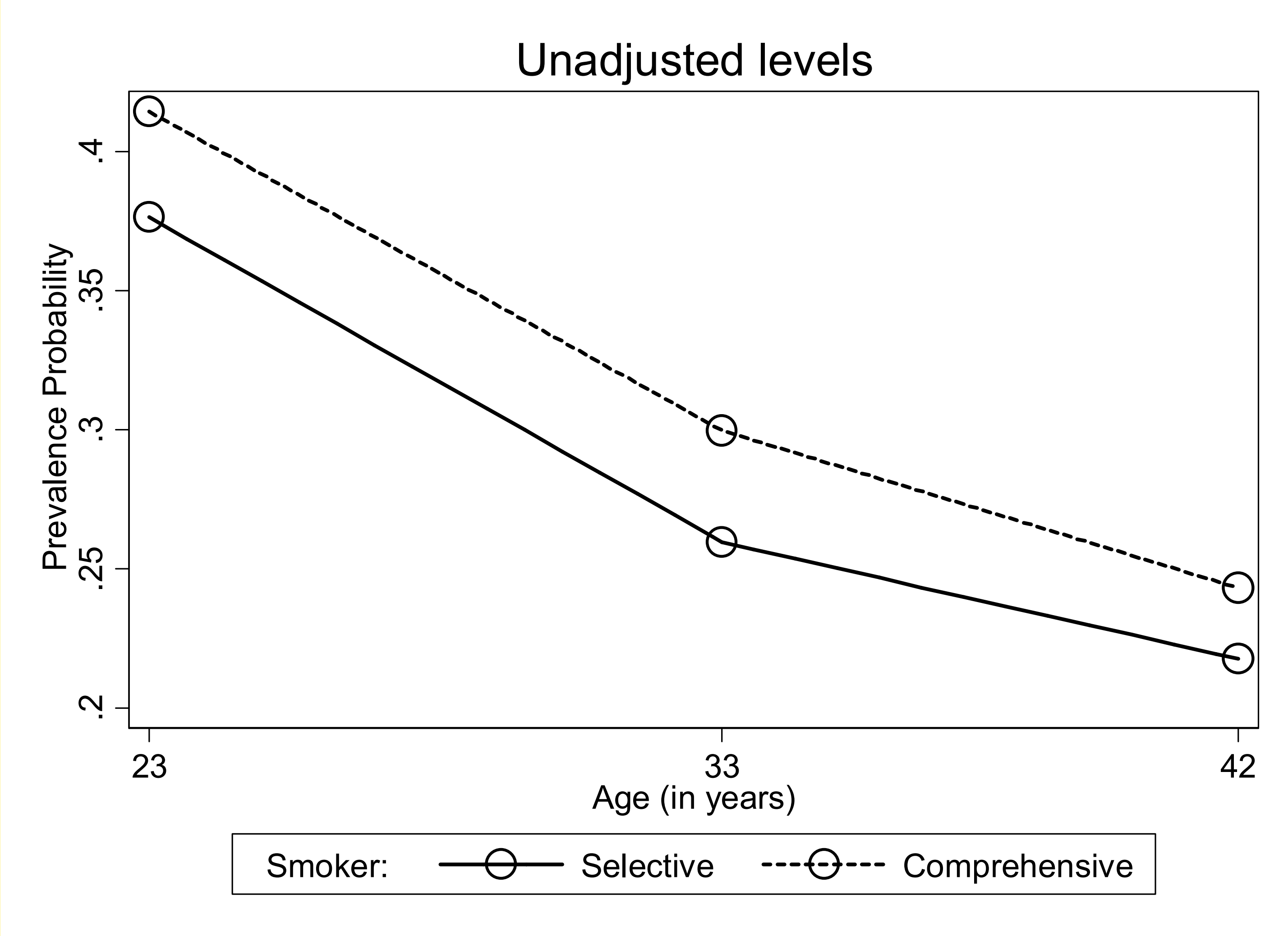

Propensity to choose comprehensive schools
P(Z,X)
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1
Selected Comprehensive School
Selected Selective school
Using IV = Concentration

# Falsification test for IV

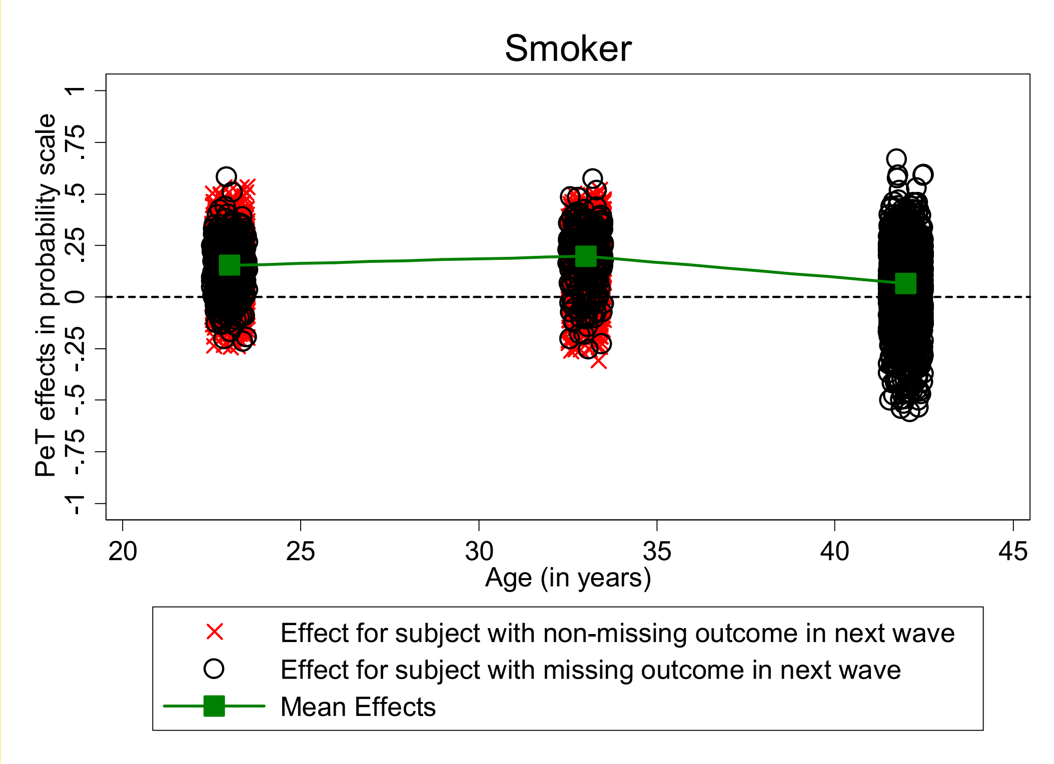
- Effect of Comprehensive vs selective school on morbidity at Age 11
- Pr(suffered > 2 acute illnesses by age 11) = 32%

- ATE = 0.01 (0.08) [p = 0.90]
- TT = -0.005 (0.08) [p = 0.95]
- TUT = 0.02 (0.09) [ p = 0.82]

# RESULTS ON SMOKING



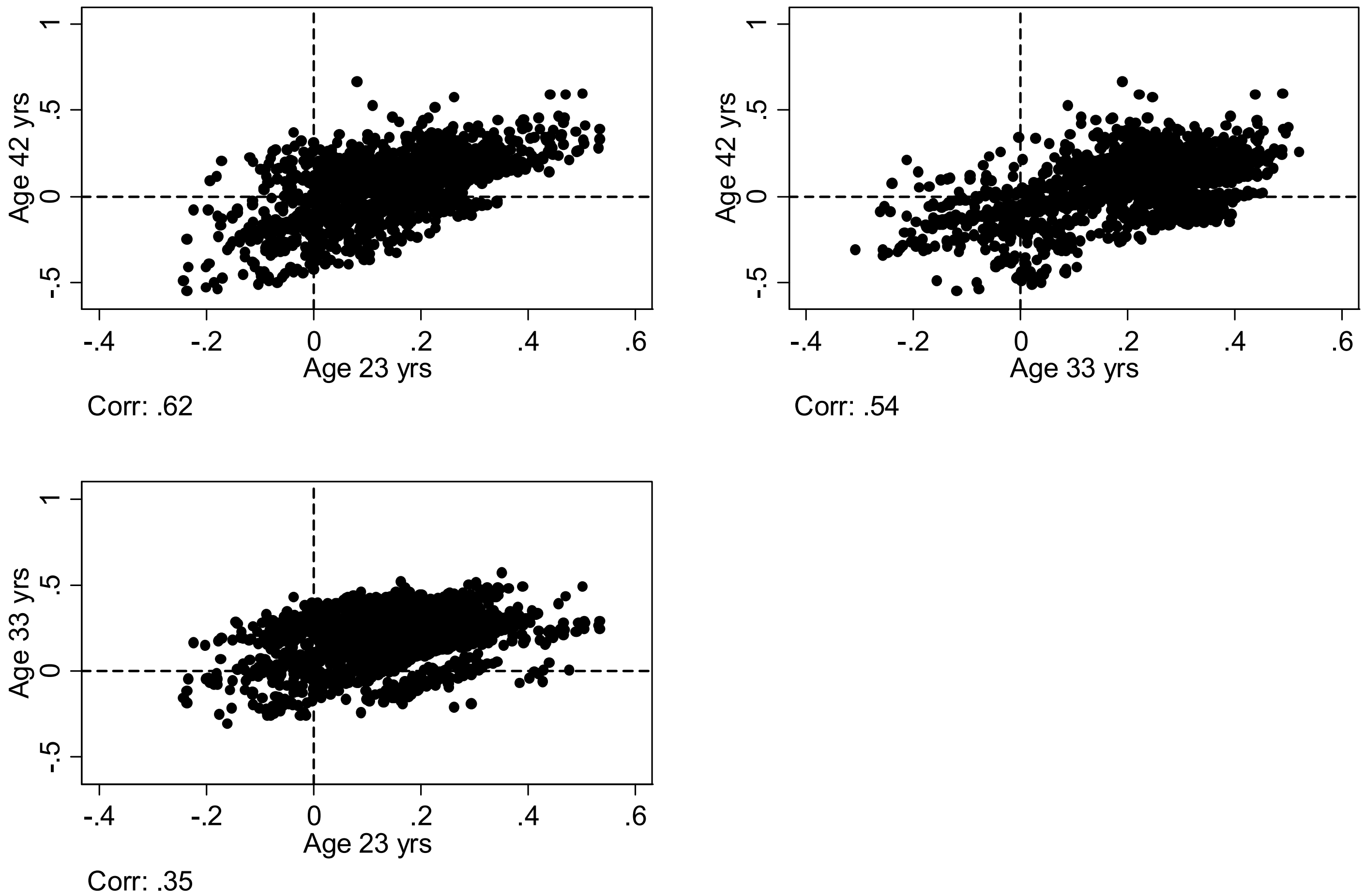
Unadjusted levels
Prevalence Probability
.2
.25
.3
.35
.4
23
33
42
Age (in years)
Smoker:
Selective
Comprehensive



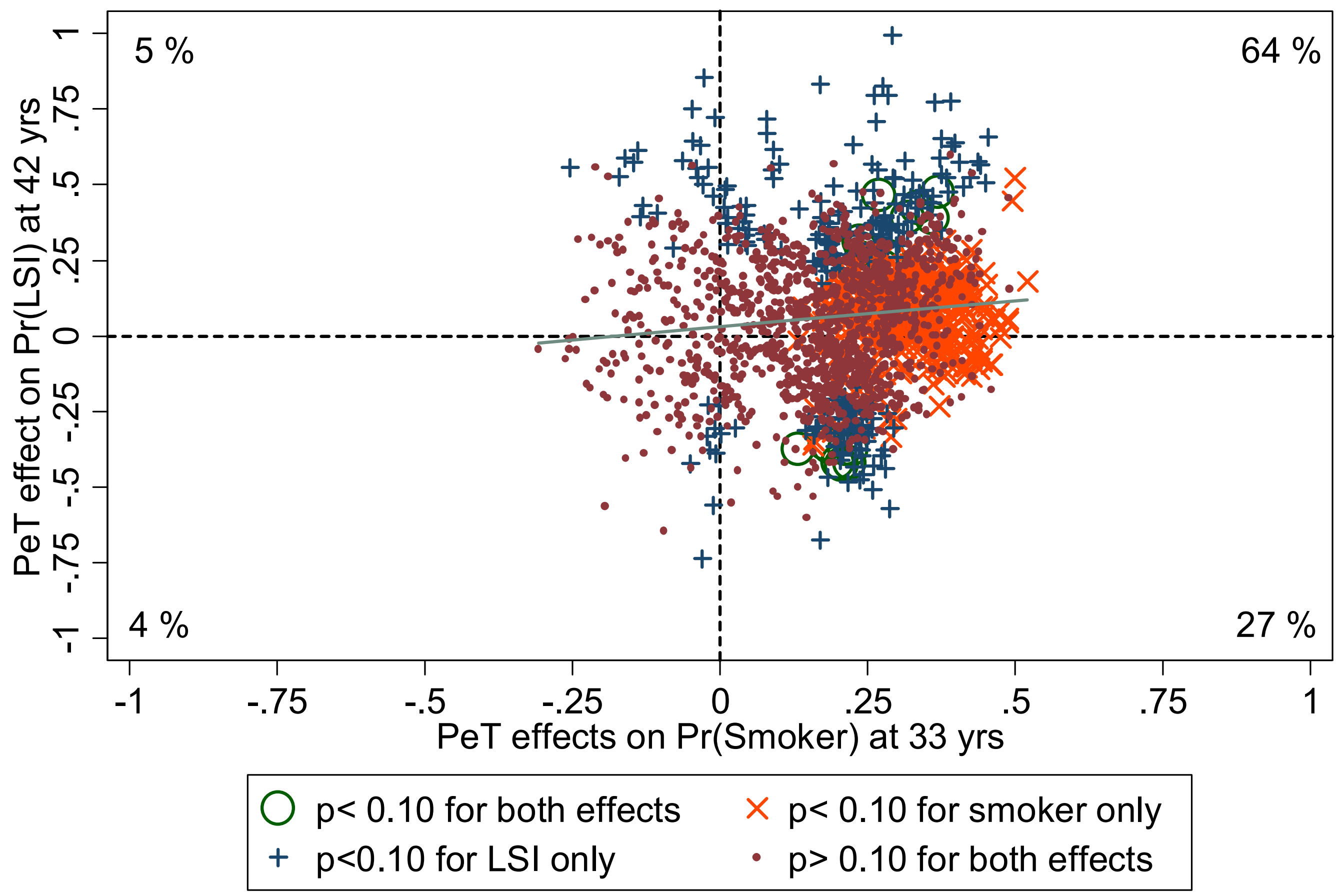

Mean effects (in probability scale): Mean (se) [p-value]

| OUTCOMES | **(SMOKER) at Age 23** | **(SMOKER) at Age 33** | **(SMOKER) at Age 42** |
|---|---|---|---|
| N | 2392 | 2134 | 2094 |
| Unadjusted | .038 ( .02 ) [ .058 ] | .04 ( .019 ) [ .039 ] | .026 ( .018 ) [ .166 ] |
| PeT-based | | | |
| ATE | .16 ( .103 ) [ .12 ] | **.20 ( .094 ) [ .034 ]** | .07 ( .085 ) [ .41 ] |
| TT | .14 ( .103 ) [ .17 ] | **.18 ( .081 ) [ .026 ]** | .05 ( .078 ) [ .52 ] |
| TUT | .17 ( .104 ) [ .10 ] | **.23 ( .109 ) [ .036 ]** | .08 ( .094 ) [ .40 ] |

# PeT effects on Pr(Smoker)

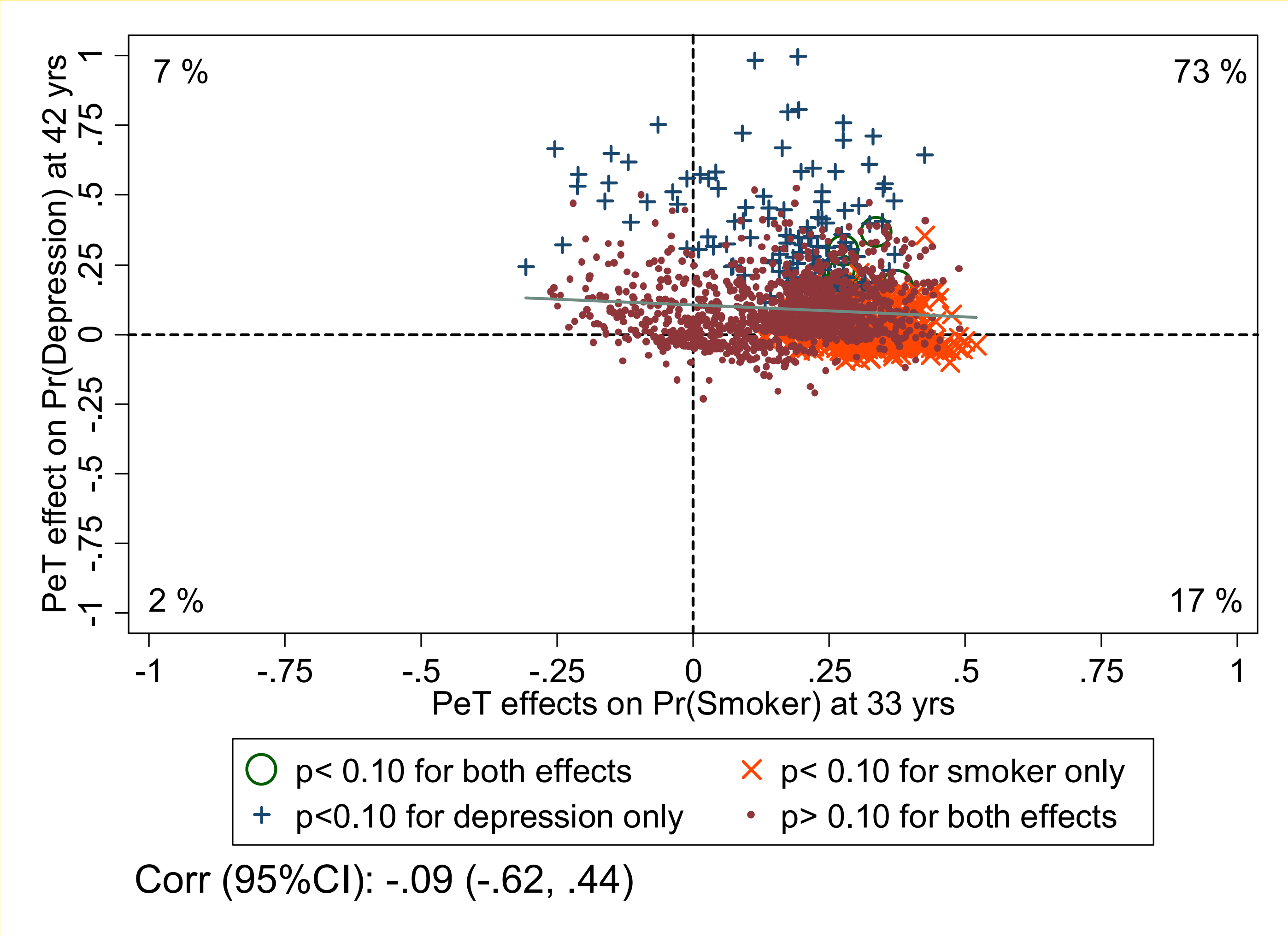


# Effect on smoking tracking effects on Long-standing illnesses



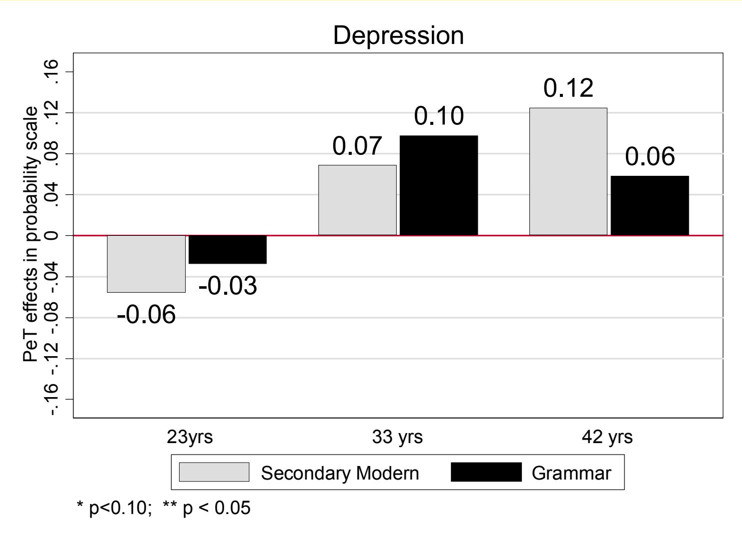

Corr (95%CI): .11 (-.48, 0.70)

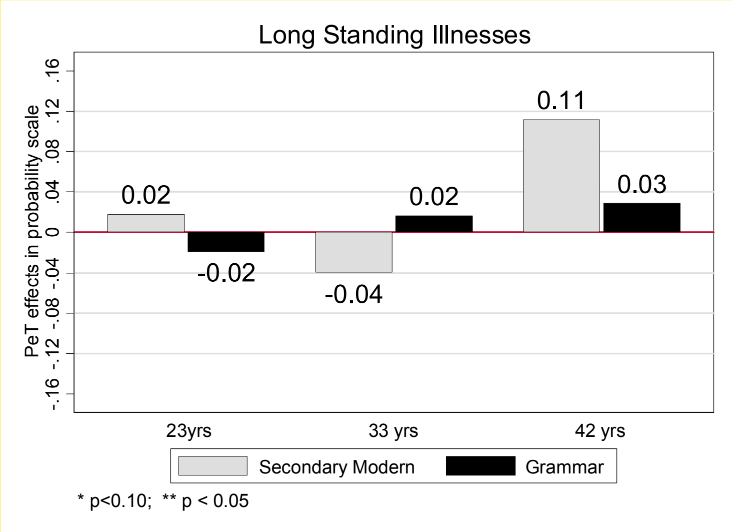
# Effect on smoking tracking effects on Depression

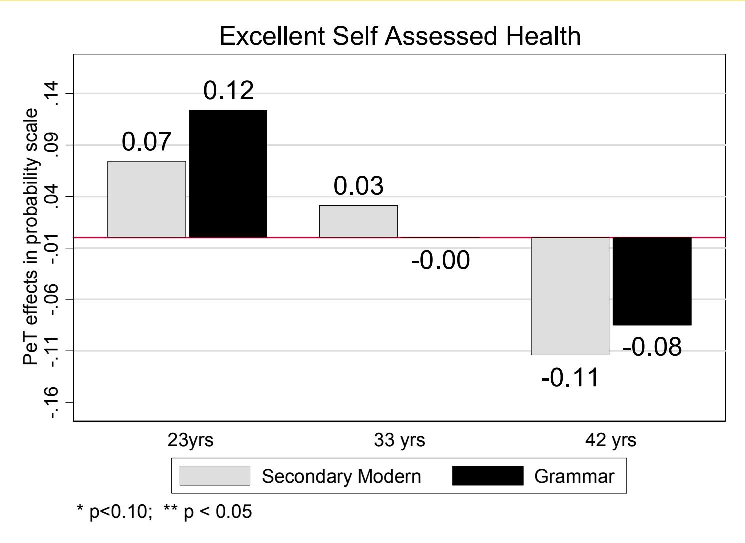


# IDENTIFYING WHO IS AFFECTED

# AMONG THOSE WHO DID NOT ATTEND COMPREHENSIVE SCHOOLS



# Findings

- Average impacts (of comprehensives) increase smoking prevalence and peak at age 33
- Considerable variation in PeTs
- Magnitude of PeTs persistent within individuals and track health effects
- Those who are significantly hurt in late adulthood are those who have lower ability in secondary school and were more likely to go to a secondary modern