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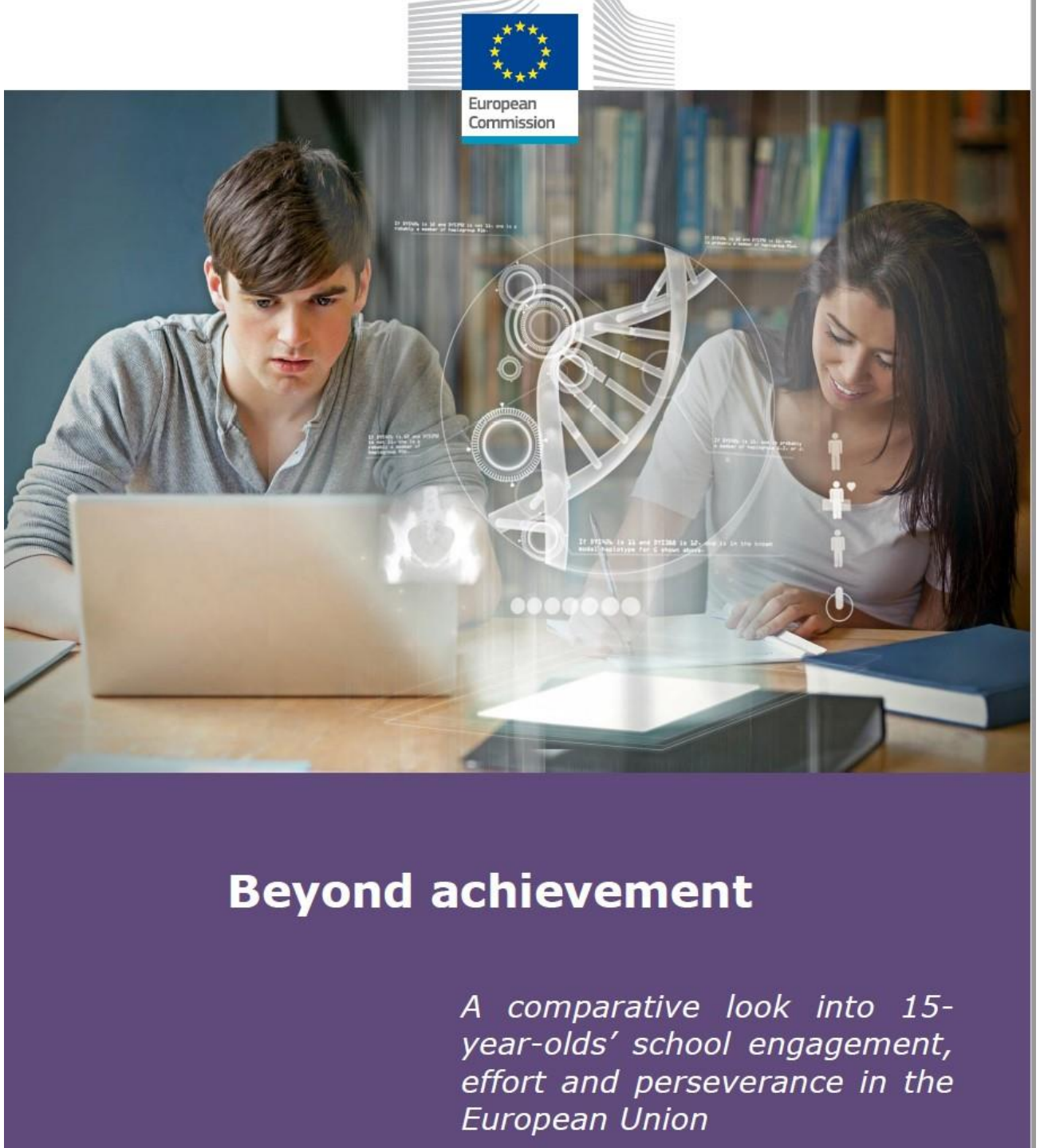
RESEARCH INSTITUTE FOR THE EVALUATION OF PUBLIC POLICIES

# Effort and achievement of 15-year-olds in PISA 2015 across EU member states

**Opportunity versus Challenge**
**Dublin, 16 – 17 May 2019**




We worked on a report for the European Commission analysing the main determinants of a set of non-cognitive competences.

The results of this report are downloadable from the following link:

https://publications.europa.eu/en/publication-detail/-/publication/0a90c7c9-2f45-11e9-8d04-01aa75ed71a1/language-en

In this presentation we try to go a bit further studying the relationships between non-cognitive competences and the scores on cognitive tests and on school attainment.

# Research group

The project has been funded by the European Commission with the *call for tender* EAC/22/2017:

"Study on engagement and achievement of 15 year olds in PISA 2015 across EU Member States"

The research group is composed by (FBK-IRVAPP and University of Liège):

Davide Azzolini, Nicola Bazoli, Ilaria Lievore, Christian Monseur, Elodie Pool, Antonio Schizzerotto & Loris Vergolini.

# Summary of the presentation

1. The measurement problem
2. Data
3. Main results
   a) Descriptive evidence
   b) Multivariate models
4. Conclusions

# 1. The measurement problem

# Measuring non-cognitive skills (1)

The literature regarding non-cognitive skills is very **broad** and **complex** → a wide range of concepts and approaches.

Our aim is **mainly empirical**, being interested in measuring a concept that can be considered as non-cognitive.

Non-cognitive skills have been traditionally measured through a set of items based on the **self-perception** of the respondents.

The main aim of this work is to highlight the **potential** of alternative data sources (**computer generated data**).

# Measuring non-cognitive skills (2)

We focus on effort that we roughly defined in the following way:

**Effort**: understood as the ability to activate one's own “mental forces” to perform a given task.

The idea is to look at the **response time** as an indicator of the effort put into solving the test.

Rapid guessing could be indicative of **unmotivated test taking**.

# Main research questions

Our research questions regards the possible influence of effort on two outcomes:

- Achievement, measured according the scores on science, maths and reading. The idea is to understand if the cognitive and non-cognitive dimensions are related.
- Attainment, measuring according to education expectation with a question about the education level that the students expect to attain. In this case, the idea is to focus on the possible long-run influences.
- Finally, we are also interested in the variations between countries.

# 2. Data

# Data (1)

The data used come from the **2015 PISA** survey in which a large proportion of the standardized tests were administered via computer in many countries.

In this way, it is possible to gather a very detailed set of **information** on how students responded to the standardized tests.

It should be noted that PISA tests belong to the family of tests known as **low-stake tests**, i.e. those tests whose results have no direct impact on the students involved.

# Data (2)

These **computer generated** information, saved in so-called **log-files**, include:

- Response times to individual items.
- Correctness of individual items.
- Number of actions taken to respond to the various items.
- Type of actions taken to respond to the various items.

Our analysis will use the first two types of information that are present in the **public log-files** directly downloadable from the PISA website.

# Data structure

| Session 1 (60 min.) | |
|---|---|
| Cluster 1 (30 min.) | Cluster 2 (30 min.) |
| **Session 2 (60 min.)** | |
| Cluster 3 (30 min.) | Cluster 4 (30 min.) |

Figure

# The operationalization

Given the available data, the two concepts of interest can be measured as follows:

- **Effort**: difference in the average response time between the 5 most difficult and the 5 easiest items within a cluster.
- The idea is to keep constant the **fatigue** that may occur during the test. The difficulty of the items is determined by the Item Response Theory (we use the parameters supplied in the Technical Report).
- The main **assumption** is that more difficult items require more effort to be answered → this could be a function of response time.

# Operative choices (1)

In the computation of the effort measure, we did the following choices:

- We consider only EU-28 member states in which the test has been administered online (exclusion of Malta and Romania).
- We consider only the two-hour test, excluding students with special need that answer to the one-hour test.
- In case of missing answer to the easiest and hardest items, the case is not consider in the computation of the index.

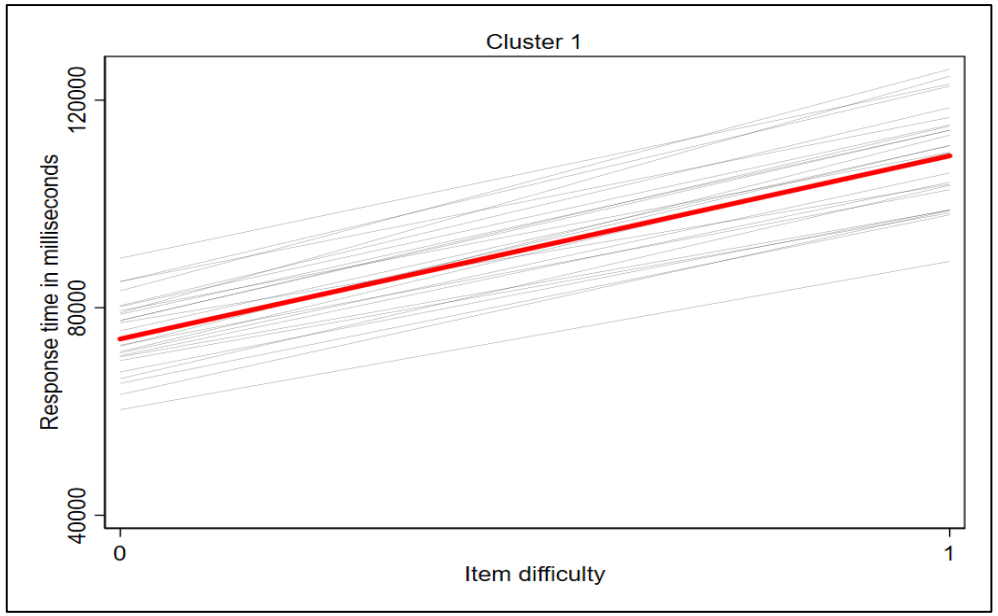
# Operative choices (2)

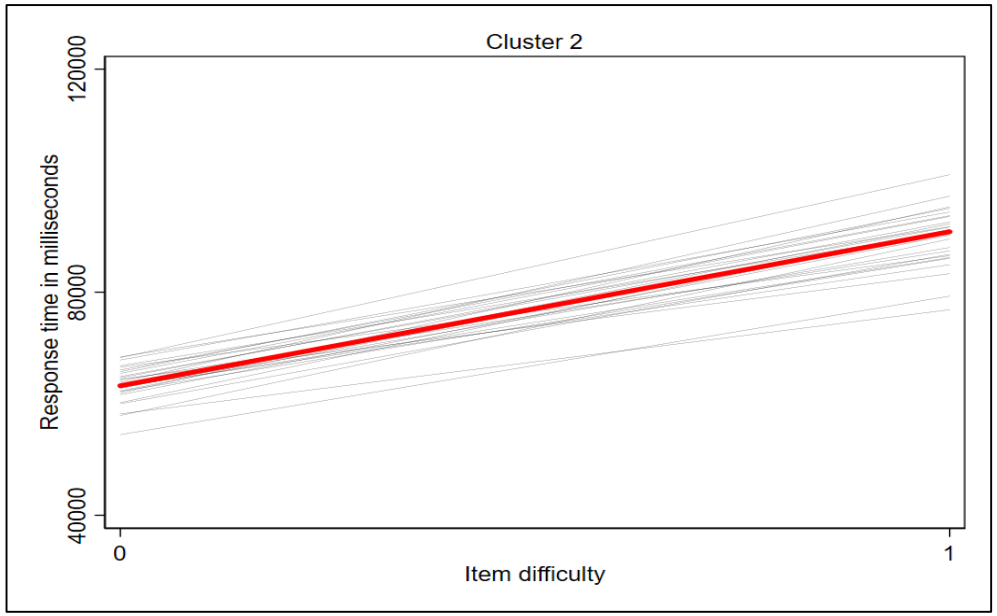
- Only base forms administered through computer and with two domain tested → receiving three domains has a negative impact on the overall performance.
- We do not consider base forms with problem solving → the format of the items is too different and it is not comparable to the format of the items in the three main domain (science, maths, reading).
- We are not able to compute the effort index considering separately multiple-choice and open-ended items.

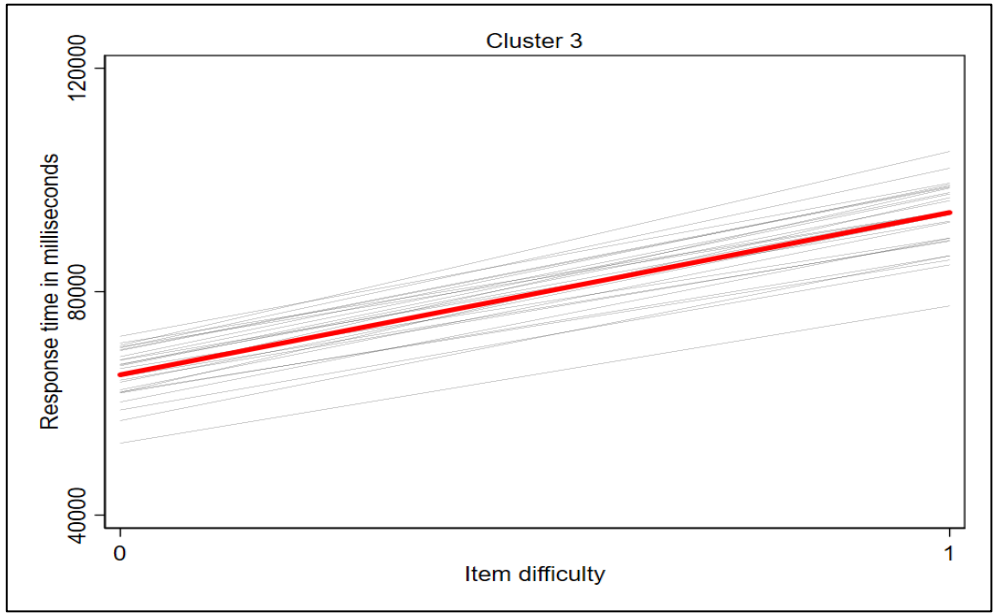
# 3. Main results

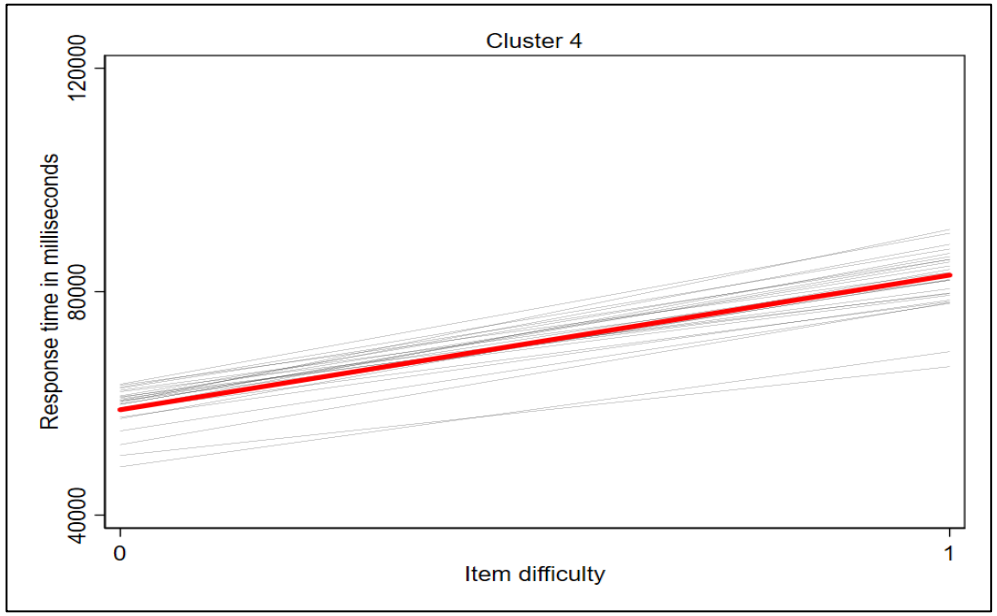
a) Descriptive analyses

# Descriptive analysis (1)



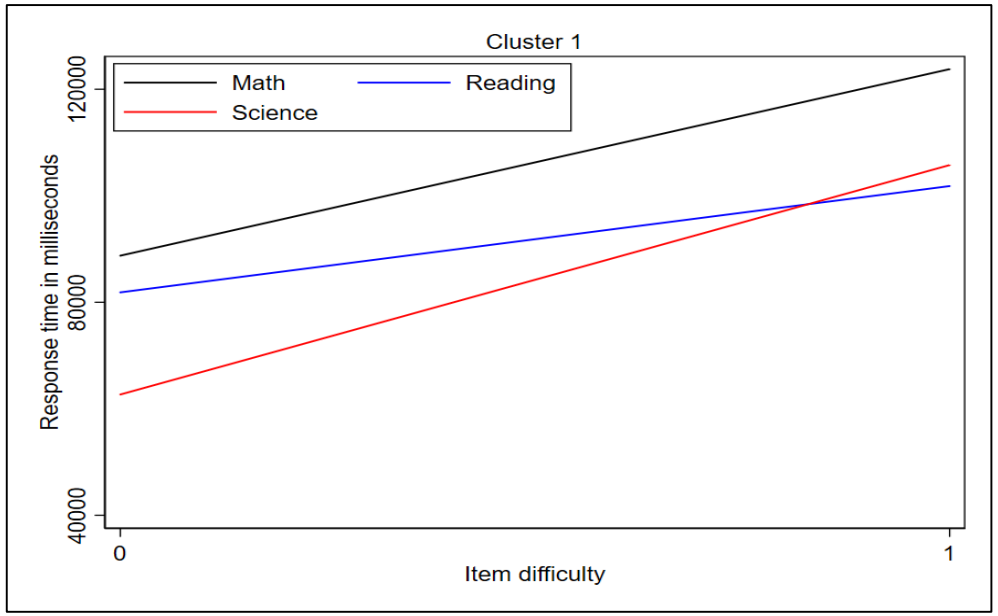



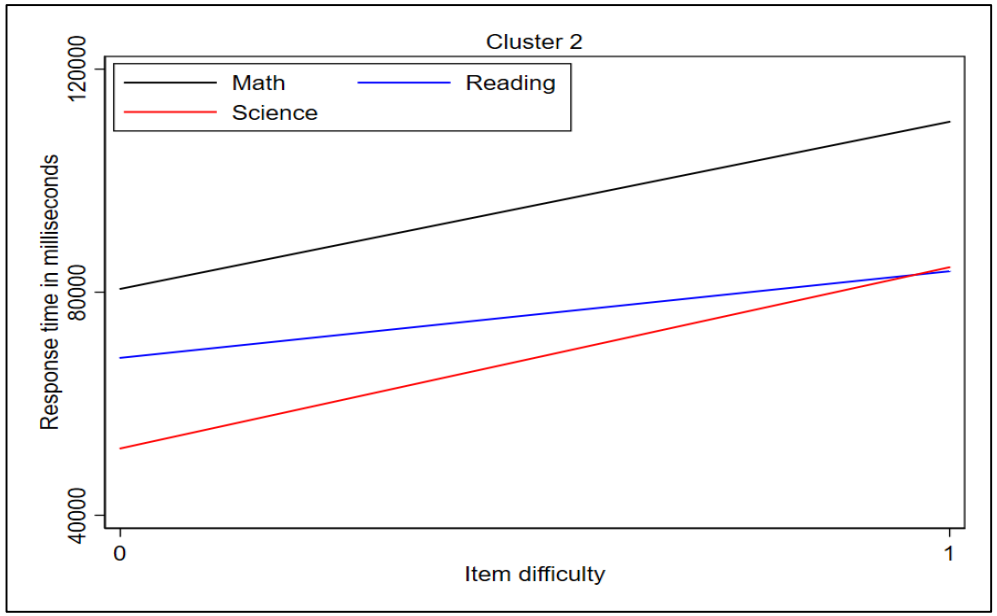



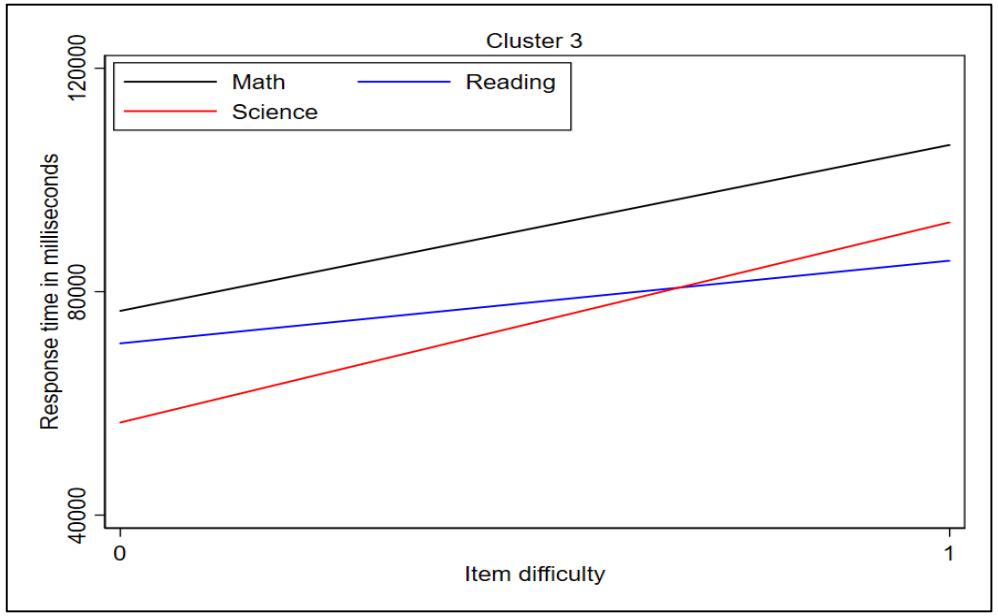



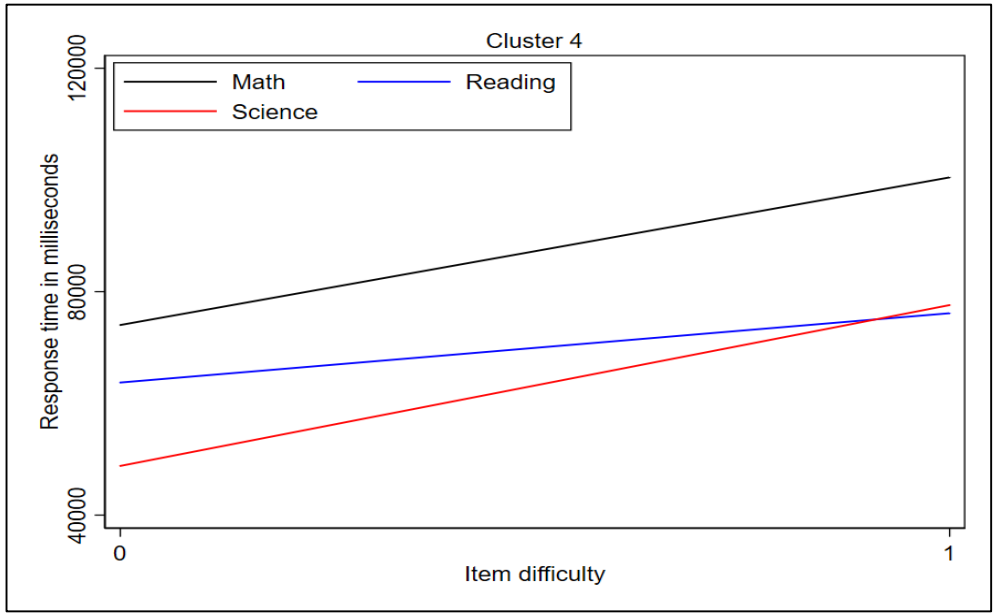

Response time in easy (0) and difficult items (1) according to cluster position.
The grey lines represent the coutries analysed, while the red lines are the overall averages.

# Descriptive analysis (2)



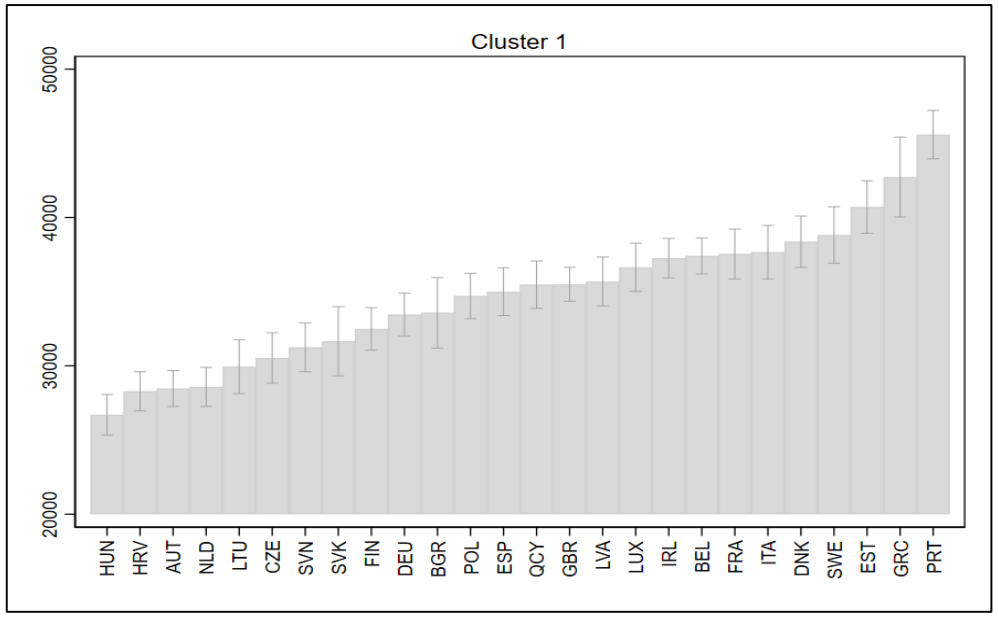



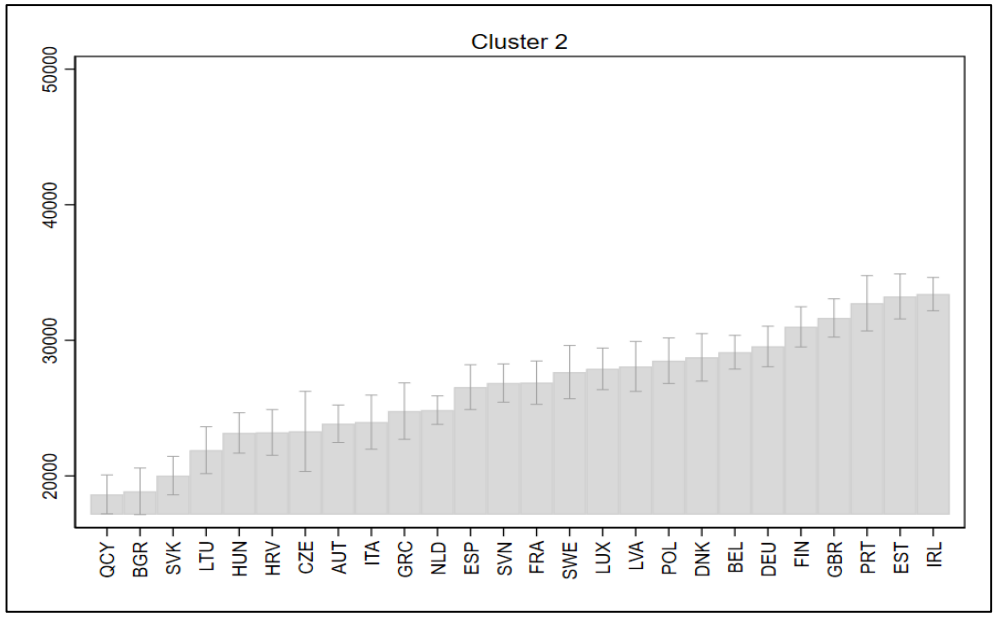



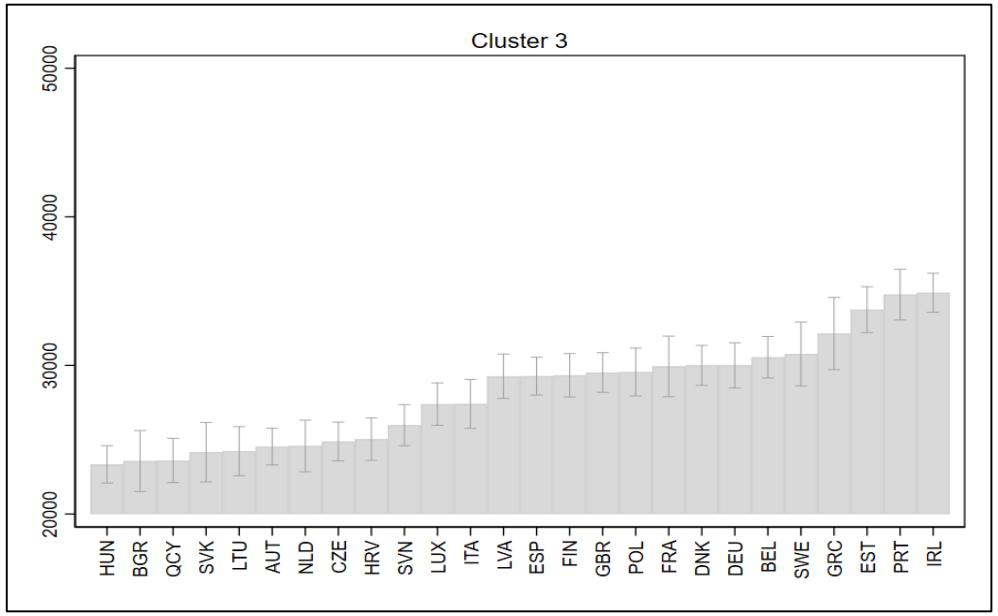



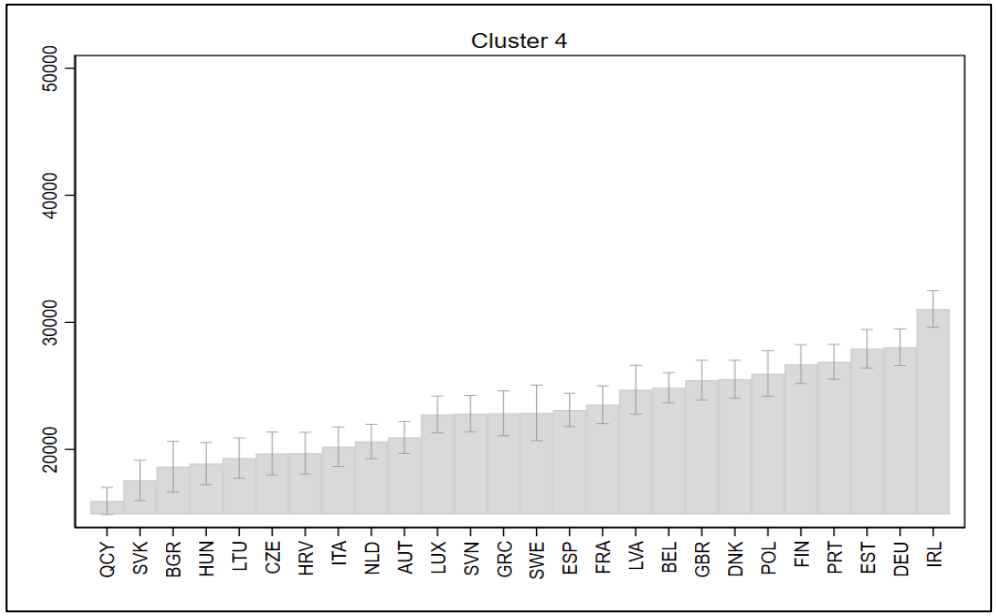

Response time in easy (0) and difficult items (1) according to cluster position and domain.

# Descriptive analysis (3)



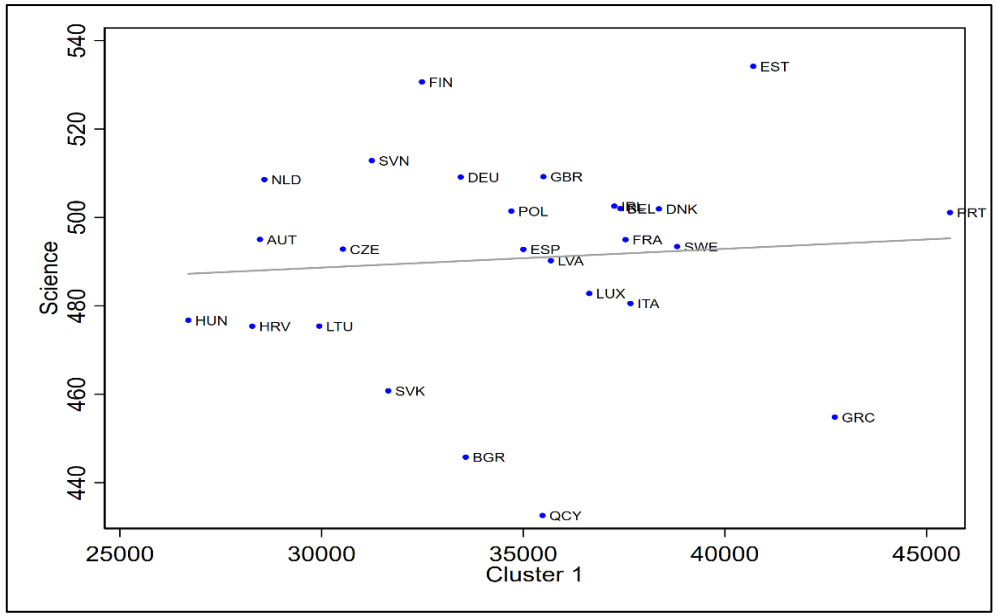



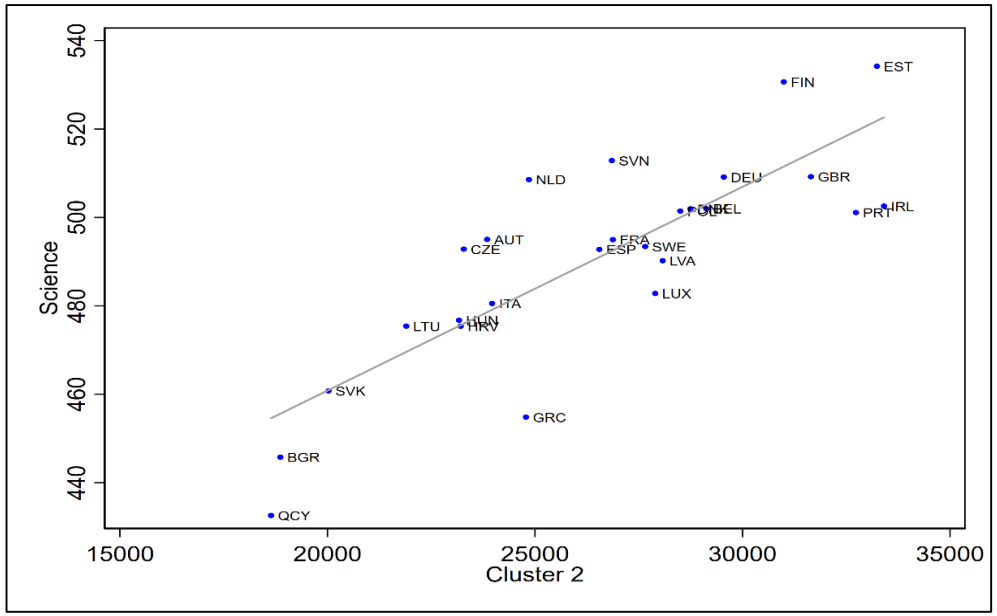



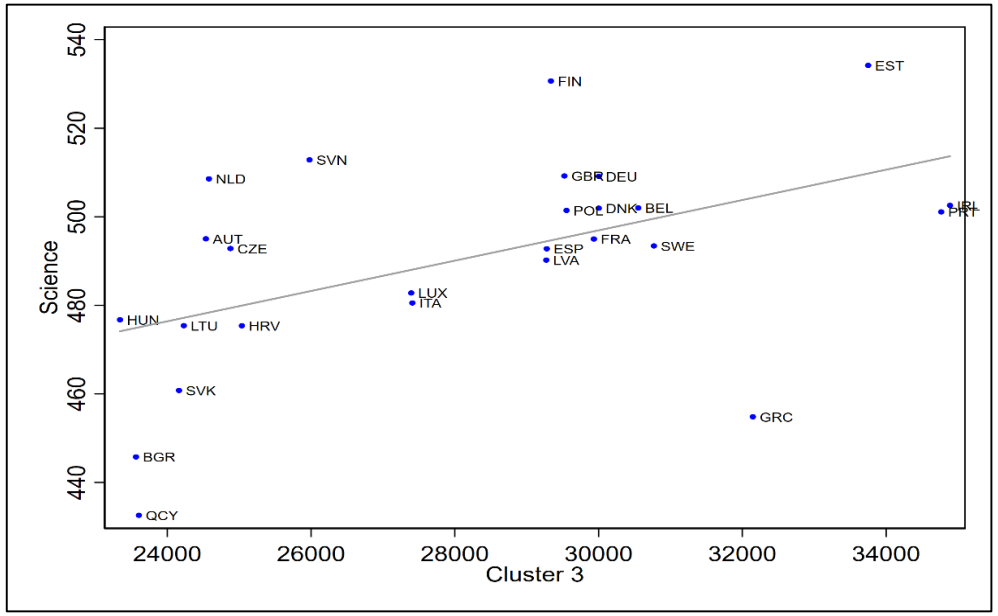

Distribution of effort across EU Member States.

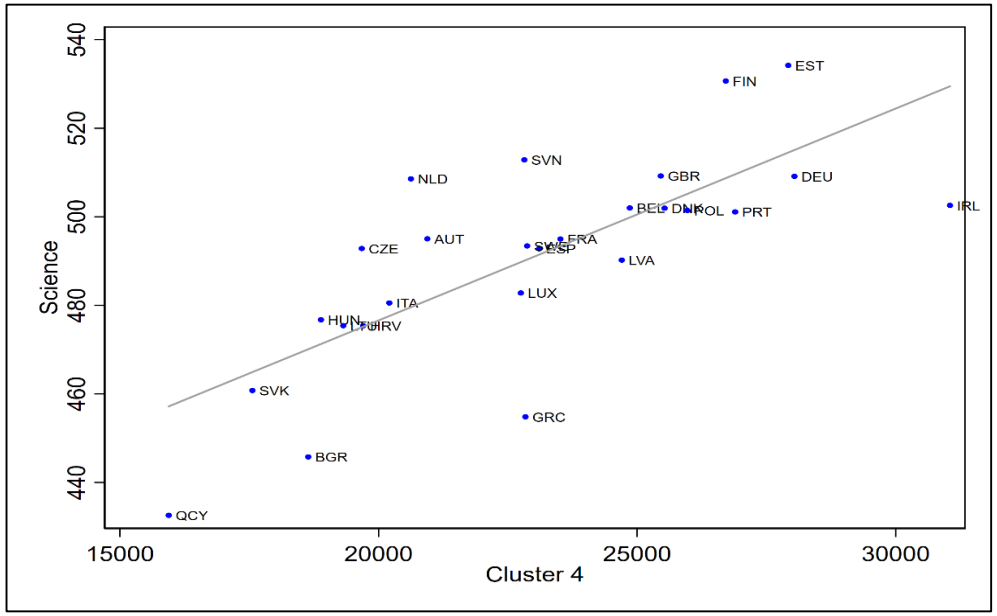
# Descriptive analysis (4)



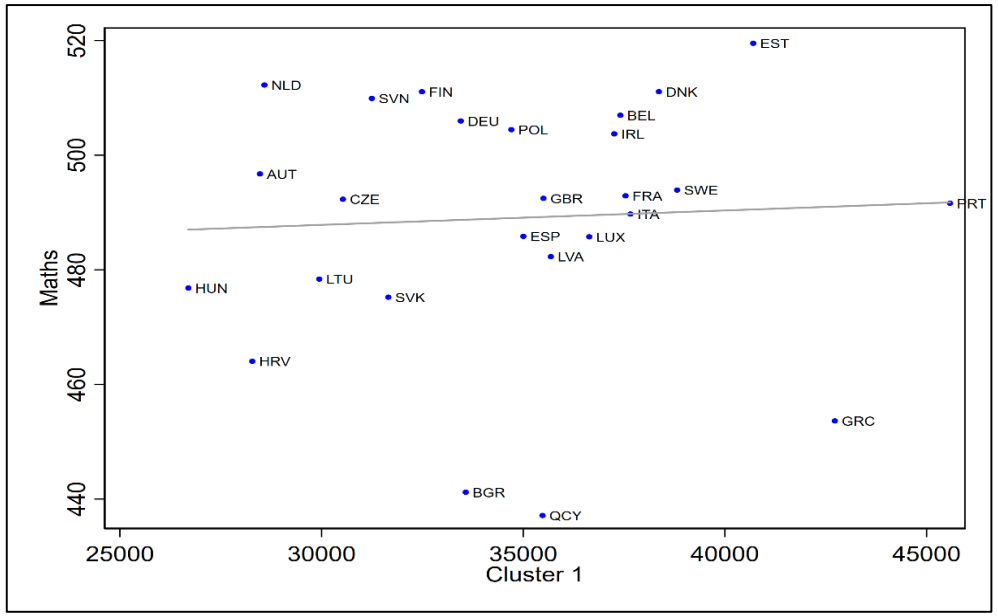



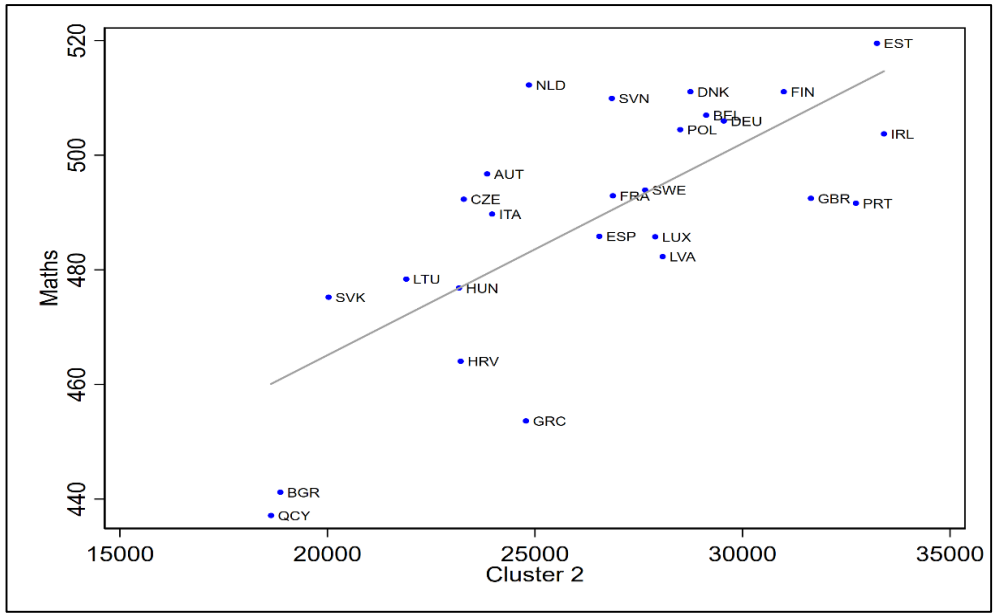

Scatter plot between score on science and effort at country level.



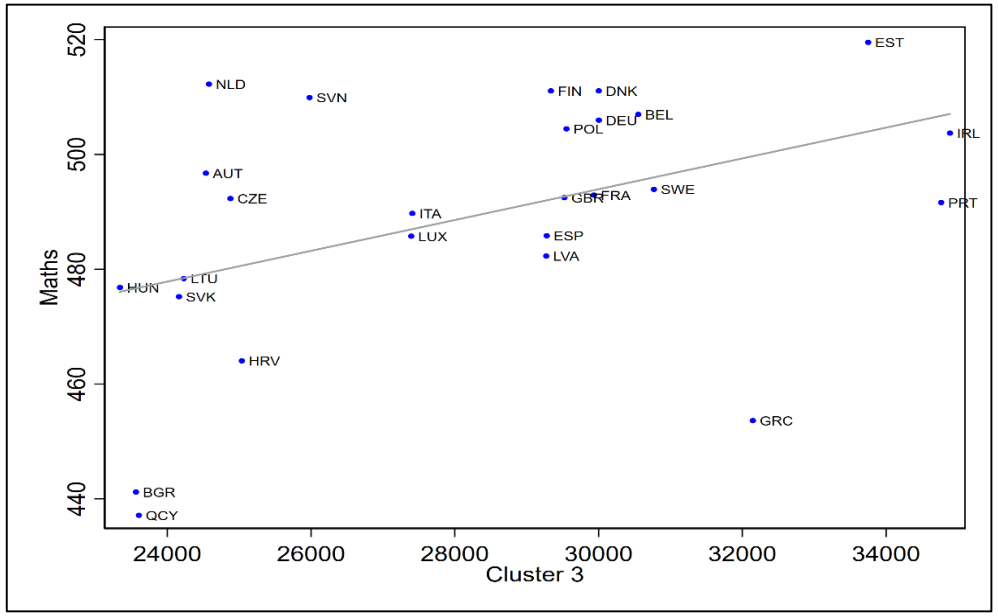



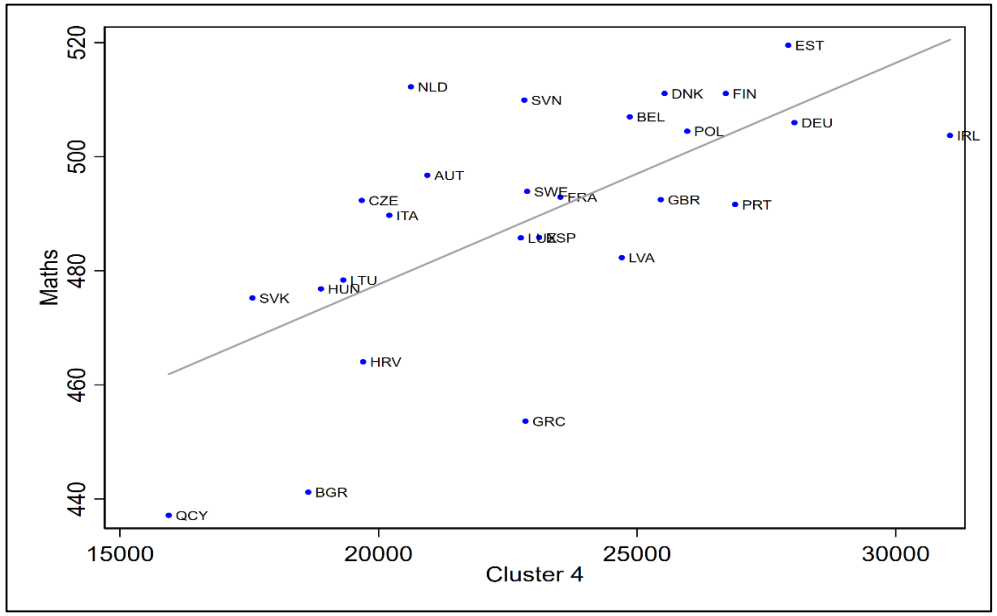
# Descriptive analysis (5)



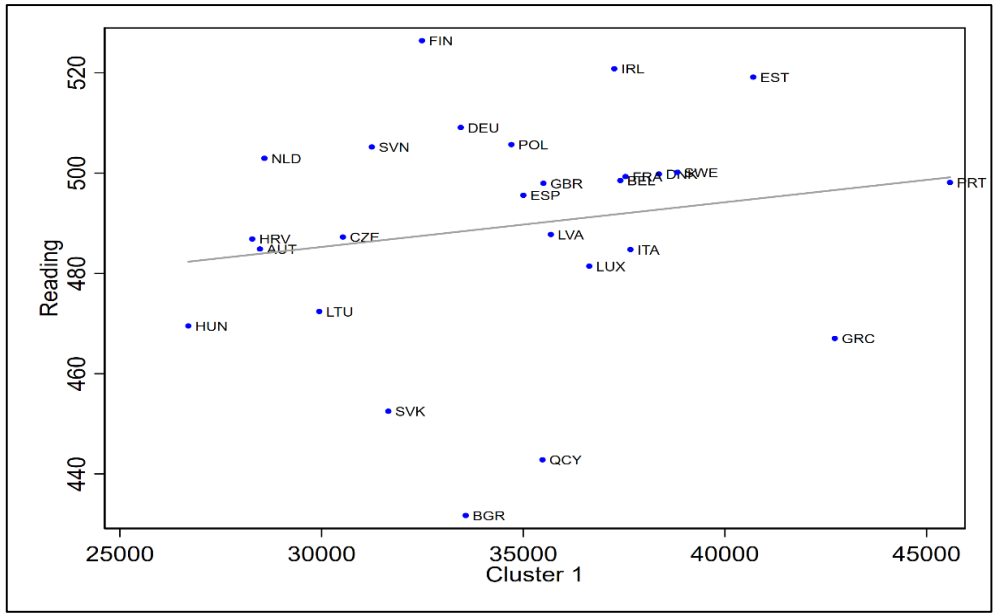



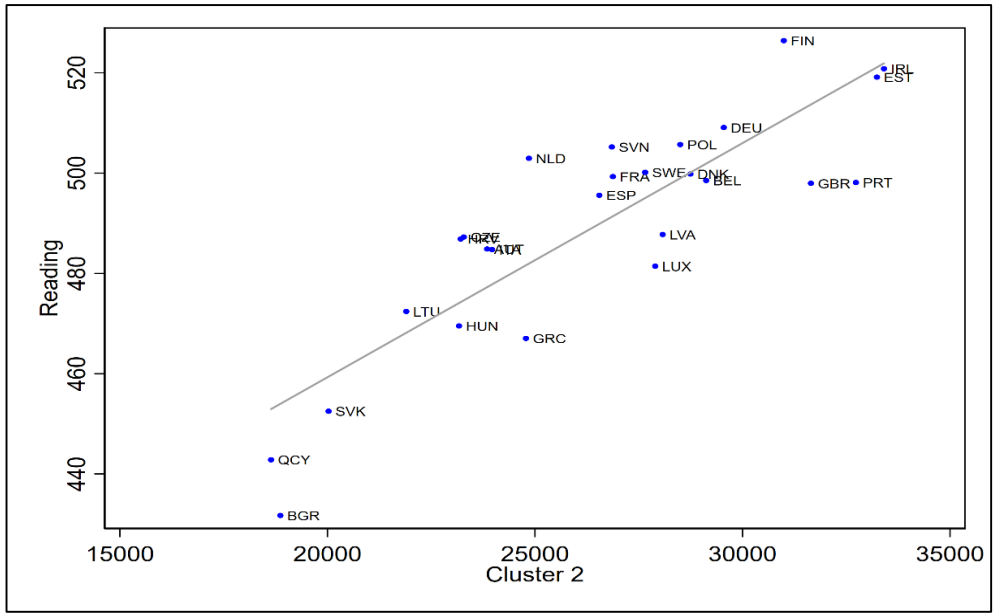

Scatter plot between score on maths and effort at country level.



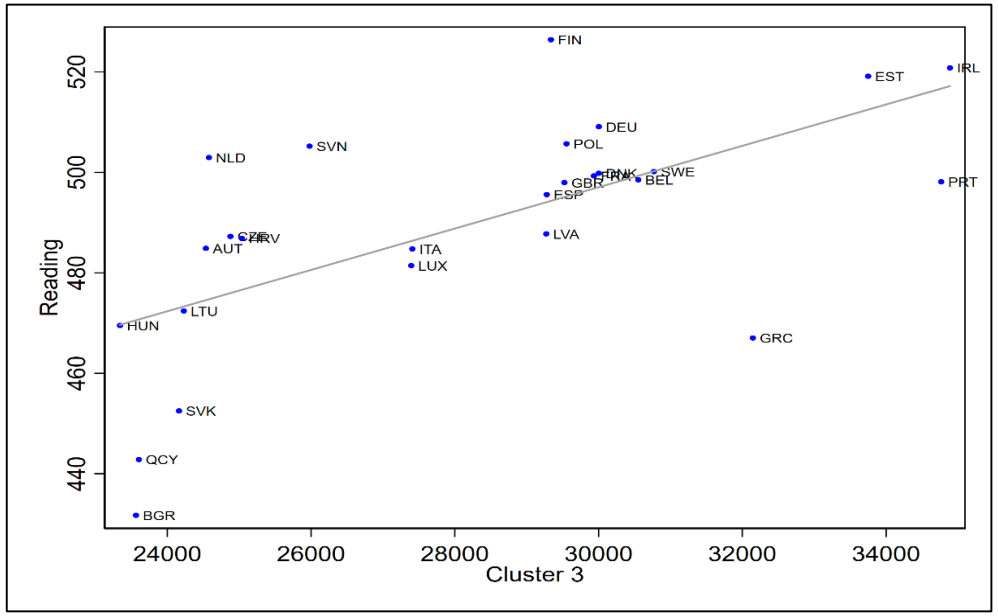



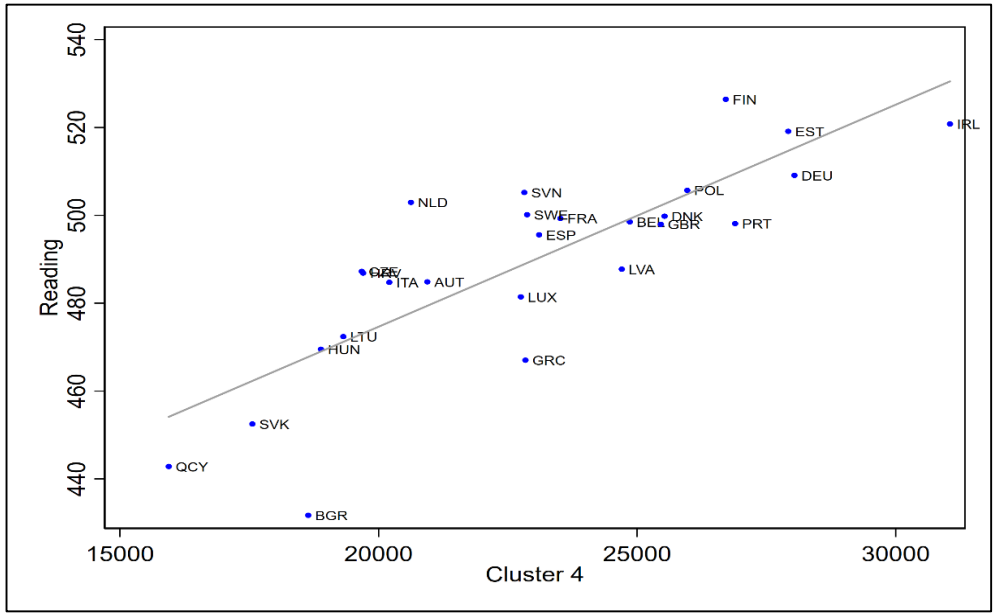
# Descriptive analysis (6)



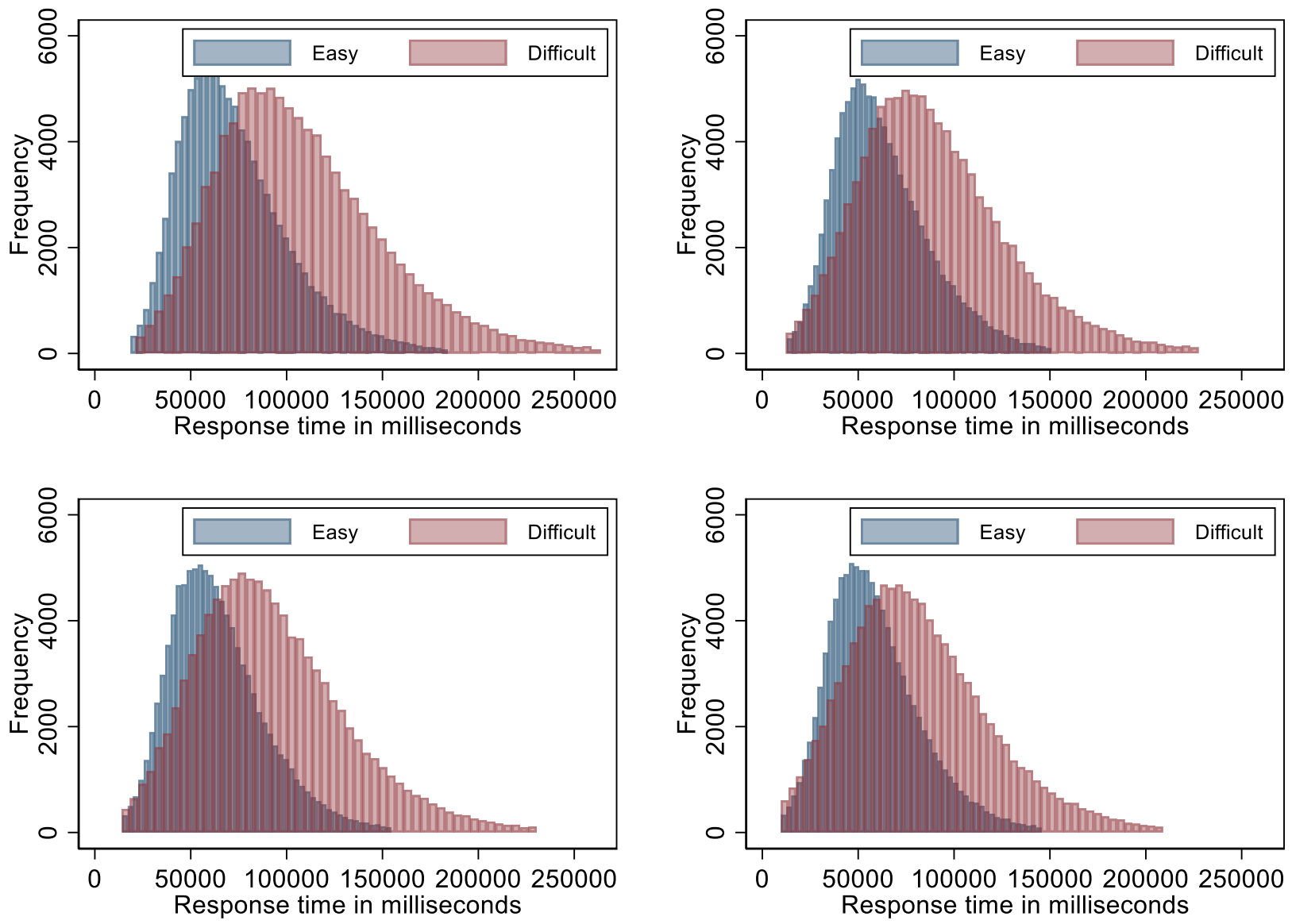




Scatter plot between score on reading and effort at country level.



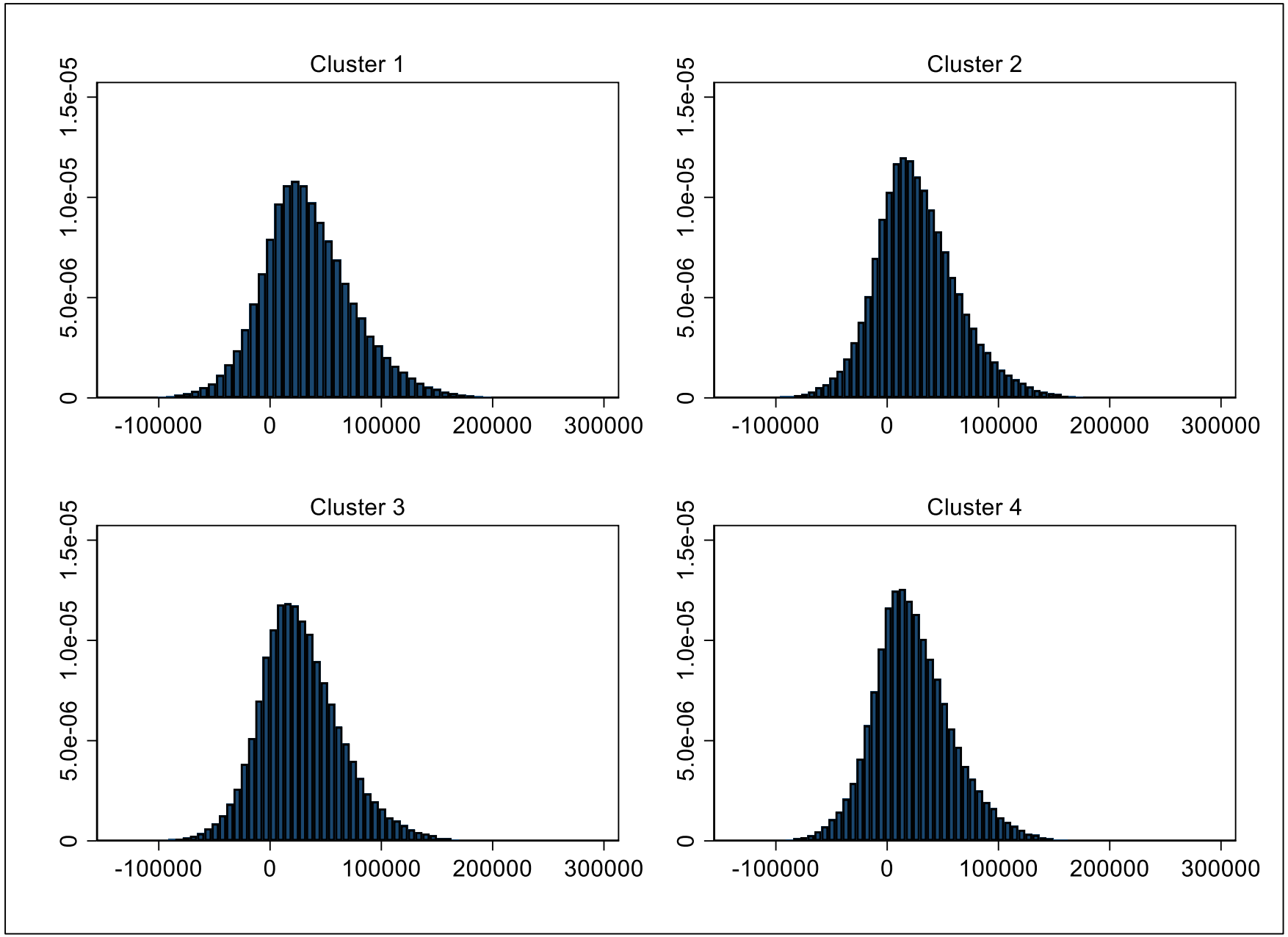



# Descriptive analysis (7)



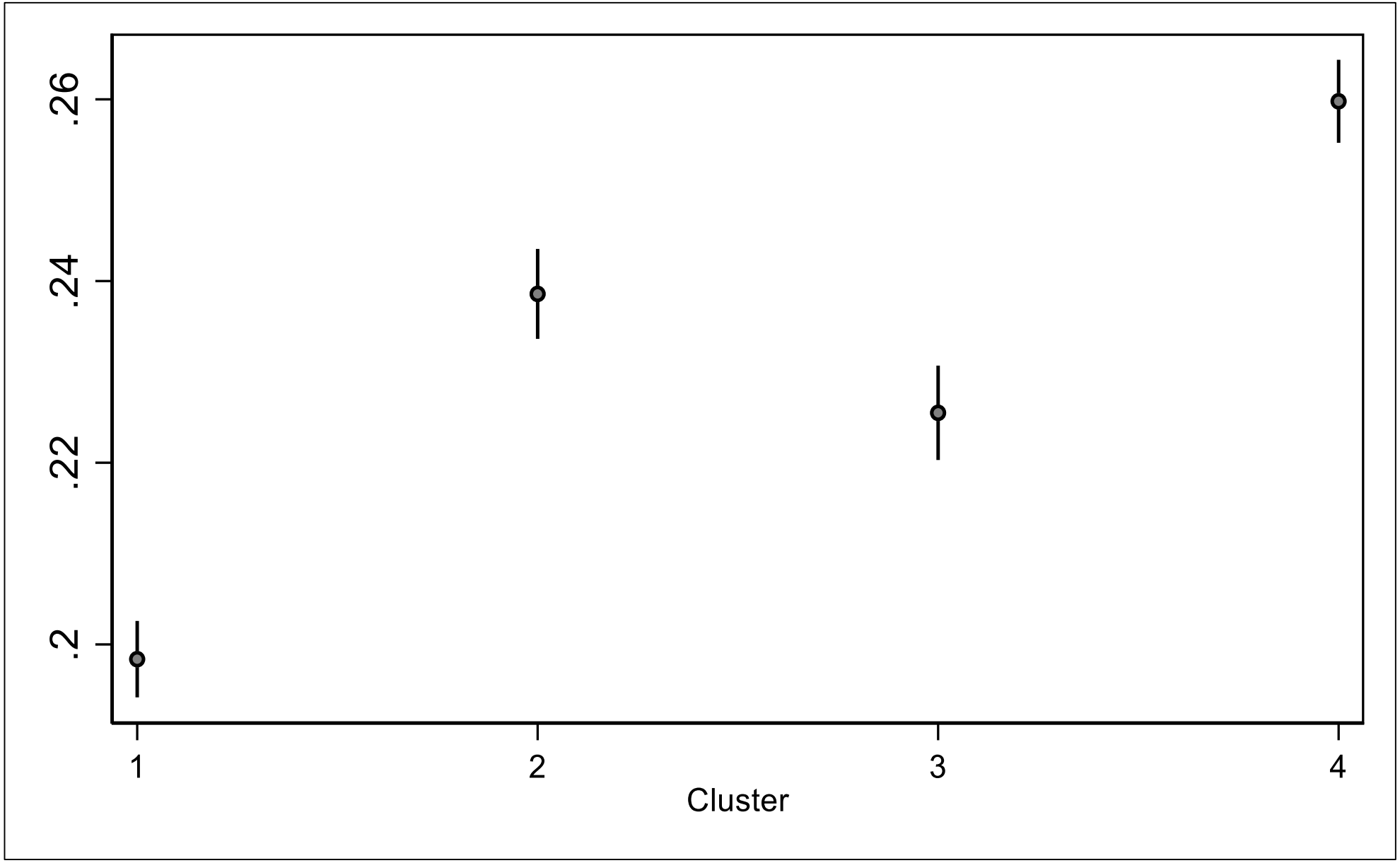

Distribution of response time for easy and difficult item at individual level according to cluster position.

# Descriptive analysis (8)




Distribution of effort at individual level according to cluster position.

# Descriptive analysis (9)

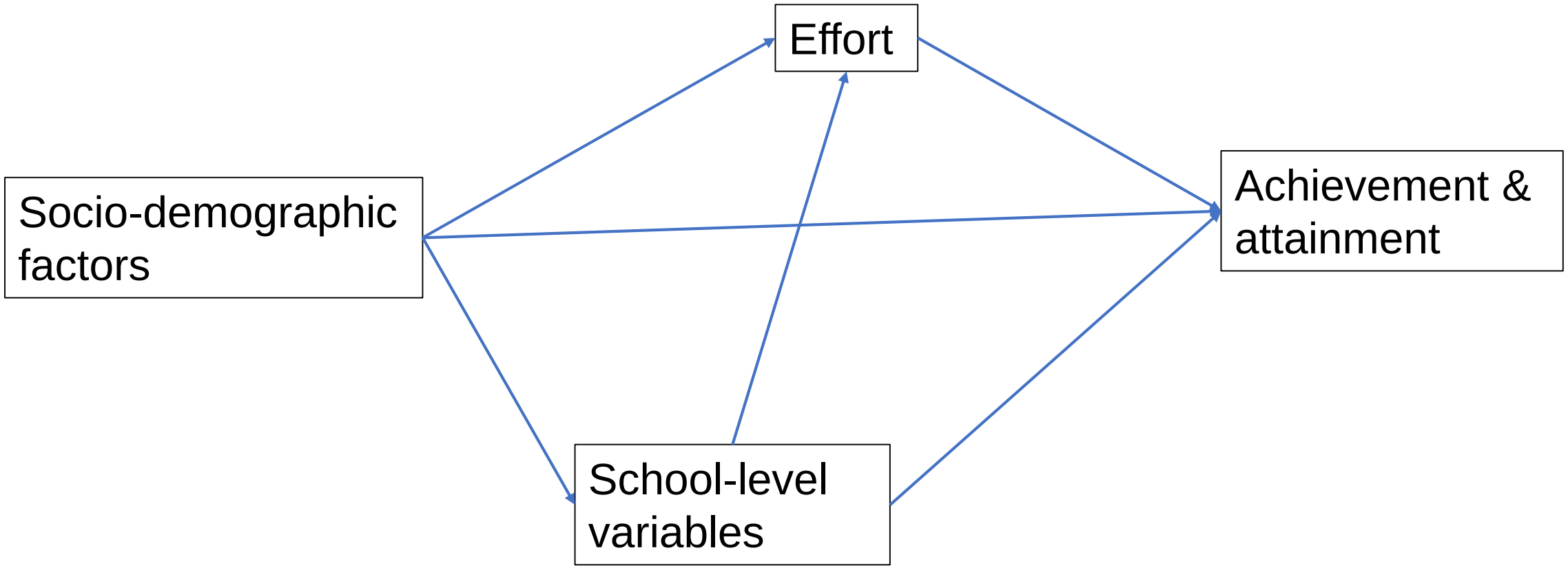



Share of students with negative effort according to cluster position.

# 3. Main results

b) Multivariate analyses

# The logic of the multivariate analysis



# The variables used in the analyses (1)

The idea is to understand which is the role of effort in influencing school achievement and attainment (**no causality**).

Dependent variables:

- Achievement: **scores** on science, maths and reading.
- Attainment: education **expectations** using the following question: "*Which of the following (Isced levels) do you <u>expect</u> to complete?*" We derive a dummy variables:
  - 0: Isced 2-4.
  - 1: Isced 5-6.

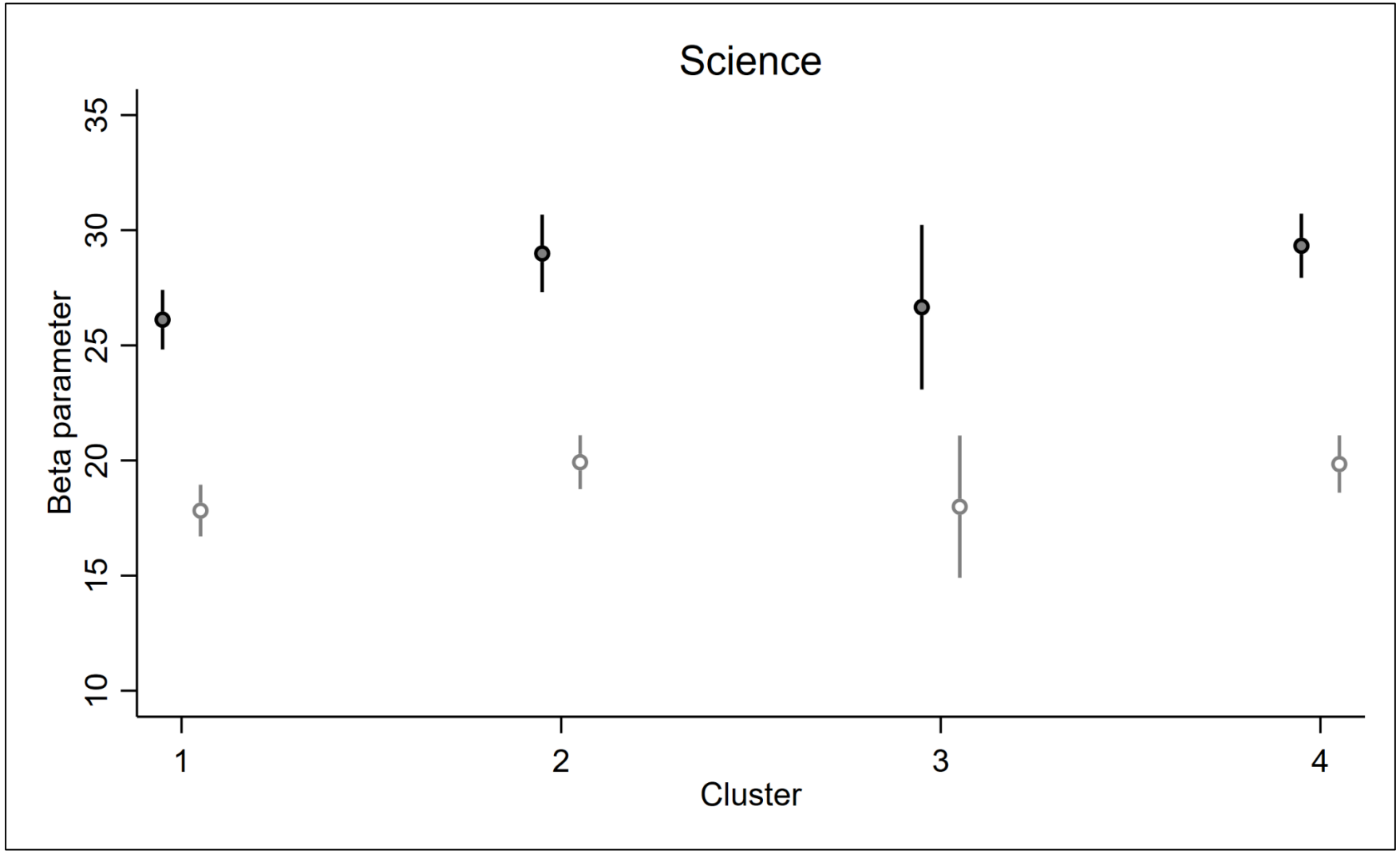
# The variables used in the analyses (2)

Main independent variables:

- Individual: sex, migration background, social origins (parental education and occupation).
- School: extracurricular activities, school climate, quality of teachers, involvement of parents.
- The models control for countries fixed effect.

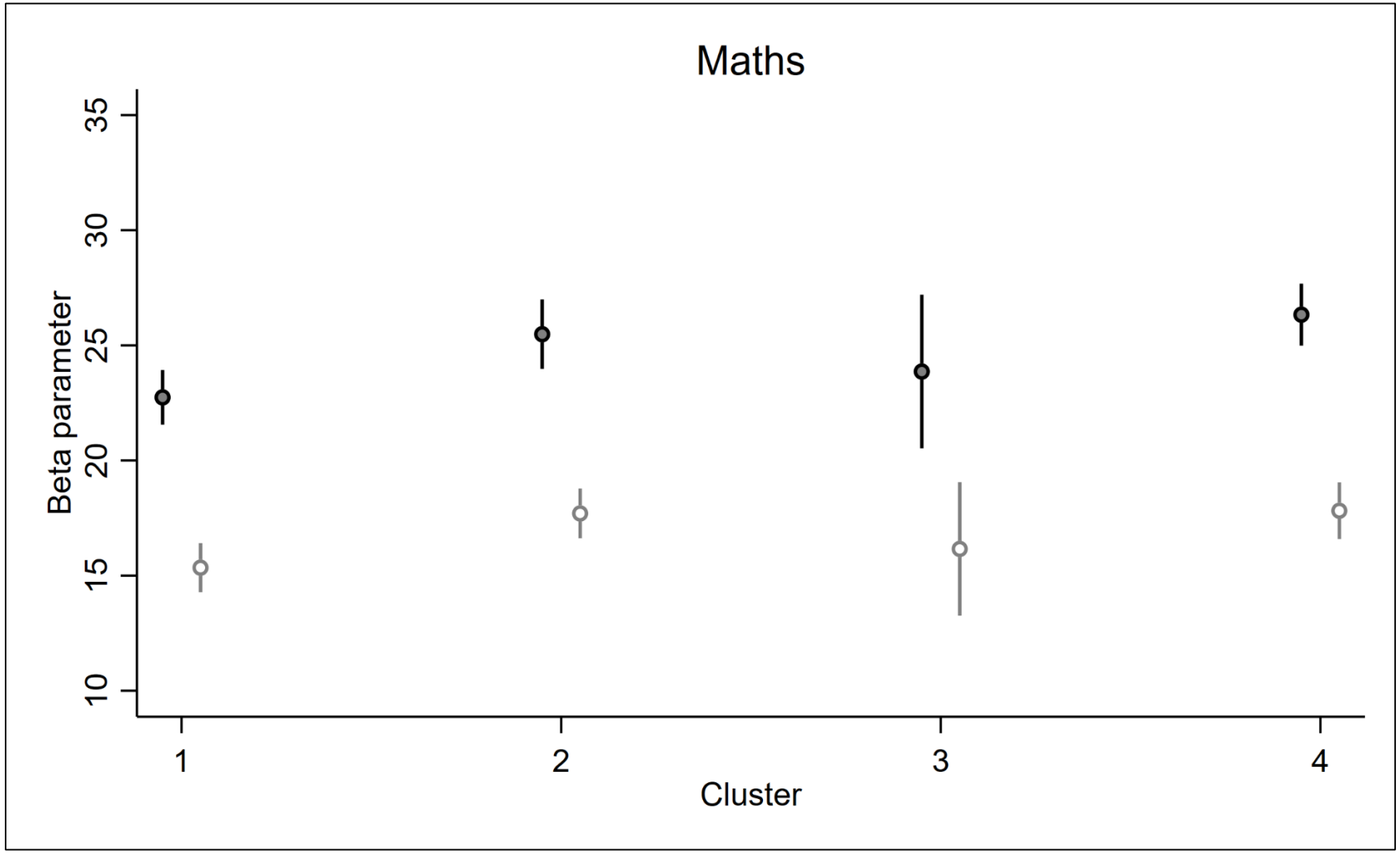
Eventually, a set of models stratified according to the country of origins have been estimated to understand if and how the influence of effort can vary across countries

# Evidence from multivariate analyses (1)



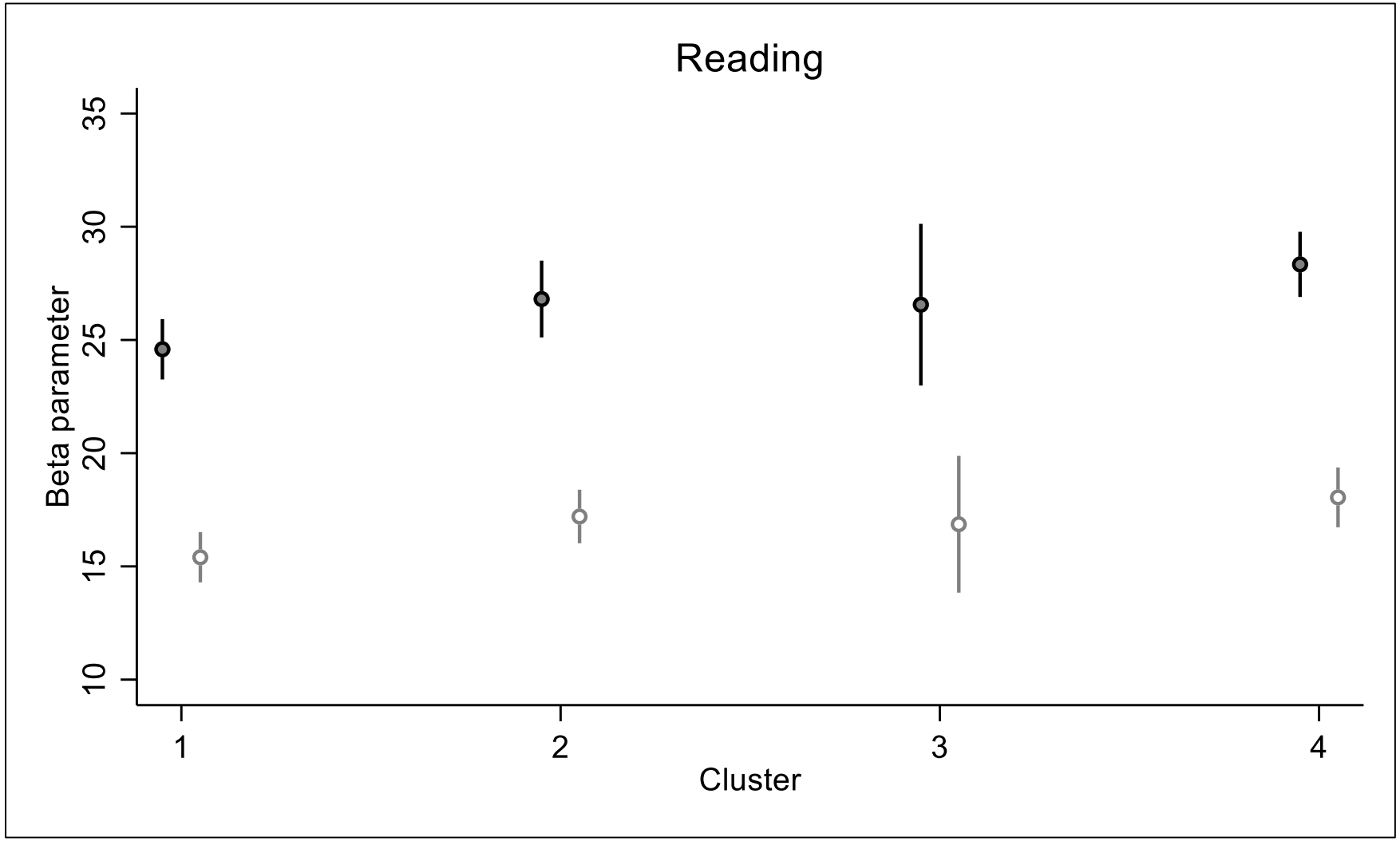

Beta parameter from an OLS regression for the effect of effort on science according to cluster position.
Filled dots represent the bivariate association, while hollow circles derive from a model controlling for variables at individual, school and country level.

# Evidence from multivariate analyses (2)



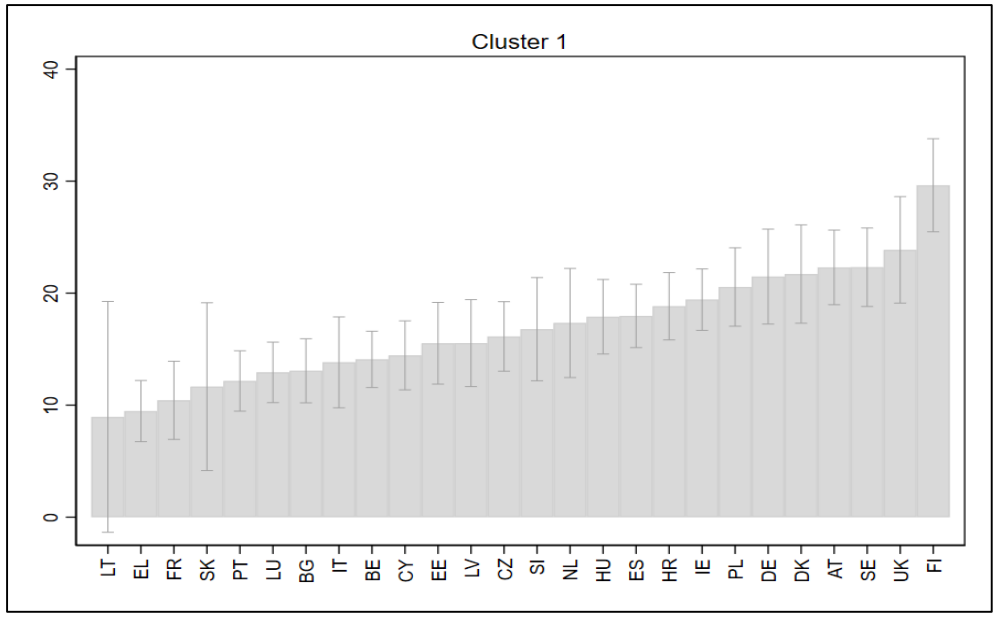

Beta parameter from an OLS regression for the effect of effort on maths according to cluster position.
Filled dots represent the bivariate association, while hollow circles derive from a model controlling for variables at individual, school and country level.

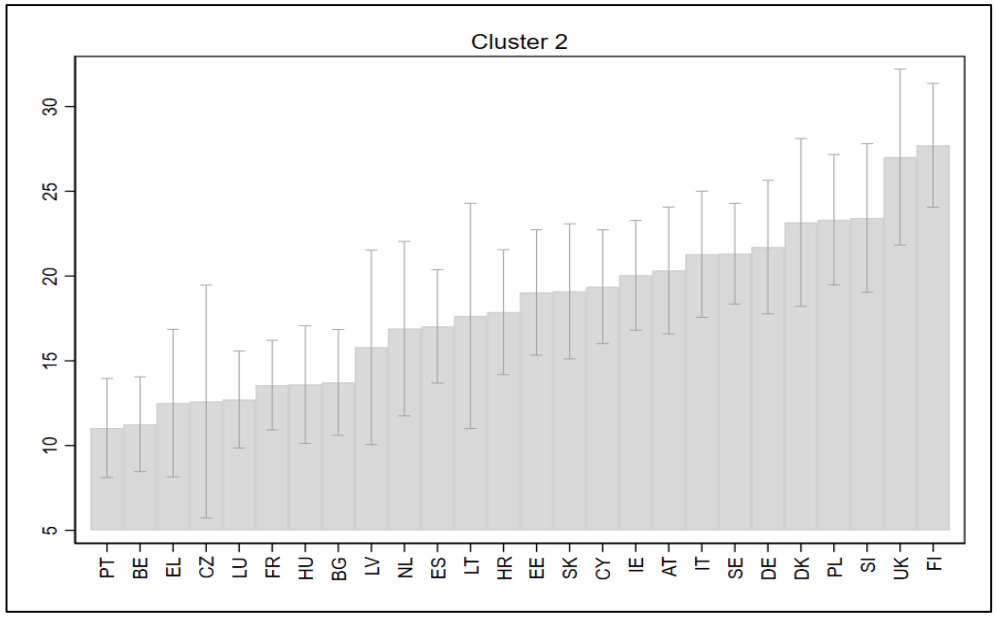
# Evidence from multivariate analyses (3)



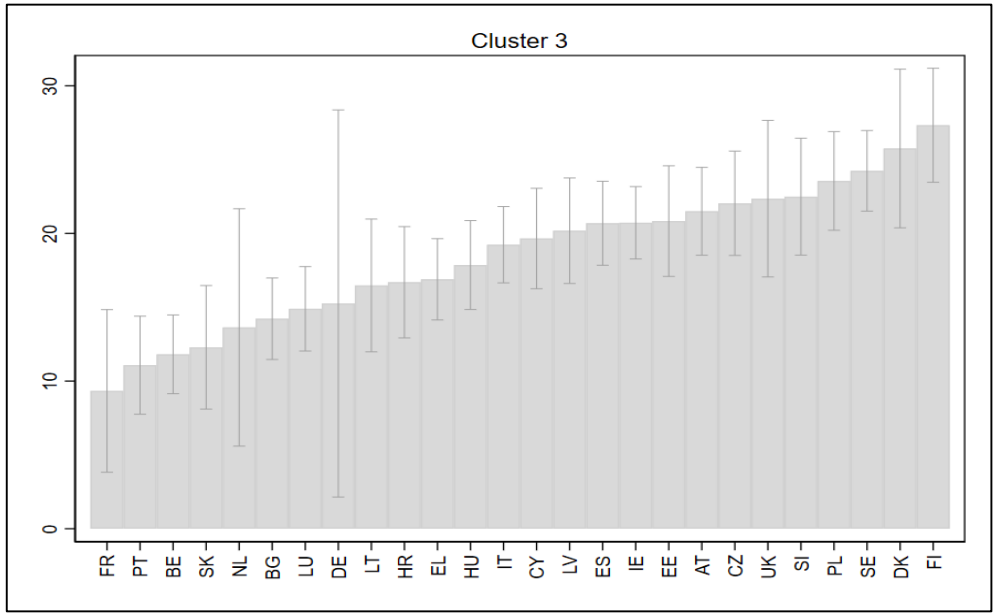

Beta parameter from an OLS regression for the effect of effort on reading according to cluster position.
Filled dots represent the bivariate association, while hollow circles derive from a model controlling for variables at individual, school and country level.

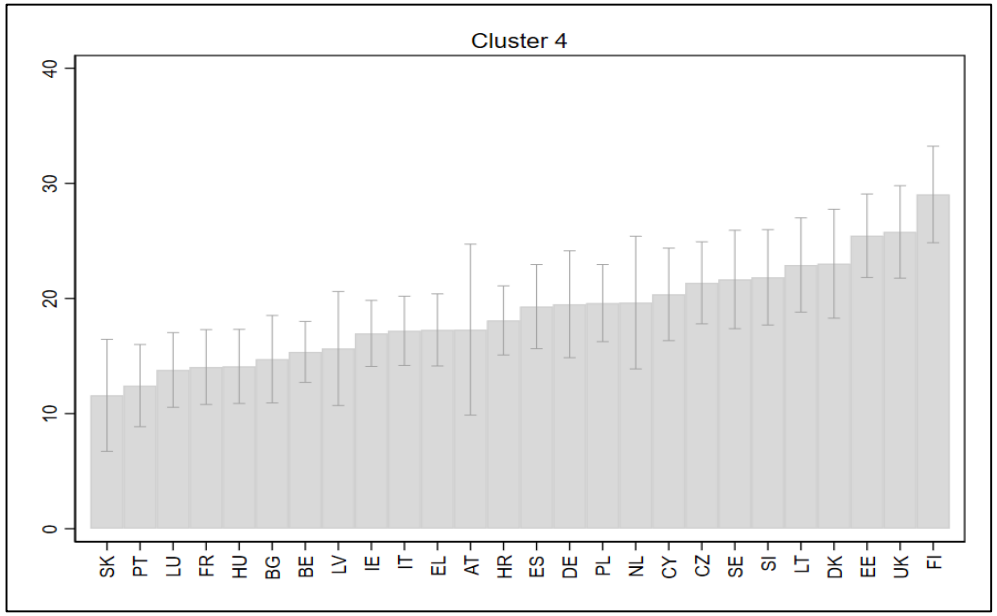
# Evidence from multivariate analyses (4)




Beta parameter from an OLS regression for the effect of effort on science according to country and cluster position.



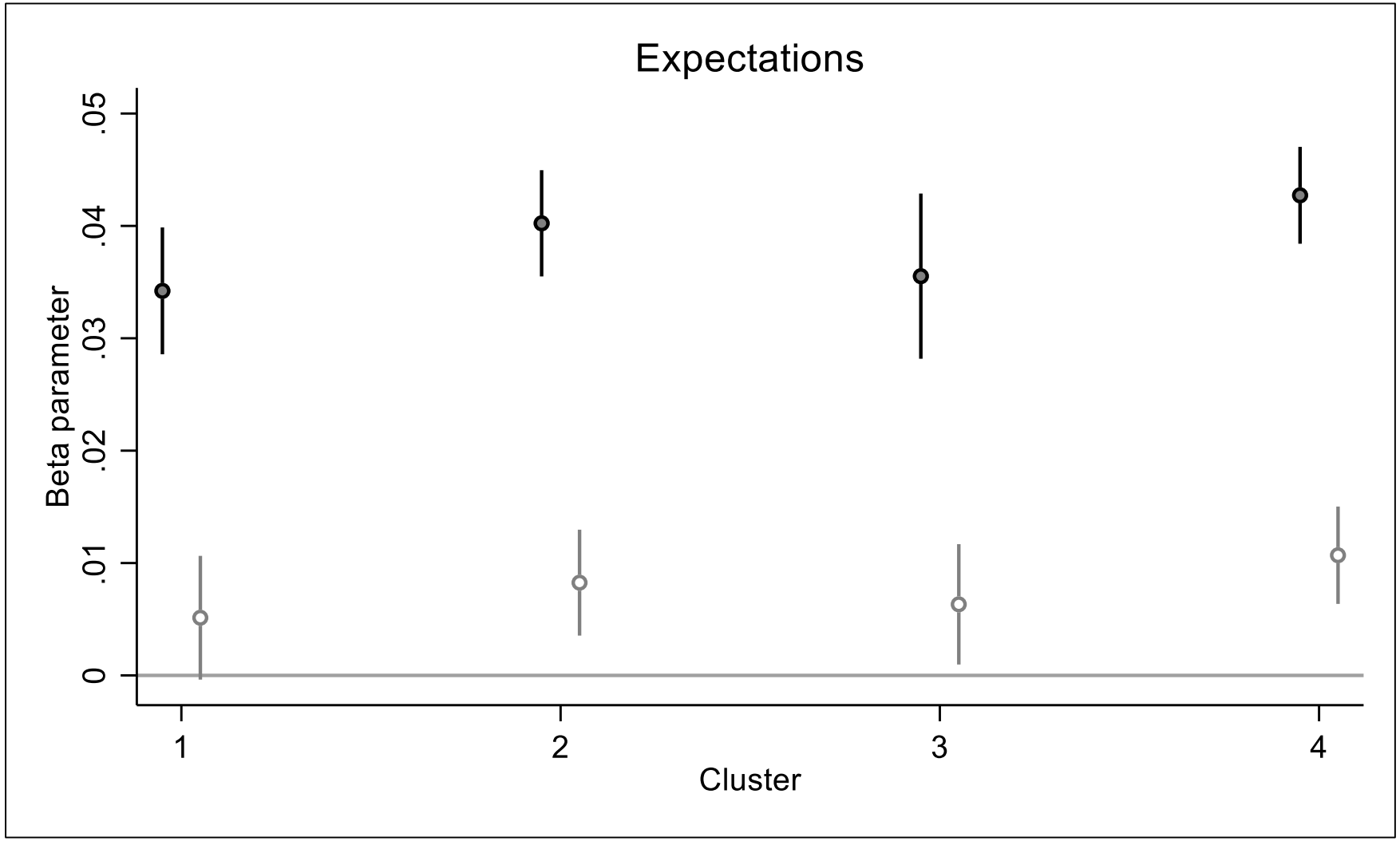



# Evidence from multivariate analyses (5)

| Countries | Rank Cluster 1 | Rank Cluster 2 | Rank Cluster 3 | Rank Cluster 4 |
|---|---|---|---|---|
| FI | High | High | High | High |
| UK | High | High | High | High |
| SE | High | Medium-High | High | Medium-High |
| AT | High | Medium-High | Medium-High | Medium-Low |
| DK | High | High | High | High |
| DE | High | High | Low | Medium-High |
| PL | Medium-High | High | High | Medium-High |
| IE | Medium-High | Medium-High | Medium-High | Medium-Low |
| HR | Medium-High | Medium-Low | Medium-Low | Medium-Low |
| ES | Medium-High | Medium-Low | Medium-High | Medium-Low |
| HU | Medium-High | Low | Medium-Low | Low |
| NL | Medium-High | Medium-Low | Low | Medium-High |
| SI | Medium-Low | High | High | High |
| CZ | Medium-Low | Low | Medium-High | Medium-High |
| LV | Medium-Low | Medium-Low | Medium-High | Low |
| EE | Medium-Low | Medium-Low | Medium-High | High |
| CY | Medium-Low | Medium-High | Medium-Low | Medium-High |
| BE | Medium-Low | Low | Low | Low |
| IT | Low | Medium-High | Medium-Low | Medium-Low |
| BG | Low | Low | Low | Low |
| LU | Low | Low | Low | Low |
| PT | Low | Low | Low | Low |
| SK | Low | Medium-High | Low | Low |
| FR | Low | Low | Low | Low |
| EL | Low | Low | Medium-Low | Medium-Low |
| LT | Low | Medium-Low | Medium-Low | High |

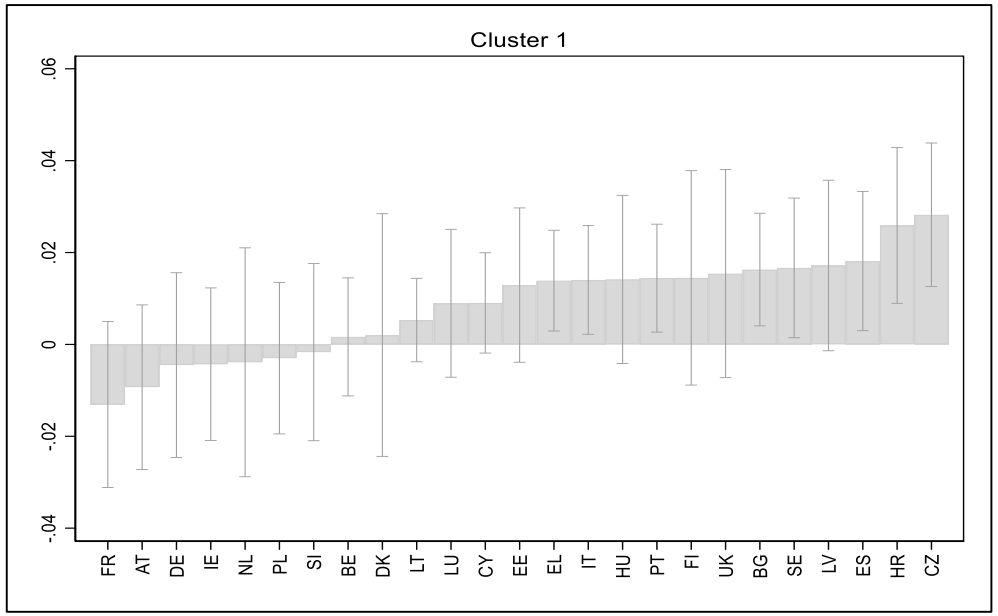
Country ranking on the basis the effect played by effort on science according to cluster position.

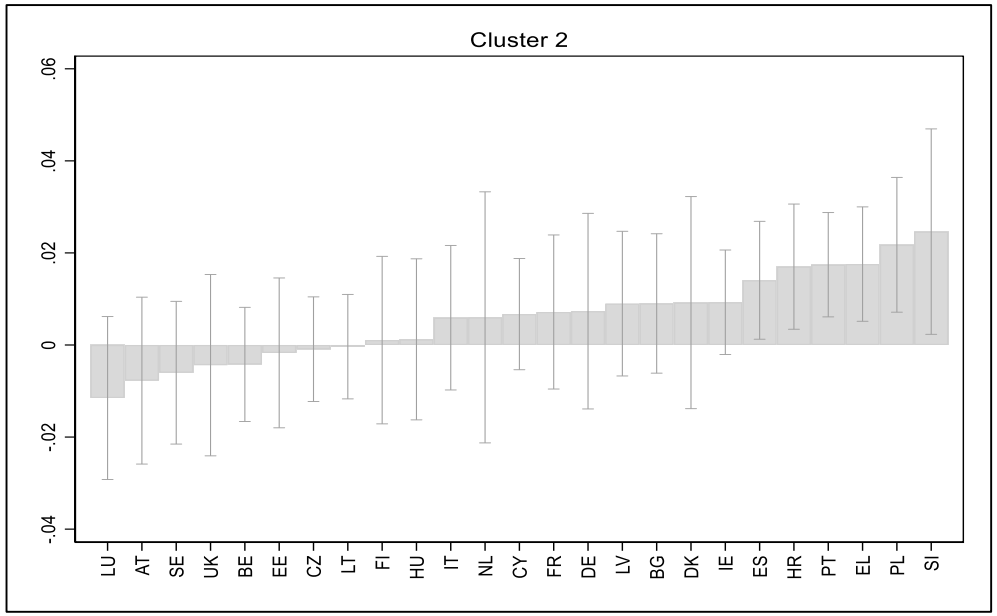
# Evidence from multivariate analyses (6)

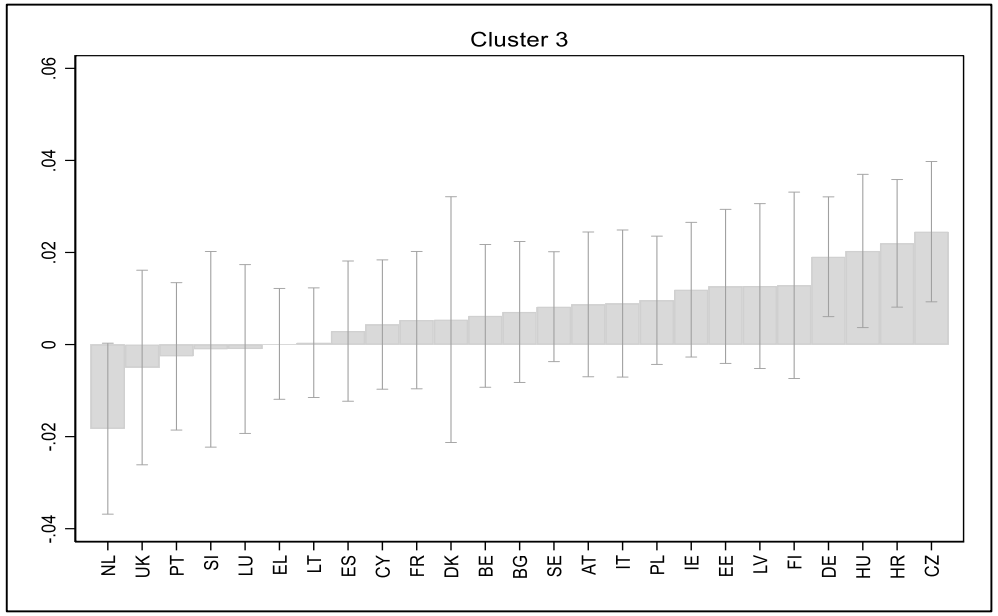


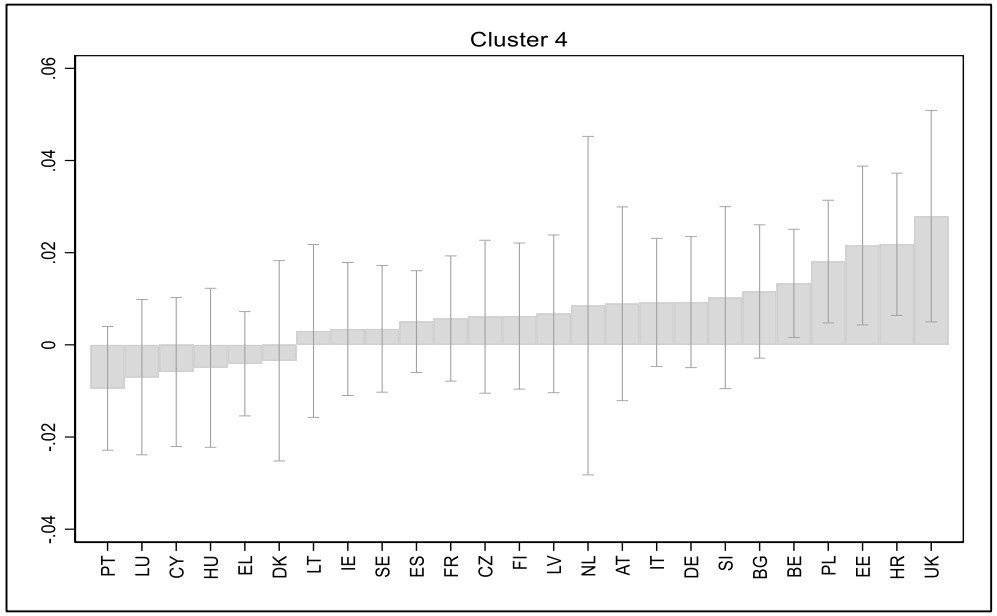

Beta parameter from an OLS regression for the effect of effort on education expectations according to cluster position. Filled dots represent derive from a model with covariates at individual, school and country level. Hollow circles derive from a model controlling also for the performance in science.

# Evidence from multivariate analyses (7)




Beta parameter from an OLS regression for the effect of effort on education expectations according to country and cluster position.

# 4. Conclusions

# Conclusions (1)

**Log-files** can provide new data/approaches in the measurement of non-cognitive skills (and more) → these data are a **by-product** of the compilation of a test and should be analyzed with caution.

Some aspects are still not fully addressed:

- The differences between the domains are due to their specific features or to the fact that science is the major domain?
- The analysis presented in this presentation cannot have any causal interpretation.
- What is the meaning of the “negative effort”?

# Conclusions (2)

**Further research**:

- An in depth analysis of the response time on the basis of item characteristics (difficulty, position in the test and in the cluster, etc.).
- After the release of PISA 2018:
  - Comparison with self-assessed items on effort (not available in PISA 2015).
  - Temporal variation in the log-files index.
  - Focus on another major domain (Reading instead of Science).

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# Thank you for your attention

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**Beyond achievement**

*A comparative look into 15-year-olds' school engagement, effort and perseverance in the European Union*