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Advanced Quantitative Methods
and Analytics for Public Policy Support



ABSTRACT BOOK

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SESSION 1

Tracking and School Selection

15 September, 15.45–17.25

Do Degree Classifications Matter? Evidence from Academic Progression Outcomes

Maxime François

Soft Skills and Teacher Track Recommendation: Evidence from the Dutch Primary-to-Secondary Transition

Jeanne Olla

From School to the Labor Market: How Illness Shapes Educational and Early Adult Trajectories

Giulia Vaiani

Non-Cognitive Skills and Educational Trajectories: The Impact of Social Relationships on Track Placement

Lynn van Vugt

Do Degree Classifications Matter? Evidence from Academic Progression Outcomes

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Extended Abstract

Motivation

Degree classifications are widely recognised for their labour market signalling value, yet their role in shaping within-university academic progression remains largely unexplored. This paper asks whether graduating with honours at the bachelor's level causally affects students' subsequent academic outcomes at the master's level, and whether these effects differ by gender. The question is particularly timely given concerns about grade inflation, which has progressively expanded the share of graduates receiving honours across higher education systems.

Institutional Setting and Data

The analysis uses administrative data from KU Leuven (Belgium), a large open-access university operating under the ECTS system. Honours classifications follow exogenously determined GPA thresholds: Cum laude above 13.6/20, Magna cum laude above 15.4/20, with higher tiers beyond. Critically, bachelor's honours carry no formal requirement for master's enrolment, limiting strategic targeting of thresholds. The dataset covers the full graduating population over five academic years (2017–18 to 2021–22), of which 2,791 students completed both a bachelor's and a master's program at the same institution and form the core estimation sample.

Methodology

Identification relies on a sharp Regression Discontinuity Design (RDD), exploiting the exogenous GPA thresholds for honours awards. Students just above and below each cutoff are plausibly comparable in ability and effort, since grades reflect cumulative assessments over a full academic year. This assumption is formally validated: density tests (Cattaneo et al., 2017; McCrary, 2008) detect no manipulation at either threshold, and predetermined covariates are balanced on both sides. We estimate the causal effect of honours on four master's-level outcomes: graduation probability, GPA, thesis grade, and enrolment in a research-oriented program. The non-parametric estimator of Calonico et al. (2017) is used with triangular kernel weighting and MSE-optimal bandwidths. Results are reported separately at each threshold and in a pooled specification following Cattaneo et al. (2024), with robustness confirmed across eight additional checks.

Results

The results are consistent and striking: bachelor's honours do not improve, and in some cases harm, subsequent academic outcomes. Students awarded Cum laude show an 8.6 percentage point decline in master's graduation probability ($p \approx 0.12$), with the pooled specification yielding a significant 11.4 percentage point decrease ($p < 0.10$). Effects on GPA, thesis grades, and research program enrolment are small and mostly non-significant, though uniformly non-positive for Cum laude recipients. For Magna cum laude, a marginally significant positive GPA effect is observed, but the overall picture remains one of limited benefit.

A pronounced gender gap emerges. Female students barely crossing the Cum laude threshold experience a significant 14 percentage point decline in master's graduation probability, alongside an estimated GPA decrease of 0.50 points (3.6% below the female mean, $p \approx 0.14$). Male students display small, non-significant positive effects. In the pooled specification, no female students enrolled in research-oriented programs just above the threshold, while male enrolment rises by 4.4 percentage points. Power analyses confirm these patterns are not driven by insufficient sample sizes, supporting the interpretation that positive honours effects on academic trajectories are unlikely.

Discussion and Policy Implications

These findings challenge two strands of existing literature. First, they call into question the transferability of signalling theory to the academic track: honours at the master's level are known to improve labour market outcomes, but bachelor's honours do not appear to generate positive academic progression. Second, the results contradict the standard positive association between past and future academic performance. A plausible explanation, grounded in the self-enhancement bias literature, is that marginally honoured students overestimate their abilities and enrol in more demanding master's programs, where they subsequently underperform. For female students, additional sorting dynamics may be at play, though these mechanisms cannot be directly tested within an administrative data framework.

For policymakers and university administrators, the findings prompt a serious reassessment of bachelor's-level classification systems, especially in open-access institutions where honours carry no formal gating function. Given ongoing grade inflation, traditional classification schemes risk providing misleading signals to students. Recommendations include establishing clear grading guidelines, raising faculty awareness, and exploring standardised scales to curb inflationary pressures. Future research should examine whether similar effects arise in other institutional contexts and test the overconfidence mechanism through experimental or survey-based designs.

Keywords: Academic performance, degree classification, regression discontinuity design, higher education, grade inflation, gender gap.

JEL Classification: I21, I23.

Soft Skills and Teacher Track Recommendations: Evidence from the Dutch Primary-to-Secondary Transition

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Background and motivation

Early educational tracking shapes long-run economic and health trajectories. In the Netherlands, the track recommendation given at the end of primary school directs students into one of three secondary tracks: pre-vocational (VMBO), pre-professional (HAVO), or pre-academic (VWO). While the recommendation rests on two inputs: a standardised primary-school exit test and the teacher's subjective assessment, the teacher advice is in practise effectively considered by schools and parents as binding. Most of literature on teacher track advice has focused on the past cognitive performance, student and socioeconomic status. The research found that while these factors account for a significant part of the teacher advice, still much rest unexplained. At the same time a substantial literature links non-cognitive (social-emotional, soft skills, traits) skills to test performance and to teachers' general perceptions of students. This paper aim at bridging the gap between these two trend of the literature by looking to what extent soft skills feed directly into the institutional decisions (teacher advice) assign students' educational paths.

Research question and contribution

This paper asks whether students' non-cognitive skills predict the track teachers recommend, conditional on prior cognitive performance, parental education, gender, and school. It further tests whether the skills that matter differ between the two adjacent margins of the recommendation — VMBO versus HAVO and HAVO versus VWO. The contribution is threefold: direct evidence on the skill to recommendation link rather than the skill to test or skill to perception link studied previously; a margin-specific design that allows the same skill to operate differently at different transitions; and evidence that some skills act partly through an indirect, test-mediated channel.

Data

We merge the OnderwijsMonitor Limburg (OML) with the Nationaal Cohortonderzoek Onderwijs (NCO) for three Grade 6 cohorts: 2018–19, 2020–21, and 2022–23. After restricting to schools with at least five observed students across cohorts, the analytic sample consists of 14,015 students nested in 251 primary schools. Five non-cognitive skills: Agreeableness, Conscientiousness, Creativity, Curiosity, and Emotional control are measured through short student self-reports on likert items administered in Grade 6. The datasets also include measures of the teacher recommendation, exit-test score, and parental education.

Methods

The five latent skills are extracted using a multi-group confirmatory factor analysis estimated in lavaan with configural invariance across cohorts. The model fits well by conventional standards (CFI = 0.962, TLI = 0.948, RMSEA = 0.044, SRMR = 0.029); standardised loadings are stable across cohorts and

McDonald's ω ranges from 0.62 to 0.76. Bartlett factor scores are extracted and standardised. We then estimate linear probability models separately at the two adjacent margins — VMBO versus HAVO (n = 10,290) and HAVO versus VWO (n = 7,311) — of the form

$$Y_{isc} = \alpha_s + \gamma_c + \beta_1 \text{StandardisedTestScore}_{isc} + \beta_2' S_{isc} + \beta_3' X_{isc} + \varepsilon_{isc}$$

where Y_{isc} equals 1 if student i in school s and cohort c receives the higher of the two adjacent tracks (HAVO at margin 1; VWO at margin 2), S_{isc} is the vector of five standardised non-cognitive skill scores, $\text{StandardisedTestScore}_{isc}$ is the standardised exit-test score, X_{isc} contains gender and highest parental education, α_s is a school fixed effect, and γ_c is a cohort fixed effect.

Results

The set of skills that predict track recommendations is not the same at the two margins. At the VMBO–HAVO margin, three skills are significantly associated with the higher track: Creativity raising the probability of a HAVO recommendation by 1.99 percentage points ($p < 0.001$), Emotional control by 1.60 percentage points ($p < 0.01$), and Agreeableness by 1.58 percentage points ($p < 0.01$). At the HAVO–VWO margin, only Creativity remains significant (2.08 percentage points, $p < 0.01$), with Curiosity marginally significant ($p < 0.10$).

The implications from these results is that teachers weigh different non-cognitive attributes depending on the track decision they are making. At the lower margin, both a school-attitude signal (Creativity) and a relational signal (Agreeableness, Emotional control) inform the move from VMBO to HAVO. At the upper margin, the relational signal fades and only the creative, idea-generating component continues to discriminate, which may be considered as more important for the pre-academic track.

Policy implications

The cross-margin asymmetry has implications for both equity-focused policy and intervention design. If creativity is the one skill teachers reward at every margin, school programmes that cultivate idea generation early in primary schooling have leverage on track outcomes that complement, rather than substitute for, gains in measured cognitive performance. Conversely, the fact that relational skills matter only at the VMBO–HAVO margin suggests that interventions targeting cooperation and emotional regulation will have their largest effects on students near that transition, precisely the population for whom upward mobility into HAVO carries the largest long-run returns.

From School to the Labor Market: How Illness Shapes Pathways

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Abstract

Childhood health has become an increasingly relevant issue for both education systems and social policy, as a growing number of children and adolescents experience chronic or serious health conditions that may interfere with learning, school participation, and the accumulation of human capital. A substantial body of literature has shown that poor health in early life can negatively affect educational attainment, cognitive development, and later socio-economic outcomes. However, important gaps remain in our understanding of how childhood illness shapes trajectories across the transition from school to adulthood.

First, much of the existing evidence focuses on short-term educational outcomes, while fewer studies are able to follow individuals long enough to observe longer-term educational attainment and early labour market integration. Second, findings remain mixed regarding the persistence and magnitude of these effects, particularly in relation to employment outcomes.

This paper contributes to the literature by examining how serious illness during childhood and adolescence affects educational trajectories and early labour market outcomes in France. Since the Law of 11 February 2005, France has progressively expanded educational accommodations and support systems for students with disabilities and long-term health conditions, including personalized schooling plans (Projet Personnalisé de Scolarisation), specialized support units within mainstream schools (ULIS), and financial assistance mechanisms for affected families. Understanding whether educational inequalities nevertheless emerge despite these institutional protections provides important insights into the limits and effectiveness of inclusive policies.

The analysis uses longitudinal data from the DEPP–EVA system administered by the French Ministry of Education (DEPP) and INSEE. The core dataset follows a nationally representative cohort of students who entered lower secondary school in 2007 and tracks their educational progression throughout secondary education and into early adulthood. The data combine administrative educational records with detailed family surveys conducted during lower secondary school, which include information on socio-economic background, family circumstances, and, importantly, the occurrence of serious illness.

A key contribution of the paper is the distinction between different illness trajectories. Indeed, the study differentiates between persistent illness, that is early-onset illness, and illness emerging during lower secondary school. This distinction allows the analysis to investigate whether the timing and persistence of health shocks matter for educational progression and later transitions into adulthood.

Methodologically, the paper adopts a quasi-experimental approach to address the non-random nature of illness exposure. Students experiencing serious illness may differ systematically from their peers in terms of family background, socio-economic status, or prior educational achievement, making simple

comparisons potentially misleading. To reduce selection bias, the analysis relies on Propensity Score Matching (PSM), matching treated students with observationally similar peers based on a rich set of pre-treatment characteristics, including parental education, socio-economic status, migration background, family composition, and adverse family events.

For students who experience illness onset during lower secondary school, the paper additionally implements a Propensity Score Matching combined with Difference-in-Differences (PSM-DID) strategy. This design exploits the longitudinal structure of the data to compare changes in academic performance before and after illness onset between treated and matched control students, thereby accounting for time-invariant unobserved heterogeneity.

The study examines outcomes across multiple stages of the life course. In the short term, it analyzes standardized test scores in mathematics and French during lower secondary education. In the longer term, it investigates educational attainment and the transition to adulthood through outcomes such as completion of compulsory and upper secondary education, access to higher education, employment status, and wages in early adulthood. The paper adopts a life-course perspective and explores the mechanisms through which health shocks may shape later inequalities. In particular, it investigates whether the consequences of illness primarily operate through educational disruption and reduced educational attainment, or whether direct labour market disadvantages also emerge independently of schooling trajectories.

Preliminary findings suggest that serious illness is associated with substantial educational disadvantages, particularly when illness is persistent or occurs early in the educational trajectory. The results point to significant disruptions in academic progression and lower probabilities of completing key educational milestones. By contrast, evidence regarding early labour market outcomes appears more limited and less consistent, suggesting that the main long-term consequences of childhood illness may operate primarily through educational pathways.

Overall, the paper contributes to ongoing debates on educational inequality, health-related disadvantage, and inclusive schooling by providing new longitudinal evidence from the French context. More broadly, it highlights the importance of understanding childhood illness not only as a health issue, but also as a factor shaping educational opportunities and transitions into adult life. The findings are particularly relevant for policymakers concerned with reducing inequalities and strengthening support mechanisms for students facing health-related challenges during critical stages of educational development.

Non-Cognitive Skills and Educational Trajectories: The Impact of Social Relationships on Track Placement

Lynn van Vugt, Mélanie Monfrance, Trudie Schils, Carla Haelermans*

Traditionally, educational outcomes are primarily attributed to cognitive performance. However, a growing body of research highlights the importance of non-cognitive (or socio-emotional) skills in shaping both educational achievement and later life outcomes (Borghans et al., 2014; Heckman & Kautz, 2012; Kautz et al., 2014; Ledoux et al., 2013; OECD, 2015; Spengler et al., 2018). Over the past decade, increasing attention has been paid within educational practice, policy, and research to the development and relevance of these skills.

This study focusses on social relations with teachers and classmates in relation to students' position in the third year of secondary education relative to the school recommendation received at the end of primary education. To do so, we combine two large-scale longitudinal datasets: the Education Monitor Limburg (In Dutch: OnderwijsMonitor Limburg - OML) and the Netherlands Cohort Study on Education (In Dutch: Nationaal Cohortonderzoek Onderwijs - NCO). The social relationships are measured using student survey data of the OML, collected in the final year of primary education (2018–2019) and in the third year of secondary education (2021–2022) and are measured through composite indices based on multiple survey items. These measures are linked to the NCO data, which include administrative information on school recommendations, subsequent track placement, and student background characteristics such as gender and socioeconomic status. Combining these datasets allows us to follow students from primary through secondary education, providing a unique opportunity to assess the role of both cognitive and non-cognitive skills in educational trajectories.

The analysis focuses on non-cognitive skills that have been shown to be both malleable and relevant for long-term outcomes. We examine how social relationships in both primary and secondary education are associated with students' educational position in the third year of secondary education, and whether these associations differ by socioeconomic background and gender.

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We estimate multinomial logistic regression models in which the dependent variable distinguishes between being below, at, or above the school recommendation. The independent variables social relationships with teachers and classmates are standardized. All models control for relevant student background characteristics. Predicted probabilities and average marginal effects are used to interpret the magnitude and direction of associations, and heterogeneous effects are tested by interaction effects with gender and socio-economic status.

The preliminary results show that social relationships in primary education are not significantly associated with track placement in the third year of secondary education. In contrast, significant associations are found for secondary education. More positive relationships with classmates are associated with a higher likelihood to end up above the school recommendation, particularly among students from lower socioeconomic backgrounds. Additionally, stronger relationships with teachers increase the likelihood of being above the recommendation and decrease the likelihood of being below it, especially for girls.

These findings underline the importance of the social context in secondary education and contribute to ongoing discussions on educational inequality and the role of non-cognitive skills in shaping students' educational trajectories.

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SESSION 2

Machine Learning

15 September, 15.45–17.25

Academic Resilience in PISA 2022: A Machine Learning Analysis

Ari Perdana

Designing Early Warning Systems for University Dropout: Integrating Machine Learning and Causal Inference for Data-Driven Education Policy

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Exploring International Learning Loss Patterns: A ML Investigation Using PISA Data Before and After COVID-19

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Beyond Prediction: Uncovering Dropout Patterns with Machine Learning in Italian Schools

Mariavittoria Ludovico

Academic Resilience in PISA 2022: A Machine Learning Analysis

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Abstract. Academic resilience—the ability to achieve strong academic outcomes despite socioeconomic disadvantage— is central to education equity debates. Using PISA 2022 data on more than 140,000 disadvantaged students across 80 countries, this study examines how student, family, and school characteristics jointly differentiate resilient from non-resilient students. Resilience is defined as belonging to the lowest national socioeconomic quintile while scoring in the top 25 percent of performance in at least two domains. Random Forest models are used to identify and compare correlates across regions. Motivational and aspirational resources consistently rank highly, but their importance varies across contexts, with structural school resources playing a larger role in some systems. The findings suggest that resilience is a context-dependent, interacting mechanism rather than a universal set of traits.

Keywords: academic resilience, machine learning, random forest, PISA, education, equity

JEL codes: I21, I24, C45, J24

Highlights

- Defines academic resilience as high achievement within the lowest SES quintile.
- Uses Random Forest models to rank resilience correlates across 80 countries.
- Finds motivational and aspirational resources as consistent key predictors.
- Shows regional variation in the relative importance of school resources.
- Demonstrates that resilience reflects context-dependent, interacting factors.

Designing Early Warning Systems for University Dropout: Integrating Machine Learning and Causal Inference for Data-Driven Education Policy

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University dropout remains a persistent challenge for higher education systems worldwide, with significant implications for human capital formation, public spending efficiency, and social equity, as non-completion rates continue to disproportionately affect students from disadvantaged socioeconomic backgrounds. Although early warning systems (EWS) have become increasingly common, most existing approaches rely primarily on predictive machine learning models that identify at-risk students but provide limited guidance on which interventions are most effective, often leading institutions to implement generalized support measures that fail to address heterogeneous student needs and result in inefficient or misdirected policy responses. This study develops and empirically evaluates a policy-oriented early warning framework that integrates machine learning with causal inference, shifting the focus from risk prediction to intervention design. The proposed framework combines a gradient-boosted tree model for dynamic dropout prediction with a causal forest approach to estimate heterogeneous treatment effects of policy-relevant interventions, including academic support, financial assistance, advising adjustments, and course load modifications. Using longitudinal administrative and behavioral data from a large public university, the predictive model demonstrates strong performance, achieving an AUC of 0.88 and significantly outperforming standard logistic regression benchmarks, while maintaining robust classification across student subgroups. The causal analysis reveals substantial heterogeneity in intervention effectiveness across student groups, showing that financial assistance reduces dropout probability by approximately 6–9 percentage points for economically disadvantaged students, whereas structured course load adjustments yield larger benefits for academically disengaged students; in contrast, tutoring interventions exhibit limited impact for students without prior academic risk, highlighting the limitations of uniform support strategies. When integrated into a policy simulation framework, the hybrid system reduces mis-targeted interventions by approximately 30–35% and improves the allocation of effective support by around 25% compared to conventional predictive EWS, demonstrating the added value of combining

prediction with causal evaluation. These results indicate that relying solely on predictive models leads to inefficient intervention strategies, whereas incorporating causal inference enables more precise and effective targeting of resources. From a policy perspective, the framework improves efficiency by directing limited resources toward interventions with the highest expected impact, enhances equity by identifying differential responses across diverse student populations, and supports adaptive policymaking through continuous data-driven updating and evaluation. Although the empirical application is based on institutional-level data, the framework is designed to be scalable and transferable across education systems, with potential integration into broader administrative and national-level education data infrastructures. This study demonstrates how early warning systems can evolve from passive risk identification tools into active instruments of evidence-based education policy, offering a practical and scalable pathway to reduce dropout rates while improving both efficiency and equity in higher education systems by linking prediction, causal analysis, and intervention design.

Exploring international learning loss patterns: a ML investigation using PISA data before and after COVID -19

4TH ANNUAL CONFERENCE OF ADVANCED QUANTITATIVE METHODS AND ANALYTICS FOR PUBLIC POLICY SUPPORT (AQMAPPS)

Tallinn 15-16 September 2026

Melvin Vooren	Melisa Diaz Lema
Ilja Cornelisz	Chris van Klaveren
	Tommaso Agasisti

Extended abstract

The Covid-19 pandemic has initiated widespread learning losses. There are significant country differences in the learning losses following the Covid-19 pandemic. Math, reading and science skills have been affected differently by the pandemic. This study utilizes OECD PISA data to estimate learning losses at the country level within EU-15 countries in math, reading, and science. The identification is based on the comparison of pre-pandemic XGBoost machine-learning model predictions in math, reading, and science scores in the PISA 2015, 2018 and 2022 survey waves. Doing so, we can compare counterfactual PISA scores. We find that the learning loss is the largest in mathematics, followed by reading and science. On the country level, the Netherlands and France suffered the largest learning losses, whereas Germany, Sweden, and Austria were the least affected. We conclude that mathematics skills, with a more cumulative nature, are associated with a higher susceptibility for pandemic-associated school closures. Reading scores, which can be learnt at home are associated with learning losses, but less so when compared with mathematics. Broad knowledge is nearly unaffected, as measured by the learning loss in PISA science scores.

Data

The starting point of our analysis are the EU-15 countries. These include the original Maastricht treaty states and the 1995 expansion: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, the United Kingdom. These countries also participate in PISA. In Europe, the Covid-19 pandemic emerged in the Lombardy region in Northern Italy at the end of February, 2020 and quickly spread across the continent by the end of the month. At the beginning of March, 2020, member states initiated lockdown measures.

There was a certain degree of heterogeneity across the continent in how these measures were effectuated and in the corresponding timeframe, but schools were generally closed by the end of March 2020, and remained closed until the end of the academic year 2019-2020. In some countries, including the Netherlands, lockdown measures remained in place in the second half of 2021, coinciding with the first semester of the 2021-2022 academic year.

Because of Covid-19, the OECD deviated from their regular 3-year PISA cycle, following the 2018 PISA wave with the 2022 wave. Therefore, the 2022 PISA wave is the first PISA wave that was surveyed right after the Covid-19 pandemic, in a back-to-normal setting. In both the 2018 and 2022 waves, around 130 thousand students were surveyed in the PISA study in the EU-15 countries. In 2015, this amounted to around 100 thousand students.

Methods

Now that we have shown that our ML model is capable of fitting the EPF in a given year, we can also test whether a model trained on data from a given year can predict learning outcomes *over time*, i.e. in the next PISA-wave that was surveyed in a later year:

$$\tilde{Y}_j = X_j^{test} \hat{\beta}_{j-1} + \epsilon \quad (1)$$

In this specification, the $\hat{\beta}_{j-1}$ term represents the vector of predictors from the PISA cycle preceding the respective PISA cycle j . The ϵ represents another vector of errors. This is the variance that the model cannot explain with the predictors from the EPF of the previous PISA cycle. This ϵ term is analogous to the shift of the EPF over time. With this setup, we can also test whether the EPF did not substantially change between pre-Covid PISA waves:

$$(\hat{Y}_j - \tilde{Y}_j) = (X_j \hat{\beta}_j - X_j \hat{\beta}_{j-1}) \quad (2)$$

In other words, we predict test scores in PISA wave j by using model coefficients from the preceding wave $j-1$. If the EPF did not substantially change over time between the pre-Covid PISA waves, we can assume that any remaining shifts in the estimated PISA math scores between pre- and post-Covid PISA-waves are due to Covid-19 (i.e. $(\epsilon - \epsilon) = 0$). If this assumption holds, the $(\hat{Y}_j - \tilde{Y}_j)$ term captures the Covid-19 learning loss which is estimated by the term $(X_j \hat{\beta}_j - X_j \hat{\beta}_{j-1})$.

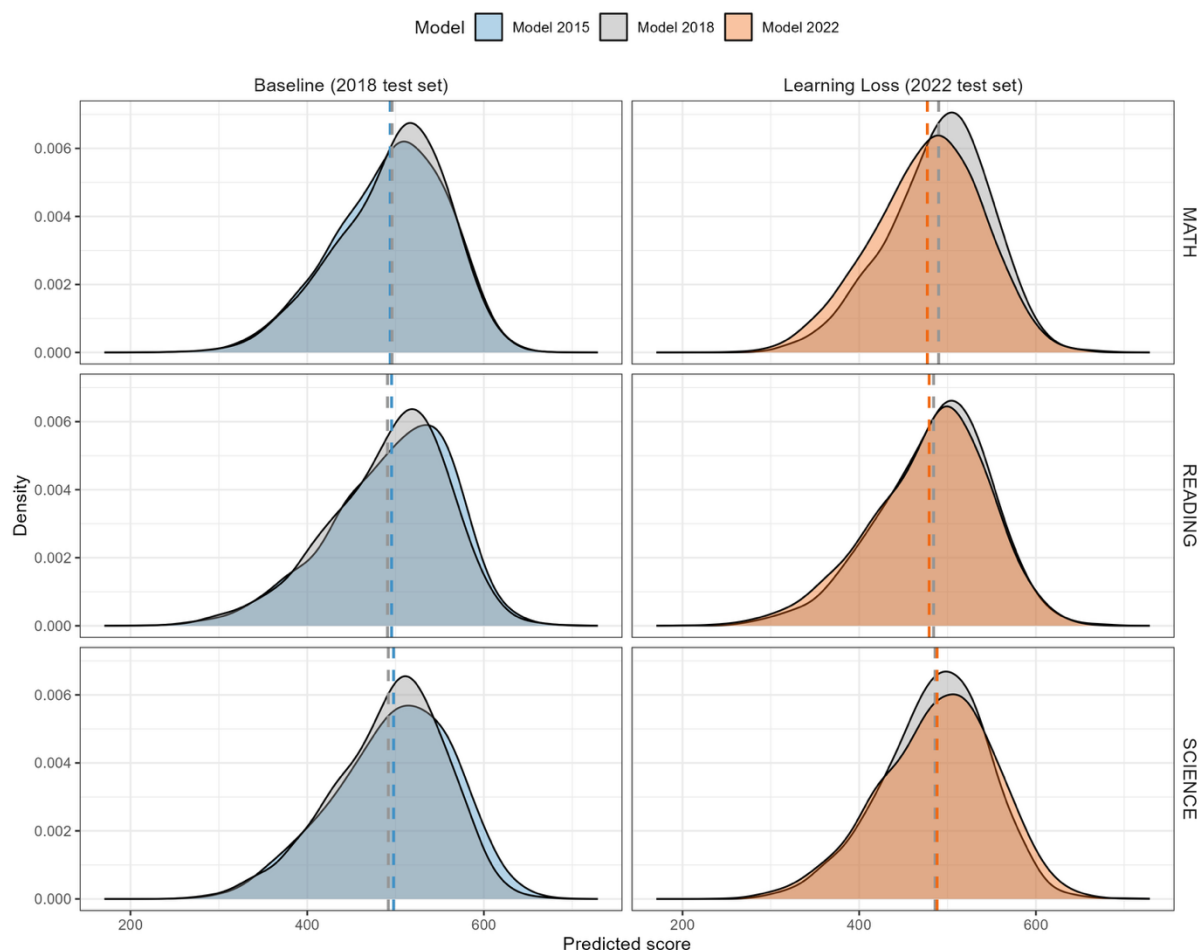
Summary of the results

Machine learning and learning loss

Figure 1 show the pooled XBoost prediction distributions. The left panel shows the baseline results. The density plots show near complete overlap between the 2015 and 2018 model predictions on 2018 student data. This validates the identifying assumption that the EPF was stable before COVID. The right panel shows the learning loss panel shows the Covid-19 learning loss, which is captured by the difference between the 2018 and 2022 model predictions

using 2022 student data. We observe a systematic leftward shift of the 2022 model relative to the 2018 model, indicating a post-COVID deterioration in the educational production function.

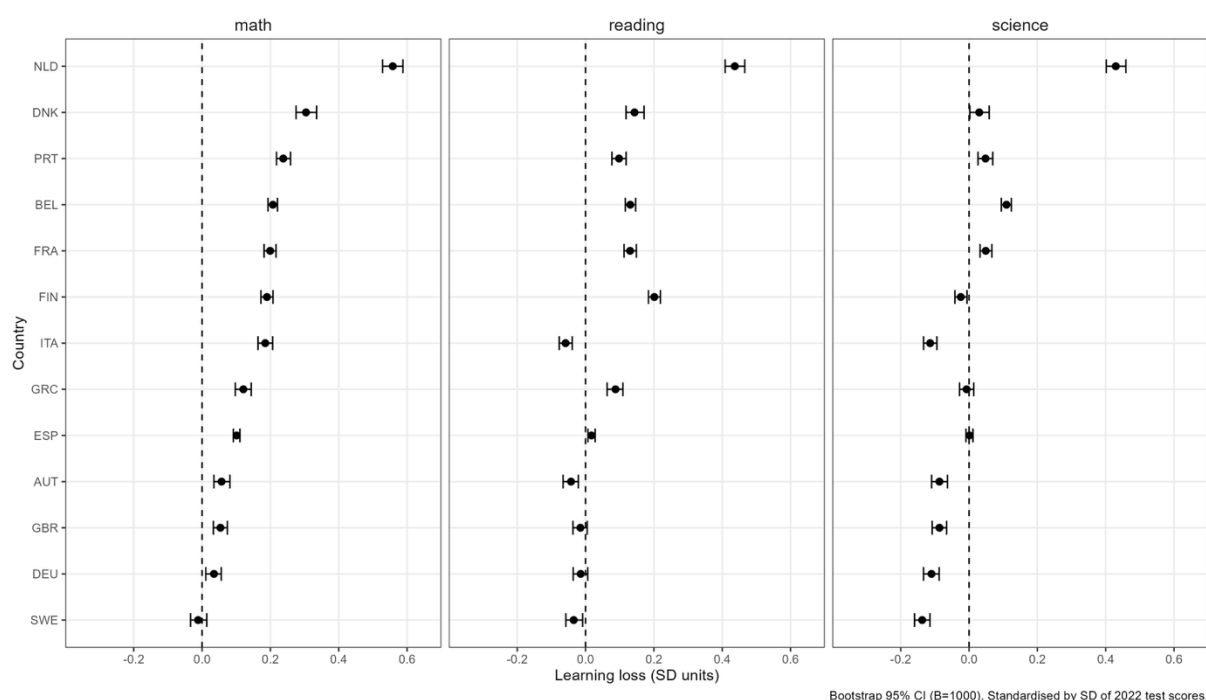
Figure 1: XGBoost model prediction distributions



Country level learning loss

We also estimate the learning loss at the country level, which is shown in Figure 2. We observe difference at the country level. On the country level, the Netherlands and France suffered the largest learning losses, whereas Germany, Sweden, and Austria were the least affected. We conclude that mathematics skills, with a more cumulative nature, are associated with a higher susceptibility for pandemic-associated school closures. Reading scores, which can be learnt at home are associated with learning losses, but less so when compared with mathematics. Broad knowledge is nearly unaffected, as measured by the learning loss in PISA science scores.

Figure 2: Standardized Covid 19 learning loss estimates by country.



Note: Bootstrap 95% CI (B=1000). Standardised by SD of 2022 test scores.

Policy considerations

The heterogeneous effects of Covid-19 at the country level can reflect and heterogeneous channels through which Covid-19 affects learning has significant, yet very broad policy implications. For instance, if Covid-19 more profoundly affects students from families with low incomes or lower levels of parental education, different policy instruments can be designed and implemented to reduce these negative effects. Policy can on the one hand be targeted at the family level, where low-income families are supported to foster the learning outcomes of the children. On the other hand, policy can be targeted directly at the students, such as with on-line learning. The differences at the country level give important cues that can strengthen educational policy during future pandemic.

Beyond Prediction: Uncovering Dropout Patterns with Machine Learning in Italian Schools

Melisa Diaz Lema, Mariavittoria Ludovico & Tommaso Agasisti *Politecnico di Milano*

Introduction

Preventing school dropout remains one of the most pressing challenges for education systems worldwide. Early school leaving carries well-documented long-term consequences: lower earnings, higher unemployment rates, worse health outcomes, and reduced civic participation (Oreopoulos & Salvanes, 2011; Lleras-Muney, 2005; De Witte et al., 2013; OECD, 2023). Despite growing recognition of the problem, dropout is still treated as a single, homogeneous phenomenon rather than as the outcome of distinct and divergent pathways. Students abandon school for fundamentally different reasons such as academic failure, disengagement, socioeconomic pressure, or sudden life events requiring very different responses (Janosz et al., 2000; Bowers & Sprott, 2012; Dupéré et al., 2015, 2018). A single risk score conflates students who need different support: the heterogeneity in dropout pathways is lost in aggregation, and so is the policy signal.

Background and Motivation

Early Warning Systems (EWS) have emerged as a promising tool for identifying at-risk students before dropout occurs, increasingly relying on high-dimensional machine learning models that outperform traditional statistical approaches in terms of predictive accuracy (Sansone, 2019; Márquez-Vera et al., 2016; Alam & Bowden, 2024). Academic achievement, absenteeism, behavioural issues, socioeconomic background, and school-level characteristics have all been identified as key predictors of dropout, reflecting the complex interplay between individual performance, family context, and the educational environment. Yet EWS show limited or no causal effect on actual dropout rates, pointing to a fundamental gap between prediction and effective intervention (Sletten et al., 2023; Haimovich et al., 2021; Canbolat, 2025). We argue this gap is rooted in the one-size-fits-all architecture of most EWS: knowing who is at risk, without understanding why, provides insufficient guidance for targeted action. This paper moves beyond a single risk score to uncover the heterogeneous pathways that drive early school leaving among Italian upper secondary students, drawing on a rich administrative dataset and an interpretable machine learning framework. Three research questions guide the analysis: (RQ1) What are the main drivers of predicted dropout risk among Italian upper secondary students? (RQ2) Can distinct typologies of dropout students be identified based on their individual risk-driver profiles? (RQ3) Does predictive performance vary systematically across these dropout typologies?

Data and Methodology

The study draws on population-level administrative records from the Italian Ministry of Education, merged with INVALSI standardised test data, covering students enrolled in Grade 9 of upper secondary school during the academic year 2021–22, in schools that recorded at least one dropout case. The dataset encompasses four information domains: student background characteristics, prior academic performance and engagement, peer environment characteristics at the classroom level and school organisational features.

The empirical strategy unfolds in three steps. First, a gradient boosting model (XGBoost) is trained to predict dropout probability, and SHAP values are computed to decompose each student's predicted risk into the individual contribution of each observable characteristic, enabling the

transition from global feature importance to individualised risk-driver profiles. Second, dropout students are clustered in SHAP space rather than on raw observables, using a partitioning around medoids algorithm with the number of clusters selected by silhouette width. Clustering in SHAP space groups students by why they are at risk rather than who they are, producing profiles that are more clearly separated and directly interpretable in policy terms (Lundberg, Erion & Lee, 2018; Cooper et al., 2021). Third, the resulting profiles are characterised through observable characteristics, and predictive performance is compared across typologies to assess whether the model identifies all dropout students equally well.

Results

The analysis yields five distinct dropout profiles, structured around a fundamental divide between retained and never-retained students, who occupy entirely separate regions of risk-driver space.

Among retained students, two profiles emerge. The first one, *Persistent Academic Failure*, is characterised by a long and cumulative history of academic underperformance, with grade retention as the dominant risk driver. These students concentrate in technical and vocational school tracks and in contexts of pronounced socioeconomic disadvantage; intervention for this group could emphasize intensive academic support and remedial programmes. *School Mobility* students, despite sharing a history of retention, show comparatively lower predicted risk and come from less disadvantaged backgrounds, suggesting that school change may in some cases reflect an active re-engagement strategy rather than a further sign of deterioration.

Among never-retained students, three profiles are identified. *Overage Disengagers* are older than expected for their grade level, often from immigrant backgrounds, with high absenteeism and low behavioural grades, suggesting a protracted process of disengagement that may have begun long before the observation window; mentoring, counselling, and closer family engagement may be most effective for this group. *Young Behavioral Risk* students exhibit characterise for significant behavioural difficulties and are concentrated especially in technical school tracks, pointing to conduct-based disengagement; mentoring and psychological counselling could prove effective. The third profile is the *Unexpected Dropout* group: students who leave school without leaving any detectable trace in administrative records, presenting near-average grades, attendance rates, and test scores. The model assigns them very low predicted dropout probabilities, meaning that a substantial share of never-retained dropouts would be systematically missed by current Early Warning Systems. Understanding why this group leaves school and how to intervene would require data that go beyond what administrative records can capture.

Discussion and Conclusion

These findings carry important implications for both research and policy. The heterogeneity of dropout pathways demands heterogeneous responses: intensive academic remediation for students facing persistent academic failure, mentoring and family engagement for overage disengagers, and community-based or school-level strategies for those whose risk is contextually driven. The existence of an undetectable dropout group raises questions about the limits of administrative data, calling for complementary data collection strategies, including non-cognitive informations, qualitative and relational information, that may capture signals invisible to current EWS architectures. More broadly, the results suggest that Early Warning Systems should move from a single-score logic toward a profile-sensitive framework, in which the nature of the risk, and not only its magnitude, guides the institutional response. Ultimately, predictive accuracy alone is insufficient: the true value of an EWS lies in its ability to transform predictions into differentiated and meaningful action.

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SESSION 3

School Financing and Resources

16 September, 09.00–10.35

Estimating the Returns to Intensive versus Moderate Support Schools Using Geographic Variation in School Access

Ilja Cornelisz

Between Autonomy and Redistribution: The Distributional Outcomes of Project-based Funding in Italian Schools

Francesco Balzaretti

The Impact of Institutional Campaigns: The Case of Flemish Summer Schools

Diogo Conceição

School Meals and Conditional Cash Transfers in Secondary Education: Effects on Educational Achievements

Carla Haelermans

Estimating the Returns to Intensive versus Moderate Support Schools Using Geographic Variation in School Access

Background

In educational systems that rely on segregated provision for students with special educational needs support is often organized at different levels of intensity. (OECD, 2023). More intensive settings typically receive substantially greater public funding, employ more specialized staff, and offer lower student–teacher ratios. Despite these differences in resource allocation, little causal evidence exists on whether more intensive and more costly forms of support improve students’ long-term educational outcomes.

This question is particularly relevant in the context of growing policy attention to educational inclusion and increasing expenditures on specialized provision. While a large literature has examined the effects of special education placement relative to mainstream education (Hanushek et al., 2002; Morgan et al., 2010; Schwartz et al., 2021), much less is known about the returns to different support levels within specialized education itself. Consequently, policymakers face limited evidence when deciding how resources should be allocated across alternative forms of support.

This study examines the effects of support intensity within the Dutch system of specialized education. We estimate the causal impact of enrollment in intensive-support schools compared with moderate-support schools on educational trajectories and attainment outcomes. In doing so, we contribute to debates on the effectiveness, efficiency, and organization of educational support systems.

Institutional Context

The Dutch education system distinguishes between moderate- and intensive-support schools for students whose needs cannot be adequately accommodated in regular education. Intensive-support schools receive substantially greater funding and staffing resources, but the distinction between support levels is not always sharp. Historical enrollment patterns and placement practices suggest that some students can plausibly be served in either setting, creating an opportunity to identify the causal effect of support intensity for students situated in the overlap between support provisions.

Data and Methodology

The analysis uses linked population-wide administrative data from Statistics Netherlands and the Dutch Education Executive Agency. The main analytical sample consists of 92,067 students enrolled in either moderate- or intensive-support schools at age nine between 2010 and 2018. The data include detailed information on students’ residential locations, school enrollment, demographic characteristics, and

neighborhood context, enabling the construction of student-level measures of geographic access to different support settings.

Estimating the effect of support intensity is challenging because students enrolled in intensive-support schools generally differ from those in moderate-support schools in ways that are directly related to educational outcomes. To address this selection problem, we exploit geographic variation in the relative proximity of moderate- and intensive-support schools, an approach related to studies that use geographic variation in school access to identify causal effects (Deming, 2011). Figure 1 illustrates the substantial geographic variation in the relative availability of both support settings across the Netherlands.

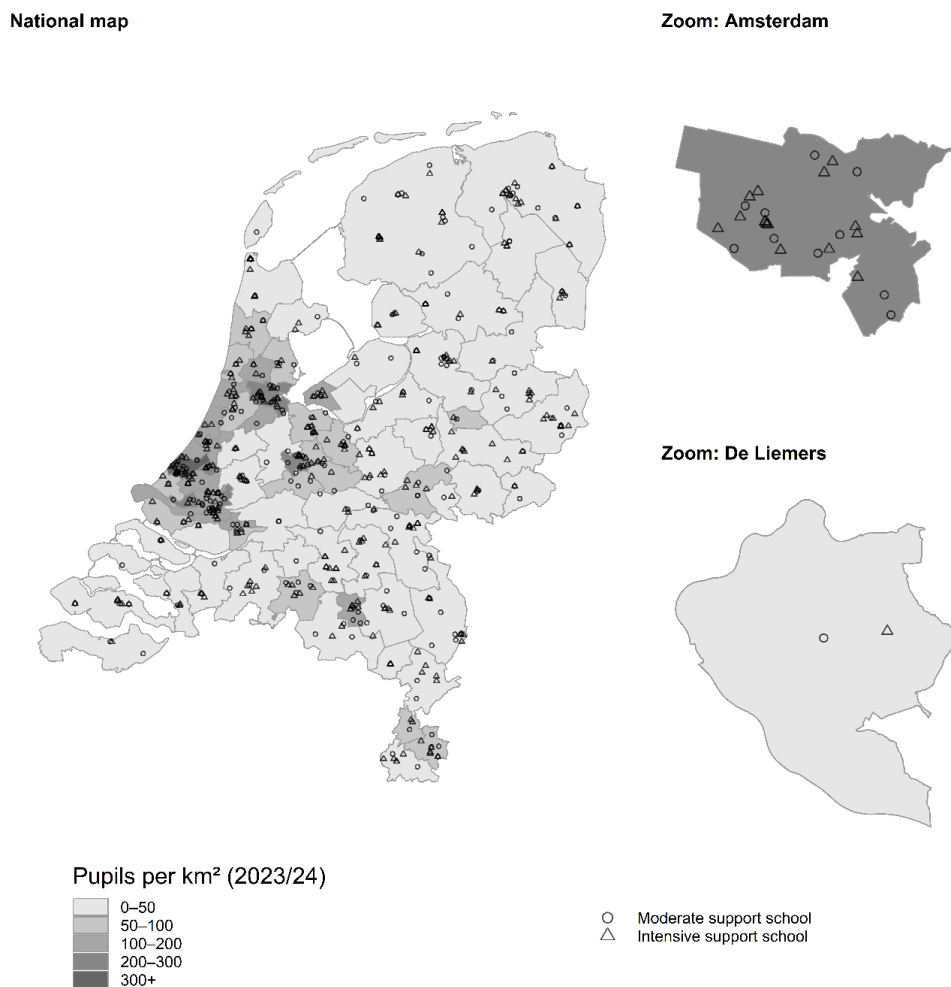


Figure 1. Spatial distribution of moderate- and intensive-support schools and student density categories across regional alliances

Note. Regional alliances are shaded by student-density categories (2023/24). The right panels show zoomed-in views of Amsterdam and De Liemers, two alliances similar in territorial extent but differing markedly in urbanicity.

Using geocoded residential and school-location data, we construct an instrumental variable based on the relative distance to the nearest moderate- and intensive-support school. The identifying assumption is that, conditional on extensive student characteristics, neighborhood characteristics, and cohort-by-region fixed effects,

relative proximity affects educational outcomes only through its influence on school placement.

The first-stage relationship is strong across specifications, with F-statistics exceeding conventional thresholds by a substantial margin. This approach identifies local average treatment effects for students whose placement decisions are influenced by geographic accessibility and for whom both support levels constitute plausible alternatives. Importantly, this is precisely the group for whom the policy trade-off between moderate and intensive support is most relevant.

Results

The results indicate that enrollment in an intensive-support school substantially reduces the likelihood of returning to regular education. The estimated effects become larger over time and peak around the transition to secondary education. For example, intensive-support placement reduces the probability of returning to regular education by approximately 26 percentage points at age thirteen and by approximately 33 percentage points at age fourteen. We find no evidence that intensive-support schools improve the probability of obtaining a secondary-school diploma or a starting qualification.

Importantly, the substantive pattern is remarkably consistent across estimation strategies and specifications. OLS and IV estimates point in the same direction across outcomes, and robustness analyses yield substantively similar conclusions. In particular, restricting the sample to students who entered regular education at age four and did not move residence between ages four and nine yields comparable results, reducing concerns that the findings are driven by residential sorting or other forms of selection related to support placement. Although precision decreases in some specifications and follow-up periods due to smaller sample sizes, the direction and interpretation of the results remain unchanged. Figure 2 summarizes the main OLS and

IV estimates across educational outcomes and follow-up periods.

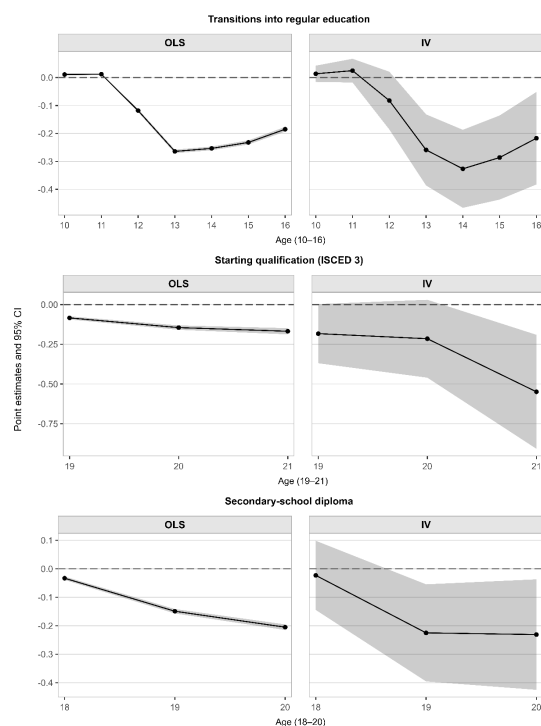


Figure 2. OLS and IV estimates of support intensity at age nine on educational outcomes

Note. Coefficients are relative to attending a moderate-support school at age nine. Points denote estimates and shaded areas indicate 95% confidence intervals based on robust standard errors. All specifications include student and neighborhood controls and cohort × urbanicity × nodal-area fixed effects.

Policy Implications

The findings challenge the assumption that more intensive and more expensive forms of educational support necessarily produce better educational outcomes. For students whose needs lie in the overlap between moderate and intensive support, additional support intensity appears to reduce transitions back to regular education without generating measurable gains in longer-term attainment.

These results have implications for the efficient allocation of educational resources and for ongoing debates about educational inclusion. More broadly, the study demonstrates how geographic variation in school access can be used to generate policy-relevant causal evidence on the effectiveness of alternative support arrangements. As education systems seek to balance equity, inclusion, and efficiency, understanding the returns to different forms of support becomes increasingly important for evidence-based policymaking.

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Between Autonomy and Redistribution: The Distributional Outcomes of Project-based Funding in Italian Schools

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Research Background

School autonomy has become a central feature of contemporary education policy and is widely promoted by international organizations (Verger et al., 2019). Empirical research suggests that, when coupled with accountability mechanisms, increased autonomy can enhance student performance (Woessmann, 2007). At the same time, however, the expansion of autonomy raises concerns about equity. By shifting responsibility to schools, it may exacerbate existing socio-economic inequalities and reinforce hierarchical differentiation (Galiani et al., 2008).

In Italy, decentralization reforms have progressively expanded school autonomy, especially in teaching, curricular, and pedagogical domains. Within this framework, schools can access additional resources through national programs or European funding schemes. These funding opportunities vary in their degree of competitiveness, depending on the design of each policy instrument. To obtain such resources, schools must submit project proposals and request a *Codice Unico di Progetto* (CUP), a unique identifier used to monitor public investments.

The CUP system places schools within a regulated quasi-market of public opportunities. Through project-based financing, schools can support a wide range of initiatives, including infrastructure improvements, expansion of educational offerings, and digital innovation. This mechanism reshapes the institutional identity of schools, positioning them not only as educational providers but also as managerial actors operating under decentralized accountability (Grimaldi and Serpieri, 2014).

Research Question

We argue that project-based funding embodies a tension between two opposing logics. On one hand, it relies on a capacity-based mechanism: schools must actively design, apply for, and implement projects, which rewards organizational skills, leadership, and procedural competence. This perspective aligns with a view of schools as managerial actors in a quasi-market environment.

On the other hand, project-based funding also carries a redistributive intent. Many programs explicitly prioritize disadvantaged schools or target specific territories, particularly Southern regions, with the aim of reducing inequalities. The coexistence of these logics suggests that different distributional outcomes may emerge depending on how policies are implemented and mediated by local contexts.

We conceptualize these outcomes as “distributional regimes,” defined along two dimensions: redistributive intensity (the extent to which funding is targeted toward lower-performing schools, *i.e.* the association between performance and funding) and concentration of resources, measured by the Gini index. This framework yields four ideal types: homogeneous autonomy, stratified autonomy, diffused compensation, and selective compensation.

This conceptualization allows us to answer to a crucial question in the Italian education policy debate: do project-based funding schemes produce stratified opportunities?

Data and Methods

This research relied on the integration of various data sources, resulting in a unique, novel dataset.

From the administrative OpenCUP dataset containing all CUPs recorded in Italy, we selected only those projects implemented between 2015 and 2024 for which the responsible entity is a school. For each school, we construct aggregate indicators capturing project-related funding trajectories, including uptake (number of projects), funding (amount of resources received), variability over time, growth, and share of active years. We then restrict the sample to pre-tracked schools. Information on school performance in the national standardized assessments is obtained through web scraping from the “Scuola in Chiaro” platform.

The final sample thus includes 4,007 Italian school institutes which may provide pre-primary, primary, and lower secondary levels depending on their specialization, followed longitudinally over at least 5 years. The total number of projects amounts to 130,186, corresponding to a volume of mobilized resources equal to approximately 4,7 billion Euros, as reported in the administrative data.

To assess inequalities in uptake and funding, we model schools’ funding trajectories as a function of macro-area, standardized test performance, and school size using regression analysis. Finally, we include interaction terms to assess whether the association between school performance and funding trajectories varies across macro-areas and regions.

Preliminary Findings

Preliminary results indicate that a one SD increase in schools’ INVALSI scores is associated with a decrease of 0.18 SD in uptake and 0.26 SD in funding. Schools located in the South and Islands exhibit higher levels of both uptake and funding compared to those in the Center, which serves as the reference category. In contrast, schools in the North display less intense funding trajectories and greater variability, as measured by the coefficient of variation, relative to both the Center and the South.

The interaction between school performance and macro-areas suggests that differences in both uptake and funding between the North and the South are larger at lower levels of performance and substantially converge at higher levels.

Overall, these findings suggest a clear redistributive gradient, with greater funding directed toward Southern regions and low-performing schools. However, this pattern is not uniform. Significant regional variation emerges: in some regions, funding allocation strongly reflects redistributive priorities, while in others it appears weakly related, or unrelated, to school performance.

Overall, project-based funding in Italy functions more as a compensatory mechanism than as a driver of school autonomy. At the same time, regions are heterogeneously distributed along the redistribution-concentration matrix: the coexistence of different regional patterns indicates heterogeneous implementation, with distributional regimes ranging from diffused compensation to forms of stratified autonomy.

The Impact of Institutional Campaigns: The Case of Flemish Summer Schools *

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Keywords: Public Finance, Summer Schools, Impact Assessment

JEL Classification: H43, H52, I24, I26, M31, M38

Public investment in education increasingly extends beyond direct instructional inputs to include outreach initiatives aimed at promoting participation in publicly funded programmes. Digital marketing campaigns, particularly those deployed through social media platforms, have become a common policy instrument in this context. Despite their growing prevalence, causal evidence on whether institutional digital campaigns effectively influence educational supply and demand remains scarce. This paper provides a rigorous evaluation of a large-scale digital advertising campaign implemented by a public authority to promote the organisation of, and participation in, free summer schools.

The policy context is a remedial education initiative launched in response to learning losses exacerbated by the COVID-19 pandemic. A substantial body of evidence documents significant learning losses during and after the pandemic, with particularly pronounced effects amongst students from disadvantaged backgrounds (Cooper et al. 1996; Meyer, Meissel, and McNaughton 2017; Alasino et al. 2024; Witte and

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François 2023), highlighting the need for effective remedial interventions. In this setting, the Flemish government introduced a subsidy scheme for summer schools offering academic and non-academic activities during the summer months, lasting between 20 half days and 10 full days, alongside a digital advertising campaign delivered primarily through Facebook Ads to increase awareness and participation (Bellens et al. 2024; Verachtert et al. 2020), which constitutes the empirical focus of this study.

From a public finance perspective, evaluating the effectiveness of such campaigns is essential. Education systems operate under increasing fiscal pressure driven by teacher shortages, post-pandemic remediation needs, and competing public spending priorities, which heightens the importance of scrutinising discretionary expenditures. Communication and marketing outlays are often modest relative to total programme costs, yet they still require careful assessment of their marginal contribution to policy objectives in comparison with alternative uses of scarce resources (Hanushek 2006). In this particular case, the Flemish government has committed up to 10 million euros for the all measures associated with the promotion of summer schools, including subsidies, which represents a significant investment in the context of public education spending. Understanding whether both this investment and the 80 thousand euros assigned to hiring a marketing campaign translate into increased supply and demand for summer schools is crucial for informing future policy decisions and ensuring efficient allocation of public funds.

This research draws on insights from the research on information and behavioural economics. Digital advertising has been shown to reduce informational frictions, increase salience, and activate behavioural responses through framing effects and social norms (Gilbert and Zivin 2014; Antoci et al. 2019), thereby potentially influencing individual decision-making. Such mechanisms could operate as low-cost instruments encouraging participation in publicly provided services (Damgaard and Nielsen 2018). At the same time, a growing empirical literature shows that large-scale digital campaigns often generate small, heterogeneous, or null average effects even in environments characterised by high exposure and substantial investment (e.g. Bond et al. 2012; Athey et al. 2023; Aggarwal et al. 2023).

The empirical analysis focuses on two primary outcomes: the number of subsidized summer schools organised; and student participation, measured as realised attendance. The impact of the campaign on these variables is identified using a combination of three sources of data. First, administrative data from the Ministry of Education covering all subsidised summer schools, including expected and effective enrolment. Second, detailed platform-level analytics on the timing, geographic targeting, and intensity of the Facebook Ads advertising campaigns. Third, federal and regional administrative sources, which provide socio-demographic controls at the municipal and school levels, including indicators of population density, income, and students' socio-economic status, which are used to support the identification strategy.

The analysis exploits staggered and continuous variation in advertising exposure across schools and municipalities measured both at the extensive and intensive margins, the latter using the number of clicks on the advertisement. In light of recent evidence on the limitations of conventional two-way fixed effects estimators in settings with heterogeneous treatment effects and variation in treatment timing (Sun and Abraham 2021; Borusyak, Jaravel, and Spiess 2024), the analysis relies primarily on heterogeneity-robust difference-in-differences estimators for non-binary treatments (Chaisemartin et al. 2025). These estimators identify average causal slopes by comparing changes amongst units experiencing variation in advertising intensity to appropriate control units, namely never-switchers and not-yet-switchers in terms of treatment exposure, under standard assumptions of no anticipation and parallel trends. Results are complemented by interaction-weighted event-study estimators and, where the data structure allows, synthetic control methods (Abadie, Diamond, and Hainmueller 2010), with inference accounting for clustering at the level of treatment assignment, in line with recent methodological guidance (Abadie et al. 2022).

Across all specifications and both outcome measures, the results show no statistically significant average effect of the digital advertising campaign on either the supply of summer schools or student participation. While the overall number of summer schools increased over time and student attendance followed a stable trajectory, these developments are not causally attributable to exposure. Event-study analyses using several estimands support the robustness of these results once covariates are taken into account, as well as other less traditional methods such as synthetic control trials.

These null results are substantively informative for both policy and research. They suggest that digital advertising, although pervasive in public policy, may have limited marginal impact. The findings are consistent with evidence from political economy, public health, and consumer markets indicating that persuasive digital campaigns often yield small average effects (Coppock, Green, and Porter 2022; Haenschen and Jennings 2019; Breza et al. 2021). More broadly, the results underscore the importance of distinguishing between awareness generation and actual behavioural change when designing and evaluating education policies, and understanding that the effectiveness of digital campaigns may be both context- and goal-dependent. From a policy perspective, the absence of detectable effects does not imply that communication strategies are unimportant, but rather that there may be more adequate approaches.

This paper contributes to literature on policy evaluation, illustrating the value of combining administrative data, platform analytics, and modern causal inference techniques to evaluate real-world public interventions in education. Additionally, it constitutes an important contribution to the literature on event-studies and the cost-effectiveness of remedial policies, thereby contributing to a clearer understanding of the role of data-driven policy instruments in supporting efficient and equitable public spending.

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School Meals and Conditional Cash Transfers in Secondary Education: Effects on Educational Achievements

Madelon Jacobs, Dieuwke Zwier, Sanne van Wetten & Carla Haelermans

Extended abstract for AQMAPPS – April 2026

Good food and nutrition are important for students' learning. To mitigate these risks, many countries have (targeted) food support programs in place, such as school meals, food stamps, or conditional cash transfers to support low-income families. The Netherlands never had such a programme, until the first School Meals Program was introduced in the spring of 2023. As part of this program, schools with a large share of students from low-income households are eligible for funding to provide meals at school or offer conditional cash transfers in the form of grocery vouchers to parents. The combination of a means-tested eligibility cut-off at the school-track level and the absence of prior food policies in the Netherlands allows us to causally analyse the effects of the policy on educational outcomes. Evidence from school meals in high income European countries with selective secondary education systems is largely absent from the literature. Hence, being able to study this in the Netherlands gives the perfect opportunity to contribute to that. We examine effects on students' academic progress by analysing grade progression, track mobility and secondary school exam results. We use a regression discontinuity design in which schools just below and just above the eligibility threshold are compared, combined with a donut-IV using eligibility as instrument. Our results indicate that the School Meals Program reduces the probability of grade repetition in secondary education. Effects on track mobility and centralised exam performance are, however, small and mostly not statistically significant. Additionally, the effects differ between students from households with different income levels. Students from middle- and high-income households tend to experience a greater effect from the program, whereas the program is targeted towards the low-income students, which is an unexpected finding.

SESSION 4

New Methods and Insights from Data

16 September, 09.00–10.35

Beyond the 10% Threshold: A Latent Profile Analysis of Attendance Heterogeneity and Behavioral Mechanisms

Andrea Vargová

Dynamic Selection Difference-in-Differences (DS-DiD): Identification and Estimation under Time-Varying Selection Bias

Damiano Baldaccini

A Quasi-Experimental Evaluation of a Reflective Cybersecurity Laboratory in Italian Public Administration

Beatrice Cotini

The Effects of Cochlear Implant on Labour Market Outcomes: Quasi-Experimental Evidence from Administrative Data

Sofía Villalobos-Aliste

Beyond the 10% Threshold: A Latent Profile Analysis of Attendance Heterogeneity and Behavioral Mechanisms

Andrea Vargová

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To effectively address absenteeism, schools require diagnostic insights that transcend simple cumulative metrics. While international research and administrative frameworks often utilize a 10% absence threshold as a primary indicator of risk, this study demonstrates how such a "one-size-fits-all" approach oversimplifies a deeply heterogeneous phenomenon. Utilizing a robust administrative dataset, we employ Latent Profile Analysis (LPA) to identify five distinct attendance typologies. Our model incorporates a multidimensional set of behavioral facets—including intensity, fragmentation, absence type, and persistence—to define these latent clusters.

To interpret the nature of these profiles, we utilize the COM-B framework (Capability, Opportunity, Motivation) as an analytical lens. We demonstrate how administrative data provide "behavioral fingerprints" where specific patterns of detachment correspond to varying configurations of student barriers. While traditionally applied to qualitative behavioral research, we demonstrate the framework's potential for translating quantitative administrative data into actionable diagnostics. This approach allows us to hypothesize whether a specific attendance pattern stems from a lack of individual skills or health (Capability), external social or environmental barriers (Opportunity), or a deficit in conscious or habitual drive (Motivation).

The utility of this approach is validated by linking latent profiles to academic outcomes in a targeted cohort of Grades 7 and 8. Our results reveal a complex, non-linear relationship between attendance and achievement, evidenced by academic resilience in certain high-absence groups, contrasted with persistent academic vulnerability among socially disadvantaged students. Our findings suggest that the internal dynamics of absenteeism offer a more reliable basis for risk identification than singular thresholds.

We conclude that these latent profiles could inform the development of more precise, data-informed identification strategies that better align interventions with specific behavioral patterns and academic needs.

Keywords: heterogeneity; absenteeism; latent profile analysis (LPA); attendance trajectories, COM-B

Dynamic Selection Difference-in-Differences (DS-DiD): Identification and Estimation under Time-Varying Selection Bias

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This paper develops Dynamic Selection Difference-in-Differences (DS-DiD), a generalisation of the standard Difference-in-Differences (DiD) framework that allows the selection bias, the gap in untreated potential outcomes between treated and control units, to evolve over time according to a stable stochastic process, rather than requiring it to be constant as under the parallel trends (PT) assumption. The key identifying condition, Conditional Stationarity, requires the transition kernel governing the selection bias process to be time-invariant, so that its post-treatment conditional mean can be forecast from pre-treatment data. Standard DiD is recovered as a degenerate special case with a constant selection bias process and zero innovation variance, so DS-DiD strictly nests rather than replaces the classical design.

The framework applies to both panel data and repeated cross-sections. Under no anticipation and conditional stationarity, the Average Treatment Effect on the Treated (ATT) is identified by forecasting the post-treatment selection bias from its pre-treatment history and subtracting this forecast from the observed cross-sectional gap; an analogous covariate-specific stationarity condition, together with overlap, identifies the Conditional ATT. We derive a three-term decomposition of the estimation error into cross-sectional sampling error, irreducible k -step forecast risk, and model estimation error. Forecast risk grows monotonically with the post-treatment horizon k , implying that confidence intervals should widen with the horizon, in contrast to standard two-way fixed-effects (TWFE) event-study designs, which report flat confidence intervals and conceal this horizon-dependent uncertainty.

A Monte Carlo study compares TWFE with a forecasting-based implementation of DS-DiD using Causal ARIMA across three data-generating processes for the selection bias: parallel trends, an autoregressive process, and an autoregressive process with deterministic seasonality. Under parallel trends both estimators perform well; once the selection bias is autocorrelated, TWFE understates sampling uncertainty and empirical coverage collapses; adding seasonality further induces a growing bias in TWFE, while DS-DiD remains nearly unbiased with approximately nominal coverage.

We illustrate the framework with an application to the 2011 Danish Fat Tax using a monthly Danish–Northern-German household scanner panel on butter consumption over 2009–2012. The pre-treatment selection bias exhibits strong seasonality driven by the moveable Easter feast. The DS-DiD specification passes an out-of-sample placebo test on expenditure and identifies a positive pass-through to butter expenditure of approximately 86 euro cents per 30-day household month, with no statistically detectable effect on physical consumption; the resulting confidence intervals widen with the forecast horizon at the rate predicted by the irreducible k -step forecast variance, a feature suppressed by construction in conventional event-study designs.

The paper's contributions are twofold: it recasts DiD as a problem of modelling the dynamics of selection bias, showing that parallel trends is one restrictive special case within a broader family of stationarity conditions; and it proposes DS-DiD as a flexible extension that exploits long pre-treatment histories to identify and estimate treatment effects when the underlying gap is dynamic but predictable,

supported by formal results on unbiasedness, pointwise consistency, and uniform convergence.

A Quasi-Experimental Evaluation of a Reflective Cybersecurity Laboratory in Italian Public Administration: from Compliance to Security-Related Organisational Citizenship Behaviour

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EXTENDED ABSTRACT

Public administrations increasingly rely on digital infrastructures to manage sensitive information, deliver public services, and coordinate data-intensive administrative processes (Budai et al., 2023). In this context, cybersecurity is not only a technical challenge but also an organisational and behavioural policy problem, where employees' safety digital competences can play a major role in contrasting these threats (Lopes et al., 2023). Research on information security shows that employees' everyday practices can create or mitigate information security risks, while evidence from public sector organisations indicates that many incidents are related to human error and organisational conditions rather than purely technical failures (Parsons et al., 2014; Evans et al., 2019). This issue is particularly relevant for public administration because citizens' willingness to disclose personal data depends partly on their trust that public organisations can protect and use such data appropriately (Beldad et al., 2011, 2012).

In response, public organisations increasingly invest in cybersecurity awareness and training initiatives. However, evidence on the effectiveness of such interventions remains mixed. The Human Aspects of Information Security Questionnaire (HAIS-Q) literature conceptualises information security awareness through a Knowledge-Attitude-Behaviour logic, distinguishing employees' knowledge of security policies, attitudes toward those policies, and security-related behaviour in workplace technology use (Parsons et al., 2014). Yet this literature also shows that knowledge does not automatically translate into secure conduct, and that knowledge, attitudes, awareness, and protection behaviour remain analytically and empirically distinct constructs (Parsons et al., 2014; Zwilling et al., 2022). Training studies similarly suggest that cybersecurity interventions may improve knowledge while producing more heterogeneous effects on attitudes and behaviour (Alkhazi et al., 2022). More reflective and participatory approaches, based on dialogue, active engagement, and situated learning, appear more promising for influencing security behaviour than one-way information transfer (Puhakainen & Siponen, 2010; Albrechtsen & Hovden, 2010; Workman et al., 2022).

This paper presents an ongoing quasi-experimental evaluation of a reflective cybersecurity laboratory implemented in a large Italian central public administration. The organisation represents a relevant setting for this study because its institutional mission is closely connected to the production, management, analysis, and dissemination of data. The laboratory is designed as a behavioural and organisational learning intervention rather than as a conventional awareness campaign. It engages employees in collective reflection on human error, digital risks, data protection, information management, password use, phishing, incident reporting, secure use of organisational devices, and artificial intelligence-related risks. This design builds on evidence that information security training should activate systematic processing of security arguments and be adapted to organisational tasks and learner contexts (Puhakainen & Siponen, 2010), and on research showing that dialogue and collective reflection can improve information security awareness and behaviour (Albrechtsen & Hovden, 2010).

The paper contributes to public policy evaluation by applying a quasi-experimental design to a real-world public sector cybersecurity intervention. The study adopts a pre-post panel design with a non-equivalent comparison group. This design is appropriate because random assignment to participation is not feasible in the organisational setting, while the intervention remains clearly defined, manipulable, and temporally prior to the outcomes. Following the logic of quasi-experimental causal inference, the empirical challenge is to approximate the counterfactual trajectory of treated employees, that is, what would have happened to them in the absence of the laboratory (Shadish et al., 2002). Pre-post designs with non-equivalent comparison groups are commonly used when both treated and comparison units can be observed before and after an intervention,

although their credibility depends on the construction of a plausible comparison group and on the assessment of threats to internal validity (Marsden & Torgerson, 2012; Miller et al., 2020).

The intervention is implemented through multiple cohorts during 2026. Four laboratory sessions are planned, each involving approximately 25 employees, for an expected treated sample of around 100 participants. Treated employees are surveyed before participation and approximately three months after the laboratory. A comparison group of non-participating employees is constructed with the support of the organisation and observed over the same pre-post windows as the treated cohorts. Comparison employees are selected to resemble treated employees on pre-treatment characteristics, including socio-demographic variables, organisational role, tenure, prior cybersecurity training, and baseline levels of theoretically relevant constructs. Aligning treated and comparison observations within the same temporal windows is intended to reduce the risk that period-specific organisational events or external cybersecurity initiatives are incorrectly attributed to the intervention.

The main empirical estimand is the differential change in outcomes between treated and comparison employees. The primary analysis will estimate treatment effects using a difference-in-differences framework applied to the two-wave panel structure of the data. The preferred specification will exploit individual fixed effects, thereby absorbing all time-invariant individual characteristics, observed or unobserved, that may influence both participation and outcomes. Cohort or session fixed effects will be included to account for the staggered implementation of the laboratory across different periods. As a robustness check, ANCOVA-type models will estimate post-treatment outcomes while controlling for baseline outcome levels, an approach commonly used in training and intervention evaluation when pre-test scores are available (Workman et al., 2022). Baseline equivalence, differential attrition, and robustness to alternative operationalisations of the main constructs will also be assessed.

The study evaluates whether participation in the laboratory is associated with changes in four related domains. First, it measures digital safety competence, drawing on the DigComp framework, which conceptualises digital competence as a combination of knowledge, skills, and attitudes required to use digital technologies confidently, critically, and responsibly (Vuorikari et al., 2022a; Cosgrove & Cachia, 2025). In line with the European Digital Skills Indicator, skills are operationalised through enacted digital practices rather than self-assessed ability (Vuorikari et al., 2022b). Second, the study measures organisational information security awareness by adapting the HAIS-Q Knowledge-Attitude-Behaviour logic to the policy domains actually addressed in the laboratory (Parsons et al., 2014). Third, it measures reflective security risk-management orientation, adapting Tangsgaard's framework of risk management in public service delivery to the individual level, in order to capture employees' tendency to anticipate risks, discuss uncertain situations, and learn from previous incidents (Tangsgaard, 2022). Fourth, the study measures security-related organisational citizenship behaviour, building on Aebissa et al.'s scale of discretionary security-supportive behaviours, such as *altruism*, including helping colleagues, *civic virtue* as participating in security initiatives, and *voicing*, including proposing improvements to security procedures (Aebissa et al., 2023).

Data collection is ongoing. At the time of submission, the laboratory is being implemented across cohorts and the pre-post survey design is being deployed. The full paper will therefore present an intervention evaluation in progress, focusing on the design, measurement strategy, causal identification logic, and expected empirical tests. By combining behavioural information security research with quasi-experimental policy evaluation methods, the paper contributes to evidence-based public management and digital governance. More specifically, it examines whether cybersecurity training can be evaluated not only as an instrument for improving compliance with organisational rules, but also as a behavioural intervention capable of fostering digital safety competence, reflective risk management, and more proactive forms of civic and participatory behaviour among public employees.

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The Effects of Cochlear Implant on the Labour Market Outcomes: Quasi-Experimental Evidence from Administrative Data

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Introduction

Cochlear implants represent a costly intervention that is largely financed by public healthcare systems. While the clinical literature has extensively documented that cochlear implantation produces substantial improvements in speech perception and quality of life, the question of whether these functional gains translate into improved socioeconomic outcomes remains.

Causal evidence on the labour market effects of cochlear implantation is absent from the literature, partly due to the limited availability of longitudinal data and the difficulty of identifying causal effects, as cochlear implantation is not randomly assigned and is potentially endogenous to unobserved characteristics related to labour market performance.

This study addresses this gap by estimating the causal effect of cochlear implantation on labour market outcomes using population-wide administrative data and a staggered treatment adoption design.

Empirical Strategy

The study exploits administrative data from Statistics Netherlands, combining healthcare reimbursement records from Specialised Medical Care (SMC) with labour market data. The Netherlands constitutes a suitable setting: cochlear implantation is publicly funded, and eligibility is determined primarily by audiological criteria, meaning that financial barriers to treatment are substantially reduced and treatment assignment is primarily determined by clinical eligibility.

CI recipients are identified using procedure-specific SMC codes that capture pre-care, surgical implantation, and follow-up. SMC records indicate that cochlear implantation occurred at different times among individuals between 2013 and 2023, producing a staggered pattern of treatment adoption. The comparison group consists of individuals appearing in Sensory Disability Care records but without CI procedure records. The analysis focuses on working-age individuals aged 15-46 at baseline (1999), ensuring consistent observation of labour market outcomes throughout the observation period (1999-2023). The final sample includes 1,097 individuals in the CI group and 1,177 in the non-CI group.

Four labour market outcomes are observed annually using the November observation of each year: employment status (a binary indicator of any employment relationship) and employment as the dominant source of income (a binary indicator equal to one when

employment constitutes the individual's primary source of income) available for the period 1999-2023. Basic contracted monthly hours and basic monthly salary are available for the period 2010-2023.

Because individuals receive cochlear implants in different calendar years, the empirical setting involves staggered treatment adoption. Standard two-way fixed effects estimators are known to produce biased estimates under treatment effect heterogeneity across cohorts. To address this, the study applies the Callaway and Sant'Anna (2021) staggered difference-in-differences estimator, which constructs group-time average treatment effects by comparing each treatment cohort with either never-treated or not-yet-treated individuals.

Results

Cochlear implantation is associated with a statistically significant increase in employment probability of 3.8 percentage points, with pre-treatment estimates supporting the parallel trends assumption. Employment effects emerge gradually over the first seven years following implantation, suggesting an adaptation process as individuals integrate the implant into working life. Effects are strongest among individuals in the intermediate age tercile and negligible among the oldest.

Findings for employment as the dominant source of income are similar, showing increases of 3.1 pp in the full sample and larger effects among intermediate-age individuals. Effects accumulate over time until around seven years post-implantation. Analyses excluding early post-treatment years suggest effects strengthen with longer exposure to the implant, although estimates become less precise at longer post-treatment periods.

Estimated effects on monthly working hours are positive but generally imprecise, except among the second age tercile (10.6 additional hours per month). In contrast, monthly salary increases are statistically significant for the full sample (€138.6 per month) and for the first and second age terciles (€218.1-€285.6 per month). Together, these findings suggest that earnings gains are driven less by increased labour supply and more by improvements within employment, such as occupational upgrading or access to higher-paid jobs facilitated by reduced communication barriers.

Conclusion

This study provides the first causal evidence on the labour market effects of cochlear implantation, drawing on large-scale administrative data and a quasi-experimental design robust to staggered treatment adoption. The results indicate that cochlear implantation improves labour market outcomes persistently. Employment gains accumulate gradually post-implantation, consistent with a process of labour market adaptation rather than immediate structural change. The salary results further suggest that implantation may facilitate better utilisation of existing human capital within employment, rather than simply increasing labour supply at the margin.

SESSION 5

Market Failures

16 September, 10.50–12.30

The Role of Gender and Socioeconomic Status in Financial Literacy

Iván Vicente

Potential Equity Market Development and Efficiency Gaps: A Four-Component Frontier Analysis

Gabriela Riveros

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Valeria Urbano

The role of gender and socioeconomic status in financial literacy

Kristof De Witte¹ & Iván Vicente²

Financial literacy has increasingly been recognized, particularly in recent years, as a fundamental competence, gaining prominence not only in the field of economics of education but also among policy makers and the general public. Using data from PISA 2022, the most recent wave available, this paper examines the relationship between financial literacy, gender, and its interaction with socioeconomic status (SES). Our findings indicate a non-linear relationship between SES and financial literacy, characterized by increasing marginal returns. This means that the marginal effect of SES on financial literacy grows as SES rises, contributing to inequality both in the short and long term. Furthermore, although females tend to exhibit lower financial performance than males on average, this pattern does not hold among low-SES students. The interaction between gender and SES reveals that the gender gap is primarily driven by students from medium- or high-SES backgrounds, whereas in disadvantaged contexts, males do not outperform females, highlighting the greater resilience of females in challenging environments. Therefore, to improve overall financial literacy performance, more attention should be directed toward low-SES students, while efforts to address the gender gap should focus on medium to higher SES levels, where gender norms may play a crucial role.

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Potential Equity Market Development and Efficiency Gaps: A Four-Component Frontier Analysis

This paper examines the determinants of equity market development across countries by employing a four-component stochastic frontier model that decomposes inefficiency into persistent and transient components. The stochastic frontier framework enables the estimation of each country's potential level of market development conditional on its economic, institutional, and financial fundamentals, while distinguishing long-run structural inefficiencies from short-term deviations arising from macroeconomic fluctuations and shocks. This approach provides a structural measure of technical efficiency, capturing the extent to which countries operate below their attainable potential. The empirical analysis incorporates a set of financial, macroeconomic, institutional, and societal covariates to characterize both the frontier and the drivers of inefficiency. By shifting the focus from frontier shifters to inefficiency determinants, the model facilitates a direct assessment of the factors influencing efficiency outcomes. Persistent inefficiency is associated with slow-moving structural and institutional characteristics, including legal origin, governance quality, and market design, which represent enduring constraints on capital market development. Transient inefficiency, in contrast, reflects short-run macroeconomic conditions, such as inflation volatility, financial crises, and policy shocks, capturing cyclical deviations from the frontier. Overall, this framework provides a unified methodology for disentangling structural and cyclical barriers to equity market development and enables a evaluation of how institutional and macroeconomic factors jointly shape countries' efficiency gaps.

Property Rights, Land Allocation, and Exports: Evidence from the Brazilian Amazon

Niveditha Prabakaran
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WORKING PAPER
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Abstract

This paper theoretically and empirically analyzes the effect of property rights establishment on exports. Using a dynamic model of land allocation, I show that property rights lead to more forest land and fewer wood exports in the long run, though deforestation can increase during the transition. Empirically, I find that wood exports from the Brazilian Amazon intensify for approximately two years following land registrations under the government's Terra Legal titling program, peaking in the third quarter after rollout before declining. The evidence suggests that medium-sized farms, which obtain titles at low cost, clear forest land for livestock production. To estimate these effects, I use confidential municipal-level export data and exploit the program's phased rollout across municipalities for identification, controlling for municipal-product and quarter-year trends.

JEL Classifications: R11, F18, O13

Keywords: Property Rights, Trade, Deforestation, Land Conversion

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The Impact of Low-Emission Zones on Student Performance: Evidence from Milan's Area C

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April 30, 2026

Abstract

Air pollution represents one of the most relevant environmental challenges in urban areas. A large body of evidence identifies vehicular traffic as one of the primary sources of air pollution in cities (Davis, 2008; Gallego et al., 2013), with detrimental effects on human health, cognitive functioning, and economic productivity (Chay and Greenstone, 2003; Zivin and Neidell, 2012; Chang et al., 2019). To address these challenges, several European cities have introduced low emission zones (LEZs). A growing empirical literature shows that LEZs are effective in reducing traffic-related air pollution, generating significant environmental and health benefits (Pestel and Wozny, 2021; Margaryan, 2021; Lehe, 2019; Beria, 2016; Gibson and Carnovale, 2015). However, recent evidence on life satisfaction outcomes shows that LEZs led to a significant decline in self-reported well-being among individuals residing within the restricted areas, suggesting that the overall welfare effects of such policies may extend beyond improvements in environmental quality (Sarmiento et al., 2023). Given the wide spectrum of potential benefits and costs, it is crucial to explore the broader externalities associated with LEZs.

To this end, an emerging body of research has focused on the effects of these policies on children, highlighting their implications for health and the indirect consequences for academic achievement. Empirical studies demonstrated that air pollution has detrimental effects on children's health and development (Stafford, 2015; Klauber et al., 2024; Park et al., 2002; Mölter et al., 2014; Khreis et al., 2017; Orellano et al., 2017; Anenberg et al., 2022). Compared to adults, children are particularly susceptible to environmental hazards, as their respiratory and immune

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systems are still developing (Etzel, 2020). At the same time, ongoing urbanization has increased the number of children exposed to traffic-related pollution, as a growing share of young cohorts live and attend school in densely populated urban centers (Bishop and Corkery, 2017) where vehicular traffic is a major source of air pollution (Raysoni et al., 2011; Bennett et al., 2019; Kumar et al., 2017). The exposure of children to air pollutants may have effect on working memory and processing speed (Alvarez-Pedrerol et al., 2017), as well as on attention (Sunyer et al., 2017) and general cognitive development (Milojevic et al., 2021). Recent research has, therefore, begun to explore not only the direct health consequences of LEZs for children health (Simeonova et al., 2021), but also their broader effects on educational achievement Conte Keivabu and Rüttenauer (2022); Avila-Uribe et al. (2024); Brehm et al. (2025); Valdés et al. (2025).

This paper examines the educational effects of Milan's Area C congestion charge using individual-level student data spanning academic years 2009/10 to 2018/19 from INVALSI. Introduced on January 16, 2012, Area C is a congestion policy implemented in Milan's city center. The policy generated a sharp and well-documented reduction in traffic and air pollution (Lehe, 2019; Beria, 2016; Gibson and Carnovale, 2015; Percoco, 2013, 2014), exposing schools located within the charging zone to an abrupt improvement in their local environment.

The contribution of this study to the literature on the educational achievement of LEZs is threefold. First, by examining the case of Milan's Area C, it extends the existing evidence to a new institutional and geographical context. Second, this study provides the first individual level analysis of the impact of a LEZ on academic achievement at the primary school level. Third, the paper provides a systematic comparison of effects across two grades within primary school (Grade 2 and Grade 5) and across two subjects (Mathematics and Italian).

Our main finding is that the introduction of Area C generated meaningful improvements in early academic achievement, with effects concentrated among second-grade students. Exposure to the congestion policy leads to a statistically significant increase of 0.256 s.d in Mathematics scores and 0.116 s.d in Italian scores for Grade 2 students. By contrast, no statistically significant effects emerge for fifth-grade students in either subject, a pattern consistent with the view that younger children's cognitive development is more malleable and hence more sensitive to reductions in environmental pollution.

Moreover, the heterogeneity analysis reveals that the gains from Area C are not uniform across students, pointing to an equity-enhancing dimension of congestion pricing that has received limited attention in the existing literature: beyond reducing traffic and improving air quality, such policies may generate meaningful redistributive effects on children's human capital formation, narrowing early inequalities that closely mirror the socioeconomic structure of the city.

These results carry important implications for the design and evaluation of urban

environmental policies. First, they suggest that the benefits of congestion policies extend beyond the direct reduction of traffic and pollution emphasized in prior work on Milan (Boniardi et al., 2025), pointing to broader societal effects. Second, the concentration of effects among younger children implies that the timing of environmental interventions matters for their educational impact. Policies that improve air quality during the early years of primary school, when cognitive development is most malleable, are likely to yield larger and more persistent gains than interventions targeting older students. Third, the equity-enhancing nature of the effects documented here provides an additional argument for congestion policies in cities characterized by pronounced socioeconomic segregation.

KEYWORDS: Low-emission zones; congestion policy; air pollution; student achievement; educational inequality; difference-in-differences.

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SESSION 6

Teaching, Pedagogy, and Schools

16 September, 10.50–12.30

Return Migration and the Wage Premium of Foreign Study: Evidence from a High-Emigration Setting

Ondrej Škvarenina

Does Alcohol Prohibition Work? Evidence from India

Yash Shekhar

Drivers of Compliance Intentions and Actual Tax Behaviour: Consistent and Inconsistent Taxpayers

Natalia Levenko

Return Migration and the Wage Premium of Foreign Study: Evidence from a High-Emigration Setting

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Slovakia has one of the highest outbound tertiary mobility rates in the OECD: about one in five students pursues a university degree abroad — the second-highest share among OECD members and a figure that has risen steadily since 2010. The determinants of leaving have been studied extensively, but two questions central to brain-drain policy remain open: what share of foreign-educated graduates eventually return home, and what they earn upon return relative to graduates of domestic universities. The first is hard to answer because students who remain abroad rarely appear in home-country administrative records, so researchers cannot separate permanent emigration from temporary non-observation. The second is understudied because few datasets link individual foreign-study histories to later domestic earnings, with existing evidence coming overwhelmingly from low-emigration Northern and Western European countries.

We address both gaps using a comprehensive linkage of Slovak administrative data covering four full cohorts of secondary-school leavers from 2012 to 2015, followed for up to ten years through 2022. The linked data combine school records and standardised school-leaving examination scores, individual employment and earnings histories with matched parental income, residence and educational attainment from the population register, unemployment-register spells, and individual health-insurance enrolment, which we use as a proxy for de facto residence. Those enrolled with a domestic insurer in a given year are almost certainly in the country, while those whose enrolment lapses have, with high probability, remained abroad.

Our empirical strategy proceeds in two stages. For return rates, we estimate logit, OLS, and LASSO models on the population of foreign-educated graduates (approximately 12,800 individuals across the four cohorts, whether they returned or remained abroad), relating residence in 2022 to examination performance, parental income and education, school type, and cohort. For the wage premium, we estimate Poisson pseudo-maximum-likelihood (PPML) regressions following Santos Silva and Tenreiro (2006) on a matched sample of 9,164 graduates — 2,532 foreign-educated returnees and 6,632 domestic-university graduates who attended the same secondary schools and are employed at the same firms. This matched specification provides a more conservative comparison by holding secondary school and employer fixed, though residual within-cell selection on unobservables may still remain. We complement PPML with doubly-robust and median (LAD) regressions.

Three findings stand out. First, only 37–43 % of graduates of foreign universities return within seven to ten years of finishing secondary school — well below the 54–84 % range typical of low-emigration European countries. Return rates rise to 73–82 % among those who studied partly abroad and partly at home, suggesting that maintained domestic ties strongly predict return. Second, academically stronger graduates return at notably lower rates than weaker ones: graduates with below-median language-examination scores return at 47–58 %, while top-decile graduates return at only 33–38 %, controlling for parental income, school, gender, and cohort. Third, return rates vary sharply across regions of origin, from above 50 % to below 35 % — implying that brain drain compounds existing regional inequalities.

Returnees earn a wage premium of 1–5 % relative to domestic-university graduates five years after finishing secondary school, rising to approximately 9 % after ten years, after controlling for examination scores, parental income, school, employer characteristics, and tenure. The premium survives in the matched school–employer specification — comparing co-workers from the same secondary school employed at the same firm — and doubly-robust and median-regression estimates yield comparable magnitudes. While residual selection on unobservables cannot be ruled out, the persistence of the wage premium under increasingly stringent comparisons is consistent with foreign study contributing to higher earnings rather than reflecting only pre-existing differences.

The paper makes three contributions. First, it demonstrates how population-level return rates can be measured credibly through multi-register administrative linkage, resolving the core observability problem in brain-drain research. Second, it provides estimates of the wage premium of foreign study from a high-emigration Central European setting, complementing a literature dominated by low-emigration contexts. Third, it documents that the most academically successful students return at the lowest rates, with implications for the design of return-incentive and scholarship policies.

Does Alcohol Prohibition Work? Evidence from India

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Abstract

Against the backdrop of an electoral victory made possible by the promise to women voters to ban alcohol if reelected, the Bihar Chief Minister moved to enforce prohibition. The Bihar Excise (Amendment) Act was passed in November 2015 and complete prohibition came into force from April 2016. Prior to the ban, alcohol excise revenue accounted for more than 15 per cent of the state's own tax revenue—a source the government lost overnight. Alcohol was linked to high rates of domestic violence, which drove the women-led demand for prohibition. Across all countries and states in recent history, this is the largest such ban by number of people impacted.

Did prohibition reallocate household budgets towards productive uses like education, health, and food—and by how much? We answer this welfare question using the Synthetic Difference-in-Differences (SynthDiD) methodology on household-level panel data from the CMIE Consumer Pyramids Monthly Expenditure survey spanning January 2014 to December 2017. This is the first household-level Synthetic DiD analysis of Indian state-level prohibition.

JEL Codes: C23 D12 H20 I18 I31

Keywords: Bihar, alcohol prohibition, synthetic difference-in-differences, household expenditure, consumption reallocation, panel data

1 Motivation and Policy Context

The policy: Bihar's population (13 crore plus) makes up roughly 9 per cent of India's total. The state has the lowest per capita income in the country, ranks in the bottom three for literacy, records the highest TFR of 3.0, and has the second-lowest urbanisation rate at just 11.3 per cent.

Why this matters beyond Bihar: Countries such as South Africa, Thailand, Botswana, Panama, and Sri Lanka banned alcohol for brief periods during COVID-19 to manage public behaviour and reduce pressure on emergency services. Within India, a similar women-led alcohol ban in Andhra Pradesh lasted around two years before policy reversal in 1997 ([Schess et al., 2018](#)).

2 Data

Source: Our primary data source is the Consumer Pyramids Household Survey—Monthly Expenses, conducted by the Centre for Monitoring Indian Economy (CMIE) Pvt. Ltd.

Sample construction: The survey spans January 2014 to December 2017 (48 months). The raw panel contains approximately 76.3 lakh household-month observations across 25 states. We exclude Gujarat, which has maintained prohibition since 1960 and would contaminate the control group as an always-treated unit.

The SynthDiD estimator of [Arkhangelsky et al. \(2021\)](#) requires a complete $N \times T$ matrix with no missing cells. Imposing this balanced-panel requirement yields 23,097 households across all 48 periods, totalling 11,08,656 household-month observations. Of these, 21,083 households belong to 24 control states and 2,014 to Bihar (the treated unit), with 22 pre-treatment periods (January 2014–October 2015) and 26 post-treatment periods (November 2015–December 2017).

Outcome variables: Seven outcomes grouped as: (i) Direct prohibition targets (2)—liquor and total intoxicants expenditure; (ii) Substitution check (1)—tobacco expenditure; (iii) Welfare reallocation (4)—food expenditure, education share, health enhancement share, and entertainment share. Shares are computed as a percentage of total expenditure.

3 Empirical Strategy

Why not standard DiD? Standard DiD requires the parallel trends assumption to hold in the pre-treatment period. We conducted joint Wald F-tests—first with three neighbouring states sharing a border with Bihar and then with all remaining states (excluding Bihar and Gujarat). The null hypothesis is:

$$H_0 : \beta_{-24} = \beta_{-23} = \dots = \beta_{-7} = 0 \quad (1)$$

High F-statistics with individually significant pre-treatment coefficients and significant linear pre-trends rendered the standard DiD analysis not credible for this study ([Baker et al., 2025](#); [Goodman-Bacon, 2021](#)).

Intuition of SynthDiD: SynthDiD employs a “double reweighting” approach: (i) *Unit weights*: re-weight control households so that their weighted average tracks Bihar’s pre-treatment trajectory, akin to Synthetic Control ([Abadie et al., 2010](#)); and (ii) *Time weights*: upweight those pre-treatment periods most informative about the counterfactual—specifically the months just before prohibition ([Arkhangelsky et al., 2021](#)).

Inference: We use a household-level cluster bootstrap with 200 replications. Each replicate resamples households with replacement and retains all 48 monthly observations per household, preserving within-household serial correlation. Confidence intervals are chosen adaptively—normal-based if the bootstrap distribution passes Shapiro–Wilk ([Shapiro and Wilk, 1965](#)), Kolmogorov–Smirnov ([Massey, 1951](#)), and Anderson–Darling ([Anderson and Darling, 1954](#)) tests; percentile-based otherwise. November 2015 is the treatment date.

The SynthDiD estimator ([Arkhangelsky et al., 2021](#)) solves:

$$\hat{\tau}^{\text{sdid}} = \frac{1}{N_{\text{tr}}} \sum_{i \in \mathcal{T}} \sum_{t \geq T_0} \left(Y_{it} - \hat{Y}_{it}^{\text{synth}} \right) \quad (2)$$

where $N_{\text{tr}} = 2,014$ is the number of treated (Bihar) households, $T_0 = 22$ denotes the last pre-treatment period (October 2015), and $\hat{Y}_{it}^{\text{synth}}$ is the counterfactual constructed from optimised unit weights $[\hat{\omega}_j]$ over control households and time weights $[\hat{\lambda}_t]$ over pre-treatment periods.

4 Preliminary Results

Liquor expenditure fell significantly after the ban, as expected.

Welfare reallocation: Education share, health enhancement share, and food share estimates are positive and significant—the most policy-relevant finding.

Substitution effect: Both tobacco and total intoxicants expenditure fell post-ban, consistent with the welfare reallocation story: households appear to have redirected spending towards productive categories rather than substituting one vice for another.

5 Contribution and Next Steps

Empirical: First household-level SynthDiD analysis of Indian state-level prohibition. The only other Indian SynthDiD study operates at the district level (Kishore et al., 2026).

Substantive: Evidence on intra-household budget reallocation following an alcohol ban—directly relevant to the welfare economics of prohibition. With around 2,000 treated units and 21,000 donor units, our panel is substantially larger than any existing SynthDiD application. The Arkhangelsky et al. (2021) asymptotics require $N_{co} \rightarrow \infty$ and $N_{tr}T_{post} \rightarrow \infty$; we satisfy both comfortably.

Next steps: The full paper extends these results to 16 outcome variables covering both absolute expenditure changes and expenditure shares. We plan to add placebo tests using pre-treatment periods and heterogeneity analysis by income quintiles and rural/urban status.

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Drivers of compliance intentions and actual tax behaviour: Consistent and inconsistent taxpayers

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Extended abstract

This paper examines the behavioural drivers of tax compliance using six waves of survey data on Estonian residents collected between 2018 and 2023. It applies the theory of planned behaviour (TPB) to analyse how attitudes, social norms, and perceived control shape compliance intentions and how these intentions translate into actual behaviour. By jointly modelling intentions and realised compliance within a structural equation framework, the paper provides a policy-relevant account of how taxpayers make decisions in practice.

The starting point is a well-known limitation of standard deterrence-based models of tax evasion. While these models focus on audits and penalties, they struggle to explain why compliance is relatively high even when enforcement is weak. This paper addresses this gap by adopting a behavioural framework in which compliance depends not only on external incentives but also on internal motivations and social context.

The empirical analysis is based on a large, repeated cross-section survey covering approximately 7,600 individuals. The data include detailed information on perceptions of the tax system, trust in institutions, moral beliefs, and behavioural intentions. These are mapped into latent constructs corresponding to the TPB components and estimated using structural equation modelling. This approach allows the paper to identify both direct and indirect effects, including a mediation channel through which norms transmit the influence of attitudes on compliance intentions.

The results show that compliance intentions are the key predictor of actual behaviour, with a strong and stable relationship across all specifications. More importantly, intentions are driven primarily by social norms and tax morale, while deterrence-related factors play a secondary role. This finding is robust across alternative measures of compliance and model specifications and points to the central importance of intrinsic motivation and perceived social expectations in shaping tax behaviour.

Attitudes towards the tax system, including perceptions of fairness, public services, and trust in government, matter mainly indirectly. Their direct effect on compliance intentions is weak, but they exert a meaningful influence through norms and tax morale. In practical terms, this means that institutional quality affects behaviour not by directly changing incentives, but by shaping what individuals perceive as socially expected and morally appropriate.

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A central contribution of the paper is the identification of substantial heterogeneity across taxpayers. The analysis introduces a novel distinction between consistent and inconsistent taxpayers, based on whether their reported intentions align with their behaviour. This distinction reveals two markedly different behavioural regimes.

For consistent taxpayers, compliance is largely driven by internalised motivations. Tax morale and social norms are strong predictors of intentions, while attitudes towards institutions play a limited role. Behaviour in this group appears stable and anchored in moral commitments and social expectations.

For inconsistent taxpayers, the picture is reversed. Tax morale is not a significant driver, and social norms are weaker. Instead, compliance intentions are strongly shaped by attitudes towards the tax system and public institutions. These taxpayers appear more responsive to external signals, such as perceived fairness, institutional quality, and policy design.

This distinction has direct policy relevance. It suggests that different groups of taxpayers respond to different levers. For individuals with strong intrinsic motivation, policies that reinforce norms and maintain trust may be sufficient. For those with weaker internal motivation, improving perceptions of fairness, transparency, and service quality may be more effective in shaping behaviour.

The analysis also shows that actual opportunities to evade taxes, proxied by self-employment, play only a limited role overall and are not significant for inconsistent taxpayers. This further underscores that compliance is not driven solely by opportunity or enforcement, but by how individuals perceive and interpret their environment.

The findings are robust to alternative measures of compliance, different specifications of the TPB framework, and subsample analyses across socio-demographic groups. Across all exercises, social norms and tax morale remain the most consistent and influential determinants of compliance intentions.

Overall, the paper offers a rigorous empirical analysis combined with actionable policy insights. It shows that tax compliance is shaped by a combination of psychological and institutional factors and that recognising heterogeneity across individuals is crucial for effective policy design.

SESSION 7

Higher Education: Returns and Policies

16 September, 14.30–16.10

Class Size and Student Performance in Higher Education

Dónal Palcic

Unequal and Persistent Effects of Student Loan Policy: Evidence from Parent PLUS Reforms

Madison Dell

Who Matters for Whom? Non-linear Peer Effects on Achievement and Absenteeism

Melisa Diaz

No Escape from Mismatch? Performance Pay and the Persistence of Overeducation Penalties in Europe

Simona Ferraro

Class Size and Student Performance in Higher Education

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EXTENDED ABSTRACT

Increasing higher education participation has been part of the policy agenda for most governments for some time as it is seen as a key measure to help reduce social and economic inequality. As class enrolment grows, higher education institutions (HEIs) are often required to accommodate increased numbers of students without a corresponding increase in resources, leading to an inevitable increase in class sizes in most areas. Within this context, this study examines the impact of class sizes on student academic performance using a large-scale administrative dataset from an Irish university that has experienced a significant increase in the number of students enrolling in the past decade.

Empirical studies estimating the causal impact of class sizes on academic performance in a higher education setting are rare. At postgraduate level, Bandiera et al. (2010) analyse the impact of class size on academic performance at a UK university and find a negative and significant impact for the smallest ranges of class sizes. Kara et al. (2021) estimate the effect of class size on academic performance for several cohorts of first year undergraduate students in a UK university and also find that larger class sizes are associated with significantly lower grades. In addition to the impact on grading outcomes, studies have investigated differences in the impact of class size across subject areas. De Paola et al. (2013) using data from a medium sized Italian university find that larger class sizes have a significant and negative impact on student performance but only in mathematics. De Giorgi et al. (2012) using data from Bocconi University find that a one standard deviation increase in class size and class composition has a negative but heterogenous effect on the average grades of males and lower income students. More recently, Maurer et al. (2026) examine gender match effects on student performance in higher education and show that they are significant in smaller classes but virtually zero in larger class sizes.

Our study differs from prior work in this area which has mainly focused on postgraduate student outcomes (for example, Bandiera et al., 2010) or outcomes for first year undergraduate students (for example, De Paola et al., 2013; Kara et al., 2021). Given the richness of our data, we are also able to observe the school that each student attended before entering university. We are therefore able to examine whether having some familiar peers in your class helps moderate the relationship between class size and student performance. Our data covers over 6,000 students from an Irish University who graduated from a four-year Bachelor's degree in 2017/18, 2018/19 and 2019/20. Students typically complete 35 modules across their four years of study giving us an analytic sample of over 225,000 student-module level observations. A student's performance is measured using their GPA which is calculated based on a student's grades (which are assigned a numerical value on a scale from 4 for an A1 to 0 for an F) and weighted by the credits associated with each module. A student's final cumulative GPA determines their degree award at the end of their four years of study (on a scale of first class honours, second class honours (upper division), second class honours (lower division), and third class honours/pass). Basic summary statistics are included in Table 1. The panel nature of the data, where students are observed across different modules and time periods is well-suited for a student fixed effects model that leverages the within-student across module variation in our data. Using this approach and controlling for time trends and other class composition factors, we estimate the effect of class size on student academic performance across three cohorts of graduating students. We also explore heterogeneous effects across faculties and gender and examine whether having familiar peers (students from the same secondary school in your university class) moderates this relationship. The latter is done by interacting our main variable of interest (class size) with the number of people in a student's class that went to the same secondary school as them.

Our baseline results are presented in Table 2 and show that larger classes are associated with significantly lower grades for students in university, with this effect driven by students in non-STEM programmes. Specifically, we find that an increase of one extra student leads to a decrease of 0.0003 in a student's GPA. While small, a more practical way of interpreting this would be that increasing class size by 20 is equivalent to reducing performance by 1% of a standard deviation. Furthermore, given that the growth of student numbers is unlikely to be isolated to one module, this cumulative effect across a student's degree may be practically significant. For example, if a student saw this decrease in every module across their 4 years of study, this could significantly affect degree award classification.

Potential non-linearities in the relationship are also examined with Figure 1 showing a greater effect on student performance at larger class sizes, with the negative effect largest for class sizes exceeding 400 students. In practical terms, our results show that going from a class of less than 50 to a class of more than 400 decreases performance by 22% of a standard deviation. Lastly, Table 3 presents the results of the interaction between school peers and class size and shows that having peers from the same secondary school in a class may help moderate the negative effect of larger class sizes, with this particularly the case for females.

In summary, we find a small but significant effect where, on average, test scores of university students in Ireland decrease by 1% of a standard deviation for every 20 extra students in class. We also find considerable heterogeneity in this relationship with stronger effects seen for very large classes but weaker effects when students have someone they went to school with in the same class. This research helps contribute to evidence-based policy in the higher education space.

Table 1: Summary Statistics

Variable	Mean	SD	Median	Min	Max	SD Within
Grade	2.91	0.67	3.0	0	4	0.57
Class Size	196.89	172.32	109	5	605	117.41
Observations	225,146					
No. of Students	6,366					

Table 2: Baseline Results

Variables	(1) Course Grade	(2) Course Grade	(3) Course Grade STEM ==1	(4) Course Grade STEM ==0
Class Size	-0.0004*** (0.00007)	-0.0003*** (0.00009)	-0.00006 (0.0003)	-0.0004*** (0.00009)
Observations	225,146	225,146	57,232	167,914
R-Squared	0.11	0.33		
Student FE	No	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Year of Study	Yes	Yes	Yes	Yes
Class Composition Controls	Yes	Yes	Yes	Yes

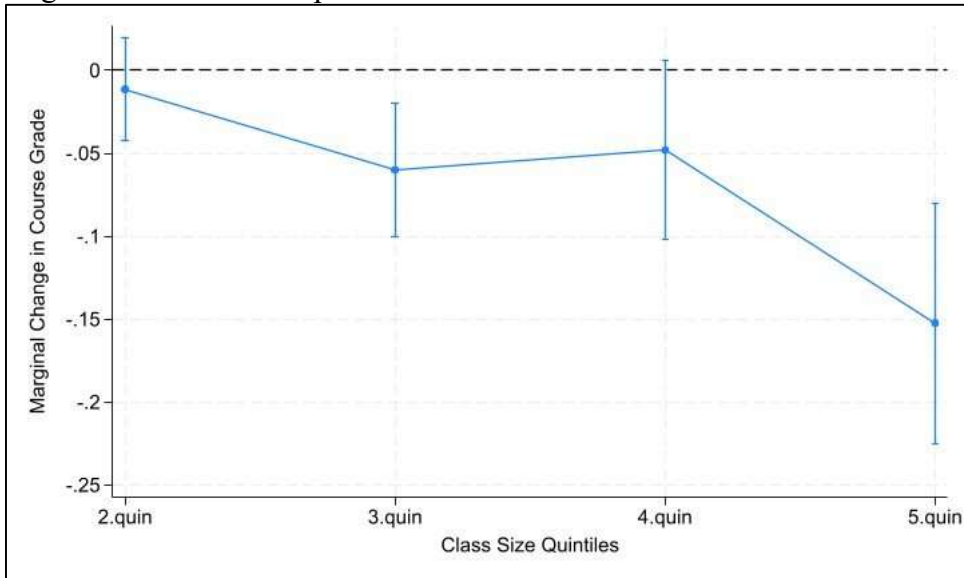
Notes: Clustered standard errors at course level in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 3: Results – Interaction with School Peers

Variables	(1) Course Grade	(2) Course Grade	(3) Course Grade
Class Size x School Peers	-0.00004*** (0.00001)		
Class Size x School Peers Female = 1		-0.00005*** (0.00001)	
Class Size x School Peers Female = 0			-0.00003* (0.00001)
Observations	225,146	131,485	93,661
R-Squared	0.34	0.33	0.33
Student FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Study Year FE	Yes	Yes	Yes
Class Composition Controls	Yes	Yes	Yes

Notes: Clustered standard errors at course level in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Figure 1: Non-Linear Specification



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Unequal and Persistent Effects of Student Loan Policy: Evidence from Parent PLUS Reforms

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Federal student loan programs in the United States aim to increase access to higher education by providing students with subsidized loans to help pay for college. These policies are typically designed as uniform interventions, yet institutions differ substantially in their exposure to and dependence on specific funding streams. As a result, policy changes that are ostensibly neutral may generate heterogeneous effects across institutions. This paper examines how institutional vulnerability mediates the effects of federal student loan policy using two reforms to the Parent Loans for Undergraduate Students (Parent PLUS) program: a 2012 tightening of credit standards that restricted borrowing and a 2015 policy revision that partially restored access.

We conceptualize institutional vulnerability as differential reliance on Parent PLUS borrowing to sustain student enrollment and institutional revenues. Institutions that enroll larger shares of students from low-income or credit-constrained families are more exposed to changes in parent borrowing conditions. Historically Black Colleges and Universities (HBCUs), a group of institutions established prior to the racial desegregation of U.S. higher education with the primary mission of educating Black students, represent a particularly salient case. HBCUs enroll a disproportionate share of students from low-income or credit-constrained families and rely more heavily on Parent PLUS loans than other institutions, making them especially sensitive to changes in credit availability (e.g., Fletcher et al., 2020; Jackson et al., 2023; Jin & Darbhamulla, 2019; Wright-Kim et al., 2024; Zhou et al., 2019). This setting provides a natural context to study how financial vulnerability amplifies the effects of credit supply shocks.

To evaluate these dynamics, we construct a panel dataset spanning academic years 2006-07 through 2023-24 by combining institution-level data from the Integrated Postsecondary Education Data System (IPEDS) with administrative records from the Federal Student Aid (FSA) Title IV Program Volume Reports. The resulting dataset includes 18 years of data across more than 1,100 institutions, allowing us to examine both the immediate and longer-run effects of policy changes.

Our empirical strategy combines several complementary causal inference approaches. First, we estimate difference-in-differences models with institution and year fixed effects that exploit the timing of the 2012 and 2015 policy changes. Second, we implement dynamic event-study specifications using Callaway and Sant'Anna (2021) estimators, which allow treatment effects to evolve flexibly over time. Third, we estimate a triple-difference model that interacts HBCU status, policy timing, and pre-policy exposure to Parent PLUS borrowing, enabling us to directly test institutional vulnerability as a mechanism. Finally, we implement a synthetic control approach to construct counterfactual institutions that closely match pre-policy trends, providing an additional robustness check.

Across specifications, we find that institutional vulnerability plays a central role in shaping policy impacts. Following the 2012 tightening of credit standards, HBCUs experienced substantially larger declines in Parent PLUS borrowing and undergraduate enrollment than non-HBCUs. In our baseline estimates, HBCUs experienced a 25% larger decline in Parent PLUS recipients and a 10% larger decline in undergraduate enrollment relative to non-HBCUs.

Event-study estimates show that these effects emerge immediately after the policy change and persist over several years.

In contrast, the 2015 policy revision led to a strong rebound in Parent PLUS borrowing at HBCUs, with a 28.5% larger increase relative to non-HBCUs. However, enrollment did not fully recover. Post-2015 estimates remain negative and statistically significant, indicating that the initial enrollment shock had persistent effects. This divergence between borrowing and enrollment responses suggests that restoring access to credit did not fully reverse earlier disruptions.

We further examine heterogeneity in these effects using the triple-difference design. While the first policy change affected HBCUs broadly, the recovery following the 2015 revision was weaker among institutions with greater pre-policy reliance on Parent PLUS borrowing. This pattern highlights exposure to credit supply as a key mechanism and suggests that the most financially vulnerable institutions experienced the most persistent impacts.

To better understand the mechanisms underlying these results, we examine outcomes related to student demand, institutional behavior, and student success. We find that HBCUs experienced larger declines in enrollment yield rates following both policy changes, indicating reduced ability to convert admitted students into enrollees. In response, institutions expanded admissions, particularly after 2015, likely as a strategy to offset lower yield rates. At the same time, HBCUs reduced spending on instruction and student services, consistent with a revenue channel in which enrollment declines translate into budget constraints. These adjustments were accompanied by increases in student-faculty ratios and declines in retention and graduation rates, suggesting that financial shocks may have affected both institutional capacity and student outcomes.

Taken together, the results point to a combination of demand-side and supply-side mechanisms. On the demand side, reduced access to Parent PLUS loans constrained students' ability to enroll. On the supply side, institutions responded to enrollment and revenue shocks by adjusting admissions practices and reducing expenditures, potentially reinforcing the initial effects. These dynamics are consistent with a broader literature on scarring, in which temporary shocks generate persistent consequences, particularly for more vulnerable populations (e.g., Kahn, 2010; Oreopoulos et al., 2012; Schwandt & von Wachter, 2019). Our findings extend this concept to the institutional level, showing that financial disruptions can have lasting effects on colleges as well as students.

The findings have important implications for policy design. Federal student loan programs are intended to expand access to higher education, yet changes to borrowing rules can have unintended consequences when institutions differ in their reliance on these programs. Our results suggest that uniform credit policies may exacerbate existing inequalities by disproportionately affecting financially vulnerable institutions. Moreover, the incomplete recovery following policy reversal indicates that temporary disruptions can have durable effects, raising concerns about the long-term stability of institutions that serve disadvantaged populations. By showing how institutional context shapes policy impacts, the results highlight the importance of accounting for heterogeneity in both policy evaluation and policy design.

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Who Matters for Whom? Non-linear Peer Effects on Achievement and Absenteeism

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Abstract

This paper examines the causal impact of peer quality on academic achievement and school absenteeism among Italian middle school students, exploiting the quasi-random reassignment of peers at the primary-to-middle school transition. Using administrative data on approximately 257,000 students linked across grades 5 and 8, we identify peer effects from variation in the prior achievement of newly assigned classmates, measured before students meet, relative to the set of peers they shared in primary school.

For cognitive outcomes, we employ both a between-student model with school-transition fixed effects and a within-student stacked design that exploits variation across subjects within the same student, absorbing all time-invariant individual characteristics. For absenteeism, we use a cross-sectional model with school-transition fixed effects, complemented by entropy balancing to address selection on observables. Average peer effects are positive and significant for achievement — a one standard deviation increase in new peers' prior scores raises grade 8 scores by 0.013–0.047 standard deviations — and negative for absenteeism, with higher-quality peers reducing absences by 0.017–0.023 standard deviations.

Our central contribution is documenting the non-linear, heterogeneous nature of these effects. For academic achievement, the benefits of higher-quality peers follow an inverted U-shape across the own prior score distribution: effects are negligible for very low performers, peak for students around the middle of the distribution, and fade for high achievers. For absenteeism, the pattern differs notably, the attendance benefits of better peers are strongest among weaker students and monotonically decline with own prior performance. This nuanced asymmetry across outcomes suggests that peer influence operates through related but distinct channels for cognitive and behavioral dimensions of human capital, with implications for how classroom composition policies may differentially affect students depending on the outcome of interest.

Keywords: peer effects, academic achievement, absenteeism, school transitions

No Escape from Mismatch? Performance Pay and the Persistence of Overeducation Penalties in Europe

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Extended Abstract

The unprecedented expansion of higher education across Europe has created a persistent mismatch between workers' qualifications and job requirements. Overeducation imposes wage penalties on affected workers, as documented since Duncan and Hoffman's (1981) seminal ORU framework. Performance-related pay (PRP) has been proposed as a potential equalising mechanism: Lazear's (1986, 2000) sorting model predicts that high-ability workers — including those whose surplus education signals latent productivity — will self-select into incentive-based schemes, recovering wage returns that fixed-pay employment denies them. Baktash (2025) provides the only empirical test, using German data, and finds that PRP significantly attenuates the overeducation penalty. Whether this generalises across the institutionally heterogeneous landscape of the European Union, and whether it holds symmetrically by gender, remains unanswered. This article fills that gap.

The empirical analysis draws on the 2010 and 2015 waves of the European Working Conditions Survey (EWCS, 8th Edition), covering 20,052 employees aged 25–64 across 24 EU member states. PRP is operationalised broadly — encompassing piece rates, productivity bonuses, profit-sharing, and equity participation — with a sample prevalence of 24.5 per cent. Educational mismatch is measured through three complementary approaches: the Realised Matches method (mean and mode), a ± 0.5 standard deviation bandwidth variant, and the Job Analysis approach based on ISCO skill level classifications, allowing robustness to be assessed across distinct construction strategies.

Because sorting into PRP is non-random, the preferred specification is an endogenous switching regression estimated by full information maximum likelihood (FIML), allowing the wage-generating process to differ fully between pay regimes. The exclusion restriction is a leave-one-out (LOO) occupational PRP share — the proportion of workers in the same country-occupation cell receiving PRP, excluding the individual — which captures institutional propensity to use performance pay without directly affecting individual wages. The instrument is strong: the LOO coefficient in the FIML selection equation is 1.037 ($z = 9.97$, $p < 0.001$). Heckman two-step estimates are reported as a robustness check and yield mutually consistent conclusions.

The analysis yields four principal findings. First, overeducated workers systematically sort into PRP schemes, but exclusively in the coworkers benchmark: each additional year of surplus education relative to adequately matched colleagues in the same occupation increases the probability of holding a performance-based contract by 1.6–1.7 percentage points. This sorting pattern is absent in the peers benchmark, where education is compared to similarly qualified workers in matched jobs. Second, wage returns to overeducation are fundamentally benchmark-dependent. In the peers frame, surplus education reduces hourly wages by 3.7 per cent (mode) to 5.8 per cent (mean) per year — a persistent structural penalty confirmed across all specifications.

In the coworkers frame, surplus education generates a wage premium of approximately 3.0 per cent per year, reflecting within-job productivity advantages. This duality is robustly replicated across the full EWCS sample.

Third, and in direct contrast to the German evidence, European PRP does not mitigate the overeducation wage penalty. The PRP $\times$ overeducation interaction is statistically insignificant or marginally negative across all OLS specifications. FIML estimates confirm this: the overeducation penalty is -5.3 per cent under fixed pay and -6.2 per cent under PRP in the peers frame. The coworkers premium increases modestly from 2.5 to 3.3 per cent under PRP, but Wald tests confirm that mismatch coefficients do not differ significantly across pay regimes. The null result holds across alternative mismatch measures and all European country groupings, with no regional moderator reaching conventional significance ($F(3, 848) = 1.85, p = 0.14$).

Fourth, pronounced gender asymmetries emerge. Overeducated women face a steeper annual wage penalty (6.2 per cent) than men (5.0 per cent) in the peers frame, and PRP amplifies rather than alleviates this gap. Endogenous switching regressions reveal a performance pay paradox: in the coworkers frame, PRP amplifies the within-job premium for overeducated women to 9.7 per cent (versus 6.6 per cent under fixed pay), substantially more than for men (8.7 per cent versus 6.3 per cent). Yet in the peers frame, PRP introduces a significant penalty for overeducated women where fixed pay generates no significant penalty at all. Overeducated women under PRP thus simultaneously recover more surplus productivity within occupations and suffer a deeper disadvantage relative to their qualified peers — a paradox entirely absent from Baktash's (2025) German results.

This article makes two primary contributions. It provides the first large-scale cross-national test of the PRP mitigation hypothesis, demonstrating that the German result does not generalise to the EU. It also identifies a gendered performance pay paradox not previously documented. The policy implications follow directly. The failure of European PRP to attenuate overeducation penalties suggests that individually performance-linked schemes — tied to observable individual output rather than collective profit-sharing — may more effectively enable overeducated workers to signal latent productivity; high PRP prevalence in Eastern Europe, driven largely by legacy collective bonus systems, does not generate the signalling channel the theory requires. The performance pay paradox for women calls for gender-sensitive design of evaluation criteria: if appraisal systems undervalue overeducated women relative to their peers, expanding PRP coverage may widen rather than narrow gender wage inequality. More broadly, the cross-national uniformity of the null result challenges optimistic assumptions about PRP as a meritocratic leveller, directing policy attention toward the structural barriers — in task allocation, occupational sorting, and evaluation practices — that prevent overeducated workers from recovering the full returns to their educational investments.

Keywords: *Performance pay; overeducation; educational mismatch; wages; gender; endogenous switching regression*

JEL Codes: I21; J24; J31; J33; M52

SESSION 8

Incentives and Welfare

16 September, 14.30–16.10

The Effects of Training Design on Teachers' Pedagogical Digital Competence: A Meta-Analytic Approach

Faisal Mohammed

Embedding Social-Emotional Skills in Everyday Teaching: Evidence from an Italian School-Based Evaluation

Gabriele Iannotta

The Price of Teaching: Housing Costs and Geographic Shortage Patterns

Mattice Venken

Who Benefits from the Assignment of Homework?

Dónal Palcic

The Effects of Training Design on Teachers' Pedagogical Digital Competence: A Meta-Analytic Approach

Mohammed, F, Effective project consortium team

Research Objectives

Teacher training for pedagogical digital competence (PDC) has become a policy priority across Europe, yet the evidence base for which training designs are most effective remains fragmented. While theoretical frameworks distinguish between knowledge instruction (KI), collaborative design (CD), and situated learning (SL) as core components of effective professional development, few studies have systematically compared these designs within a coordinated measurement framework. This meta-analysis addresses this gap by asking whether the design and complexity of teacher training predict differential gains across distinct PDC outcomes: conceptual knowledge, self-efficacy, technology adoption intentions, and the quality of technology integration as measured by the ICAP framework.

Drawing on 25 pre-post intervention cases from a coordinated multi-site project spanning five European countries (Estonia, Germany, Israel, Finland; $N \approx 500$ teachers), we examine four training designs: KI only, KI+SL, KI+CD, and the most complex design combining all three components (KI+CD+SL). Building on the Kirkpatrick model and teacher professional development research, we test four pre-registered hypotheses: (H1) KI alone produces the strongest gains in conceptual knowledge; (H2) KI+SL produces the strongest gains in practice-oriented outcomes (technology adoption, ICAP-based integration); (H3) CD-containing designs produce the strongest gains in self-efficacy; (H4) more complex designs outperform simpler designs on classroom-oriented outcomes.

Method and Data

We conducted a three-level random-effects meta-analysis (effect sizes nested within cases nested within institutions) with cluster-robust standard errors. Effect sizes are computed as Hedges' g from pre-post gain scores. Sensitivity analyses include post-test-only comparisons using within-institution matched pairs. The sample comprises 25 intervention cases distributed across four training designs: KI only ($k = 10$), KI+CD ($k = 4$), KI+CD+SL ($k = 4$), and KI+SL ($k = 7$). Outcome domains include objective knowledge measures, self-efficacy scales, technology adoption intentions, and ICAP-based technology integration subscales.

Key findings

Across all four hypotheses, the results are uniformly null at conventional statistical significance levels. For H1, KI-only training does not produce significant gains in conceptual knowledge. For H2, adding situated learning to knowledge instruction does not significantly improve practice-oriented outcomes such as technology adoption or ICAP-based technology integration. For H3, collaborative design-containing trainings show a directionally consistent but non-significant positive trend for self-efficacy in digital teaching, though they do not outperform non-CD designs on self-efficacy for self-regulated learning instruction. For H4, more complex training designs do not outperform simpler designs on classroom-oriented adoption or integration outcomes. Importantly, no training design produces evidence of harm. Between-case heterogeneity is large across most models, indicating that unmeasured intervention features such as duration, instructor quality, and implementation fidelity matter more than design classification.

Implications:

These findings suggest that coarse training design labels capture only a small fraction of what makes teacher training effective for PDC. The large unexplained heterogeneity points to two priorities for future research: richer coding of intervention characteristics (e.g., duration, fidelity, instructor factors) and within-institution randomisation to separate design effects from institutional traditions. For practice, adopting a particular training label is no guarantee of effectiveness; implementation quality and contextual fit matter more. The study demonstrates the value of coordinated multi-site measurement for meta-analysis and the importance of reporting null results transparently in a literature prone to publication bias toward positive findings.

Section: Paper

Keywords: knowledge instruction, situated learning, collaborative design, attitudes, knowledge, classroom adoption

Embedding Social-Emotional Skills in Everyday Teaching: Evidence from an Italian School-Based Evaluation

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1. Motivation

Social-emotional skills are increasingly viewed as a key component of educational development, with implications for students' academic trajectories, well-being, classroom relationships, and long-run outcomes. While school-based social-emotional learning has been widely studied, comparatively less is known about scalable models that integrate these skills into everyday disciplinary teaching. This distinction is relevant for policy and practice: when social-emotional learning can be embedded in ordinary classroom routines, it becomes more compatible with existing curricular and organizational constraints.

This paper evaluates a teacher-led intervention implemented in an Italian primary and lower-secondary school. The study examines how a broad teacher-training programme translates into classroom practice, how context-specific priorities can be incorporated into measurement, and whether students' social-emotional development changes over the course of the intervention.

2. Setting and intervention

The study is conducted within a 2024–2026 research collaboration between Politecnico di Milano and a large school in Northern Italy. Thirteen teachers in fifth-grade primary and second-grade lower-secondary classes completed a structured emotional-intelligence training programme for educators, delivered by an external certified provider, for approximately 20 hours between November and December 2025. The programme aimed to strengthen teachers' capacity to recognize, support, and integrate social-emotional development across a broad range of classroom situations. It was complemented by a project-work component in which teachers translated the tools acquired during the training into disciplinary activities and classroom practices.

The intervention combines a broad social-emotional learning framework with a context-sensitive implementation strategy. During the preliminary diagnostic phase, based on school leadership interviews, teacher interviews, and classroom observations, a small set of locally salient competences was identified for each school level. For primary school, these are teamwork and collaborative problem-solving, effective communication, and stress management. For lower secondary school, they are teamwork and collaborative problem-solving, emotion management, and self-efficacy. These competences guide the contextual adaptation of the intervention and provide a dedicated measurement focus within a broader assessment of social-emotional skills.

The defining feature of the intervention is integration. Social-emotional skills are addressed within standard subject lessons through classroom routines, group work, activity design, feedback practices, and teacher-student interactions, rather than through a separate curricular track.

3. Data and design

We adopt a comparison-cohort pre-post design. Treated classes are fifth-grade primary classes and second-grade lower-secondary classes whose teachers participated in the training and implemented social-emotional practices during the school year. Comparison classes are drawn from contiguous grades within the same school: fourth-grade primary classes and third-grade lower-secondary classes. The sample includes 88 treated and 37 comparison students in primary school, and 100 treated and 105 comparison students in lower secondary school.

The design leverages the within-school structure of the implementation. Baseline and endline measures allow us to estimate pre-post changes among treated students and to benchmark these changes against adjacent, non-treated cohorts. We report baseline balance diagnostics and estimate standardized changes separately by school level.

Outcomes are measured through a student questionnaire adapted from the OECD Survey on Social and Emotional Skills, which covers a broad set of social-emotional domains and was augmented with grade-specific items targeting the locally prioritized competences. Each student is also rated by teachers on the same priority constructs, generating a dual-perspective dataset that combines student self-reports with external behavioral assessments and enables the analysis of perception gaps between students and teachers.

Survey data will be linked to individual-level administrative and standardized achievement data from the Italian national assessment system (INVALSI), including ESCS, parental education and occupation, language spoken at home, migration status, and standardized scores and proficiency levels in Italian, Mathematics, and English. This linkage allows us to account for academic achievement and family background, and to explore heterogeneity across baseline academic and socio-economic profiles.

The baseline wave was administered in February 2026 to 330 students; the endline is scheduled for 26 May 2026. Treated teachers also completed a post-training feedback questionnaire covering perceived usefulness, professional relevance, transfer to practice, organizational value, and sense of agency, which we use as implementation evidence.

4. Empirical strategy

The empirical analysis has two complementary layers. First, we estimate pre-post changes in broader social-emotional skill indices covered by the student questionnaire, comparing treated cohorts with adjacent comparison cohorts. Second, we conduct a focused analysis of the locally prioritized competences measured through both student self-reports and teacher ratings. Outcomes are standardized to compare effect sizes across skill domains and school levels. Estimates will be reported separately for primary and lower-secondary students, controlling for baseline scores and available covariates, including achievement and socio-economic background from INVALSI data.

This strategy reflects the structure of the intervention. The teacher training addressed social-emotional learning as a broad pedagogical capacity, while the diagnostic phase identified priority competences that make implementation responsive to the specific school context. The analysis

therefore examines both general social-emotional development and changes in the competences that received dedicated contextual attention.

Conditional on sample size and baseline distributions, we will explore whether changes differ by students' initial social-emotional profiles, academic achievement, and socio-economic background. We will also descriptively relate teacher engagement with training and implementation to within-class changes in student outcomes, and analyze student-teacher perception gaps as both an outcome and a marker of alignment between self-perceived and externally observed skills.

5. Preliminary evidence and expected conference contribution

At submission, baseline data have been collected and are being processed. By the conference, we plan to present four sets of preliminary results: baseline balance diagnostics and descriptive evidence on student self-reports and teacher-rated social-emotional skills; within-treated and comparison-cohort pre-post changes in broader indices and locally prioritized competences; exploratory evidence on student profiles, heterogeneity by academic and socio-economic background, teacher engagement, and perception gaps; and qualitative implementation material collected during the teachers' project-work and classroom implementation phase.

6. Contribution

The paper contributes on three fronts. Substantively, it adds early evidence on social-emotional skills interventions integrated into ordinary classroom practice, with implications for scalability under curricular constraints. Methodologically, it combines within-school cohort comparisons with multi-source measurement, distinguishing between broad social-emotional development and locally prioritized competences. Practically, it produces lessons for school leaders on adapting social-emotional learning protocols to context-specific needs while preserving a broad approach to teacher training and classroom implementation.

The price of teaching: Housing costs and geographic shortage patterns

Venken Mattice¹, Iliopoulos Takis¹, and De Witte Kristof¹²

1. Motivation

Teacher shortages represent one of the most pressing challenges for education systems worldwide (UNESCO, 2023). Crucially, these shortages tend to cluster in urban schools serving disadvantaged student populations, undermining educational equity (Hanushek et al., 2004; Lankford et al., 2002). In the Flemish region of Belgium, this challenge is particularly salient. Schools located in and around large cities consistently report the highest shortages, with disadvantaged schools being disproportionately affected (Figure 1). While qualitative evidence suggests that local conditions such as the cost of living play a role, little is known about the quantitative magnitude and spatial structure of these effects.

This study therefore asks a critical question: to what extent do local conditions and spatial relationships shape the geographic distribution and persistence of teacher shortages? To address this question, we integrate spatial econometric methods with rich administrative data to uncover how teacher shortages diffuse across municipalities and persist over time. By explicitly modelling spatial spillovers, we move beyond isolated, school-level explanations to reveal the broader geographic mechanisms driving teacher labour market imbalances.

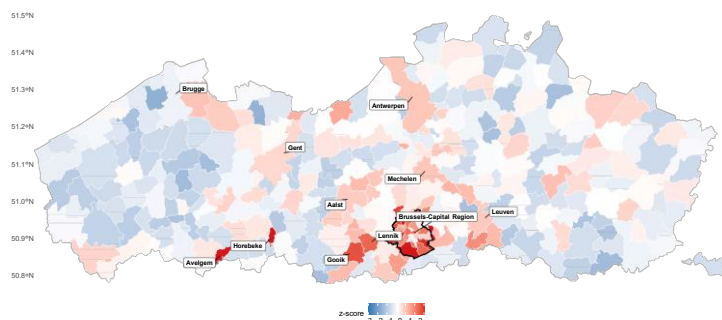


Figure 1: Percentage of unfilled replacement hours relative to total hours performed within schools, averaged over the municipality

2. Literature Review

Teacher labour markets are highly localised, with teachers preferring to work close to home (Boyd et al., 2005). This intensifies competition in teacher recruitment in hard-to-staff areas where factors such as housing costs and alternative job opportunities influence location choices (Booi et al., 2021; Eacott, 2024; Torres et al., 2023). Consequently, shortages are most persistent in urban schools serving low socio-economic status (SES) populations (Guarino et al., 2006). Despite growing attention to these spatial dynamics in the qualitative literature, much of the existing research remains limited by aggregation bias as analyses at national or regional levels often obscure substantial variation between nearby schools (Edwards et al., 2024).

Two significant gaps remain. First, rigorous econometric studies that account for spatial interdependencies remain rare in education economics literature, with those present focusing on teacher wage spillovers (Bruno, 2024). Second, findings related to local conditions such as the cost of living, crime rates, and adjacent labour opportunities are still limited to recent qualitative research (Gorard et al., 2024; Medlin et al., 2024). This research fills these gaps by applying dynamic spatial econometric techniques to model these complex interactions using rich school-level and municipal data.

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3. Objectives

This study aims to investigate the spatial and temporal dimensions of teacher shortages in Flanders. It advances the literature on teacher labour markets in three primary ways. First, we examine whether teacher shortages in one school are influenced by shortages in neighbouring schools, revealing the existence and magnitude of spatial spillovers. Second, we link localised shortages to broader regional factors such as housing affordability, labour market conditions, and demographic shifts to estimate the effect sizes. Lastly, we introduce interaction effects to measure which schools experience disproportional effects of these regional conditions.

By focusing on both spatial competition among schools and regional contextual factors, this study provides the first comprehensive spatio-temporal analysis of teacher shortages. The findings will inform both academic understanding and policy design by highlighting how teacher shortages diffuse across space and persist through time.

4. Data and Methodology

This study utilises a panel dataset covering 2,974 geocoded school units in Flanders, Belgium, from 2018 to 2023, provided by the Flemish Ministry of Education. This dataset contains a rich amount of school- and teacher-level variables, together with our dependent variable being the share of unfilled replacement teaching hours per school. This school-level data is merged with a rich set of municipality-level variables. These include socio-economic and demographic indicators, crime rates from the Federal Police, and economic and housing price data from Belstat. The dataset is further enriched with the locations of daycare facilities and each school's proximity to one of 28 teacher education centres.

The empirical strategy begins with an exploratory spatial data analysis using Moran's I and LISA to confirm that teacher shortages are geographically clustered. We then employ a dynamic Spatial Durbin Model (SDM) to quantify how local conditions and the characteristics of neighbouring schools influence teacher shortages. The SDM specification includes spatially lagged covariates, allowing us to capture the indirect effects of neighbours' characteristics:

$$y_{it} = \rho W y_{it} + \eta y_{it-1} + \kappa W y_{it-1} + X_{it} \beta + W X_{it} \theta + \mu_i + \xi_t + \varepsilon_{it}$$

This formulation addresses simultaneity and reverse causality by introducing time lags (y_{it-1}), ensuring that current shortages cannot influence past values and we control for school- (μ_i) and time fixed effects (ξ_t). We verify model stability following Elhorst (2022) by confirming that the spectral radius condition is satisfied. Finally, we compute LeSage–Pace direct, indirect, and total impacts, providing meaningful policy interpretations of both short- and long-run effects.

5. Preliminary Results

Preliminary results from the dynamic spatial Durbin model reveal strong spatial and temporal dependencies in teacher shortages across Flemish municipalities. The analysis provides evidence of competitive spatial dynamics, where a significant negative coefficient on the spatially lagged socio-economic status (SES) variable suggests a "relative attractiveness" mechanism: as the share of disadvantaged students in neighbouring schools increases, a given school's shortages tend to decrease.

Furthermore, housing affordability emerges as a critical determinant, with a municipality's own housing prices and those in neighbouring areas showing significant positive effects on shortages. This spatial spillover of housing costs contributes to regional "hotspots" of acute shortages in urban areas. Crucially, the burden of these high-cost markets is not borne equally. A significant positive interaction between housing prices and the share of low-SES students shows that the difficulty of staffing high-need schools is disproportionately amplified in these expensive areas. While the analysis of other municipal characteristics is ongoing, initial findings also highlight the relevance of the local crime rate, unemployment, and median income.

6. Conclusion

This study addresses the geographically clustered nature of teacher shortages in Flanders by applying a dynamic spatial Durbin model to a rich panel dataset. Our findings reveal that the difficulty of staffing high-need schools is disproportionately amplified in municipalities with high housing costs, creating regional "hotspots" of acute shortages. Furthermore, the analysis uncovers evidence of competitive spatial dynamics, where a school's ability to fill vacancies is influenced by the changing characteristics of its neighbours, suggesting a "relative attractiveness" mechanism.

Taken together, these results demonstrate that teacher shortages are not isolated institutional problems but spatially diffused phenomena driven by the interplay of school demographics, local economics, and regional labour market competition. The study underscores the necessity of moving beyond school-level interventions towards coordinated, spatially-aware policies that integrate educational strategy with housing and urban development. By providing the first comprehensive spatio-temporal analysis of teacher shortages in Flanders, this research offers a new lens for both academic understanding and effective policy design.

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Who benefits from the assignment of homework?

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EXTENDED ABSTRACT

Increasing student achievement is a key policy objective for most governments around the world. However, many policies that may help to achieve this, such as increased school resources or higher teacher salaries, can be costly. In this context, a low-cost tool to potentially improve student achievement may be the assignment of extra schoolwork outside of the classroom. However, public opinion and attitudes toward homework can often be quite polarised, with policymakers and the media frequently questioning the purpose and benefits of homework. Our study builds on previous studies in this area in a number of significant ways. Previous research in this space that goes beyond descriptive analysis or has a focus beyond individual countries is rare. Furthermore, there is an even greater paucity of literature to date that has provided a robust analysis of the heterogeneities in this relationship. Furthermore, there is an even greater paucity of literature to date that has provided a robust analysis of the heterogeneities in this relationship.

Using data on maths and science performance for 8th grade students from the 2019 Trends in Maths and Science Study (TIMSS) survey we examine the effect of time spent on homework by students on their academic achievement across 23 countries. The nature of the data allows us to use a student fixed effects model which helps mitigate concerns of individual-level and school-level bias. We are also able to control for a wide range of teacher characteristics in examining this relationship. Table 1 shows the results of our student fixed effects models with either science or maths test scores as the dependent variable for the pooled sample. For comparative purposes, column 1 reports the results with just country by subject and school fixed effects included, while the results in columns 2 and 3 incorporate student fixed effects and an increasingly broad set of controls. All specifications cluster the standard errors at the teacher level and are weighted using students' sampling probabilities within countries that give equal weight to each country. We find that an additional hour of homework completed by students per week increases student test scores by 0.014 standard deviations.

To further examine whether the benefits of homework vary beyond the mean hours assigned, we run the same model as that in Table 1 but change our independent variable of interest from hours of homework per week to a homework ‘mix’ variable with these results presented in Table 2. We find that a combination of high frequency and high volume/intensity of homework increases test scores by around 4% of a standard deviation compared to when homework is not assigned. Table 2 also shows that a combination of higher frequency and low volume of homework increases test scores by around 3% of a standard deviation while neither of the low frequency homework types are statistically significant from assigning no homework. This suggests that the benefit derived from homework stems from assigning it regularly rather than in high volumes.

We also examine possible heterogeneities in the relationship between being assigned homework and student performance in Table 3. Our results show that the assignment of homework is more effective when assigned by more experienced teachers or higher qualified teachers but find no such evidence with regard to engagement with professional development. We also find that a more modern style of teaching reduces the overall positive effect homework has on student test scores.

The results above present the mean effect of homework hours for different groups. However, we are also interested in examining the relationship between test scores and homework across the performance distribution. Figure 1 presents the results of a variety of unconditional quantile regressions (with fixed effects) corresponding to the 25th, 50th, and 75th percentiles of the dependent variable. This shows that an extra hour of homework per week increases test scores by 0.016 of a standard deviation for students in the 25th and 75th percentile of performance respectively while increasing by 0.0023 for those at the median. Figure 1 also shows a relatively steep drop in the effect below the 20th percentile of performance implying that extremely weak students do not benefit from the assignment of homework.

The range of countries in our analysis can be considered as beneficial for the external validity of our results, however, it also raises the possibility of significant heterogeneities across different education systems and cultures. For example, the ability of students to effectively complete assigned homework, student or parental attitudes towards undertaking schoolwork at home, and teacher training/attitudes towards the type of homework assigned may differ across countries.

From figure 2, we can see that 6 of the 23 countries (New Zealand, Israel, Australia, Taiwan, USA and Malaysia) present as having significant and positive estimates with broadly similar coefficient sizes. However, it is notable that 5 other countries (Korea, South Africa, Ireland, Italy and Turkey) show similar coefficient sizes but have p-values between 0.1 and 0.15 (as can be seen by the

respective confidence intervals for these countries) suggesting a limitation in statistical power from the reduced sample rather than an absence of effect.

In summary, find a small but significant effect where, on average, test scores increase by 1.4% of a standard deviation when an extra hour of homework is assigned, with this benefit largely driven by students that receive homework more frequently rather than in high volumes. We also find considerable heterogeneity in this relationship with stronger effects for students that have more experienced teachers but weaker effects for teachers that adopt a more modern teaching style. We also find that, overall, this positive effect does not hold for students towards the very bottom of the performance distribution, but our country-by-country analysis suggests lower ability students in some jurisdictions may see some benefits.

Table 1 – Baseline Results

	(1) Test Score	(2) Test Score	(3) Test Score
Homework Hours	0.05***	0.015***	0.014***
	(0.004)	(0.002)	(0.002)
Observations	192,198	192,198	192,198
R-Squared	0.57	0.95	0.94
Subject FE x Country FE	Yes	Yes	Yes
School FE	Yes	No	No
Student FE	No	Yes	Yes
Class Controls	No	No	Yes
Teacher Controls	No	No	Yes

Source: Analysis of TIMSS data for 2019.

Notes: Dependent variable: TIMSS student test score in math and science in 8th grade in 2019 in column (1) to (3); Instruction time is aggregated on school-by-subject level. Teacher controls are teacher gender, teacher age, teacher master's degree, teacher job satisfaction, and traditional/modern teaching index. Regressions run as in Eq. (1). All regressions are weighted by students' sampling probabilities within countries and give equal weight to each country. Clustered standard errors at teacher level in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 2 – Marginal Effect of Homework Mix on Student Test Scores Across Country Type

	(1) Test Score Full Sample	(2) Test Score OECD countries
Homework Mix (ref = no homework)		
Low Frequency and Low Intensity	0.001	0.002
	(0.01)	(0.01)
Low Frequency and High Intensity	0.001	-0.005
	(0.01)	(0.01)
High Frequency and Low Intensity	0.029**	0.038***
	(0.01)	(0.01)
High Frequency and High Intensity	0.044***	0.056***
	(0.02)	(0.02)
Observations	192,198	76,268
Within R-Squared	0.94	0.94
Student FE	Yes	Yes
Subject FE	Yes	Yes
Class Controls	Yes	Yes
Teacher Controls	Yes	Yes

Source: Analysis of TIMSS data for 2019.

Notes: Dependent variable: TIMSS student test score in math and science in 8th grade in 2019 in column (1) to (3); Instruction time is aggregated on school-by-subject level. Teacher controls are teacher gender, teacher age, teacher master's degree, teacher job satisfaction, and traditional/modern teaching index. Regressions run as in Eq. (1). All regressions are weighted by students' sampling probabilities within countries and give equal weight to each country. Clustered standard errors at teacher level in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

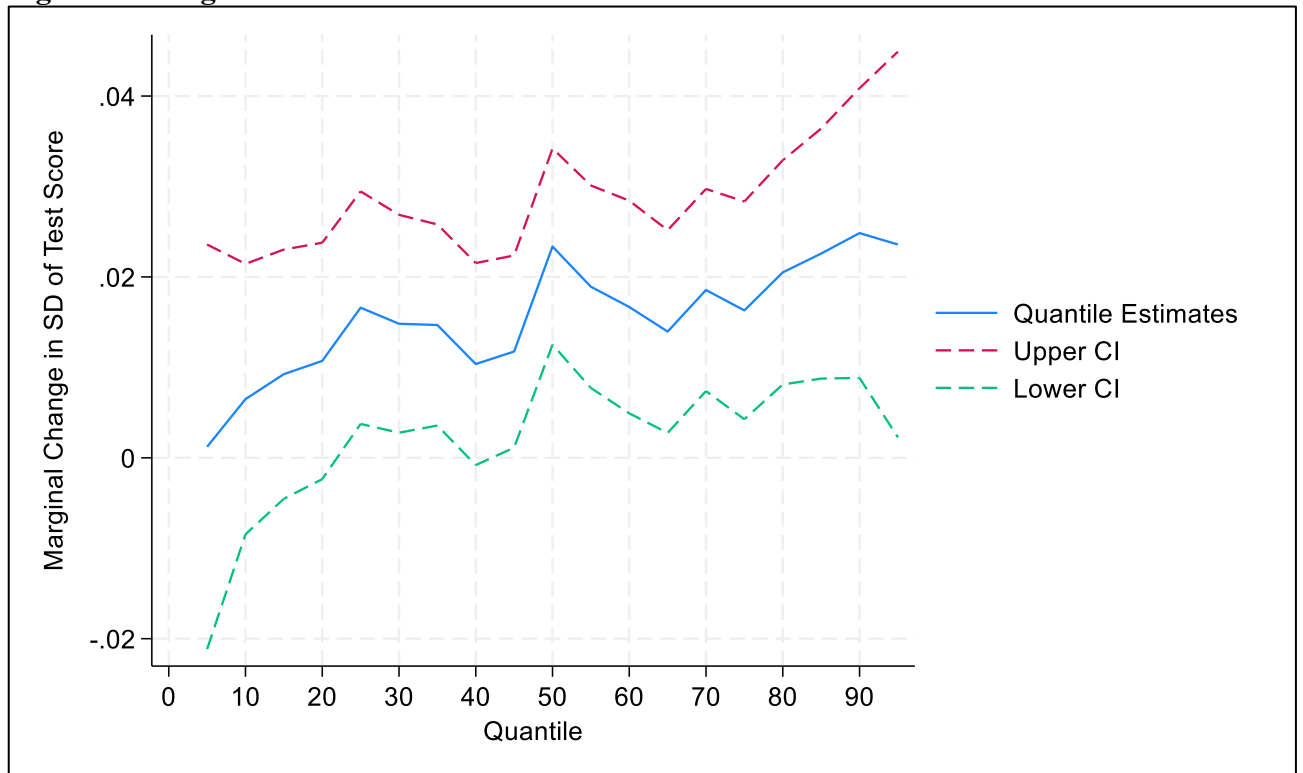
Table 3 – Heterogenous Effect of Homework Assignment on Student Test Scores- Teacher Characteristics

	(1) Test Score	(2) Test Score	(3) Test Score	(4) Test Score	(5) Test Score
Homework Hours per Week	0.005	0.011***	0.015*	0.032***	0.012**
	(0.004)	(0.004)	(0.007)	(0.008)	(0.005)
Homework Hours x teacher experience	0.001*				
	(0.0003)				
Homework Hours x teacher holds master's degree in subject		0.014**			
		(0.008)			
Homework Hours x teacher's traditional style index			-0.0005		
			(0.01)		
Homework Hours x teacher's modern style index				-0.025*	
				(0.014)	
Homework Hours x teacher's professional development					0.004
					(0.006)
Observations	192,198	192,198	192,198	192,198	192,198
R-Squared	0.94	0.94	0.94	0.94	0.94
Student FE	Yes	Yes	Yes	Yes	Yes
Subject FE	Yes	Yes	Yes	Yes	Yes
Class Controls	Yes	Yes	Yes	Yes	Yes
Teacher Controls	Yes	Yes	Yes	Yes	Yes

Source: Analysis of TIMSS data for 2019.

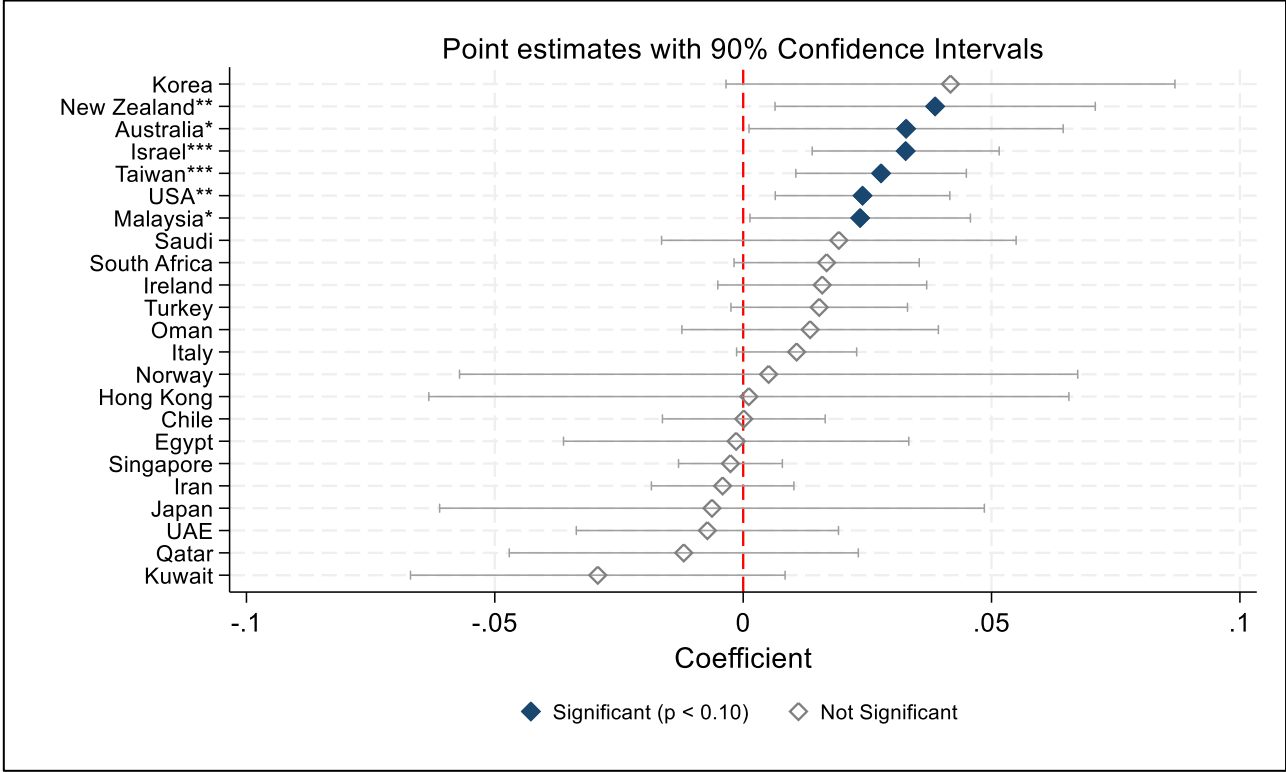
Notes: Dependent variable: TIMSS student test score in math and science in 8th grade in 2019 in column (1) to (3); Teacher controls are teacher gender, teacher age, teacher master's degree, teacher job satisfaction, and traditional/modern teaching index. Regressions run as in Eq. (1). All regressions are weighted by students' sampling probabilities within countries and give equal weight to each country. Clustered standard errors at teacher by subject level in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Figure 1: Marginal Effect of Homework Hours Across Student Performance



Source: Analysis of TIMSS data for 2019.

Figure 2: Marginal Effect of Homework Hours by Country



Source: Analysis of TIMSS data for 2019.

Note: These estimations are based upon the same model as that seen in Table 1 but run for each country individually. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

SESSION 9

Family and Social Environment

16 September, 16.25–17.40

School Choice as a Social Dilemma: The Role of Parenting Styles in Opting Out of Neighbourhood Schools

Nilay Rammul

Early School Leaving and Social Relationships in Dutch (Pre-)Vocational Education

Chayenne Smeets

Does Timing Matter? Parental Separation Around Educational Transitions

Hannelore Nelissen

School choice as a social dilemma: The role of parenting styles in opting out of neighbourhood schools

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Abstract

School choice is typically framed as a mechanism of parental agency and is often analysed through the lens of class-based family strategies when explaining patterns of educational segregation. This paper argues that parenting styles play a role in the school choice process and examines whether authoritarian and authoritative (democratic) parenting styles are associated with prioritising different educational benefits. Building on this motivational dimension of parental choice, we perceive school choice as a prisoner's dilemma played by parents in choosing whether to opt out of neighbourhood schools or not. Using PISA 2022 data from Ireland, the findings show that authoritative parenting is consistently associated with stronger prioritisation of both academic and pedagogical criteria, contrary to neighbourhood schooling. The findings suggest that dilemmas intensify when democratic (authoritative) parents must trade off between educational priorities, such as academic performance and pedagogical fit. At the same time, these tensions highlight opportunities for designing more responsive policies that allow key educational benefits to coexist.

Keywords: School choice, parenting styles, Ireland, education, academic, pedagogy

Early School Leaving & Social Relationships in Dutch (pre-) Vocational Education

Chayenne Smeets, Carla Haelermans, Trudie Schils and Lynn van Vugt

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Reducing early school leaving (ESL) is a key policy priority of the European Union, which aims for all young people to complete at least upper secondary education before the age of 24. Early school leaving is associated with a wide range of negative consequences, including lower employment prospects, higher job insecurity and increased chances of living in poverty. Consequently, the EU has set a target to reduce the share of ESL to below 9% by 2030. While progress varies across member states, the Netherlands consistently reports relatively low ESL rates compared to other EU countries. However, more than 80% of early school leavers in the Netherlands originate from vocational education, raising questions about the underlying causes within this specific group.

Early school leaving is widely understood as a long-term process of disengagement that may begin as early as childhood and is shaped by a complex interplay of individual, family, and institutional factors. As ESL in the Netherlands is largely concentrated within a particular student group, it is essential to examine the extent to which this phenomenon is linked to factors within vocational education institutions. This study focuses on the role of students' social relationships—specifically their relationships with teachers and classmates—and examines how these are associated with the likelihood of early school leaving among Dutch vocational students.

To address this research question, the study combines administrative register data from the Netherlands Cohort Study on Education (NCO) with self-reported survey data from the Education Monitor Limburg (OML). The NCO dataset provides detailed longitudinal information on students' educational trajectories, including school enrolment, diploma attainment, and background characteristics such as parental income, family composition, and migration background. The OML dataset complements this with measures of non-cognitive skills, including school motivation, curiosity, problem-solving abilities, and self-reported social relationships with teachers and peers.

The analysis uses OML data from the years 2014, 2016, 2018, and 2020, resulting in a sample of approximately 9,300 students. These data were linked to NCO records covering pre-vocational education from the 2013–2014 to 2023–2024 school years, vocational education from 2015–2016 to 2023–2024, and background characteristics.

The study employs linear probability models (LPM) to estimate the relationship between social relationships and the likelihood of ESL, controlling for age, gender, level of pre-vocational education, parental income, and region.

The findings reveal a significant negative association between the quality of students' social relationships with teachers and the likelihood of early school leaving. Specifically, students who are less satisfied with their relationships with teachers during pre-vocational education are more likely to drop out during vocational education. Similar results are observed for relationships with classmates, indicating that poorer relationships with classmates during pre-vocational education are associated with a higher probability of ESL in vocational education.

Overall, the results highlight the importance of social relationships within the school environment as a factor in preventing early school leaving among vocational students in the Netherlands. Strengthening teacher relationships and classmate relationships may therefore represent an important avenue for policy interventions aimed at reducing ESL rates.

Does Timing Matter? Parental Separation Around Educational Transitions

Abstract

Parental separation has become increasingly prevalent in recent decades. Although a large body of research examines how children's age at separation affects educational outcomes, it remains unclear whether the timing of separation relative to key educational transitions matters. This paper examines whether parental separation before an early high-stakes educational gateway shapes children's subsequent educational and early labour market trajectories. Drawing on Dutch administrative data covering all children born between 1995-2011, we leverage within-family variation in whether siblings experienced separation before or after the primary-secondary school gateway, applying sibling fixed effects to account for time-invariant family characteristics. Children who experience separation within the five years preceding the gateway score, on average, 0.11 standard deviations lower on standardized tests than their siblings who experience separation later. They are also about 5 percentage points more likely to receive a vocational track recommendation and 2 percentage points more likely to be placed in the vocational track. Separation before this stage is associated with a 1-percentage-point reduction in high school graduation and a 4-percentage-point decrease in college enrollment. In the short term, however, these children show higher employment levels and wages, consistent with earlier entry into the labor market. These findings underscore the importance of the timing of family disruptions within institutional educational transitions and highlight the need for targeted support during these critical periods.

Keywords: Parental separation; Educational transitions; Sibling fixed-effects

Introduction

Parental separation¹ has become an increasingly common experience for children across many countries. In the European Union, divorce rates more than doubled between 1970 and 2023, rising from 0.8 to around 2 divorces per 1,000 persons (Eurostat, 2025). Similar levels are observed in the United States, where the divorce rate reached 2.3 divorces per 1,000 persons in 2023 (National Center for Health Statistics, 2023). Across OECD countries, approximately half of all divorces involve at least one child under 18 (OECD, 2019), and roughly one third of children in the United States experience parental divorce before adulthood (Johnston et al., 2025). Beyond formal divorce, declining marriage rates and rising cohabitation imply that nonmarital union dissolutions, although less systematically documented, constitute an increasingly relevant component of children's family instability (Eurostat, 2025; OECD, 2019).

A substantial literature documents adverse effects of parental separation on children's well-being and academic achievement (e.g., Amato & Anthony, 2014; Bernardi & Radl, 2014; Guetto et al., 2022; Steele et al., 2009). Evidence is more mixed, however, on the age at which parental separation is most

¹ For consistency and to capture the full scope of family instability, 'separation' is used throughout this paper to encompass the dissolution of both marital and cohabiting unions, a broader term than 'divorce' which refers specifically to legal marriage dissolution

consequential (e.g., Anthony et al., 2014; Bjorklund et al., 2006; Laird et al., 2020; Lansford, 2009; Le Forner, 2020; Steele et al., 2009). Rather than age alone, research argues that the timing of parental separation relative to educational transitions might critically shape children's future life outcomes (Chen et al., 2025, Sigle-Rushton et al., 2014; Steele et al., 2014), though empirical evidence remains limited.

This paper examines how parental separation occurring before an early high-stakes educational gateway shapes children's educational and early labor-market trajectories. Children experiencing family shocks might already face educational disadvantages, and if the timing of parental separation alters their educational and labor market trajectories toward more limited opportunities, it risks amplifying existing patterns of inequality. We focus on the Netherlands, where a high-stakes standardized test and teacher recommendations at the end of primary school (around age 12) shapes secondary school track placement. This educational transition shapes future schooling and labor-market opportunities (Borghans et al., 2020). We study how separations occurring within 5 years before this gateway affect test performances and teacher recommendations, but also the chain of track assignment, upper-secondary completion, tertiary enrollment and early labor-market status.

The Dutch context is well-suited for this analysis because its divorce rates align with EU averages (Eurostat, 2025), the strongly tracked school system creates a clearly defined early high-stakes transition, and the country's population registers provide detailed longitudinal information on family structure and children's trajectories. We use administrative data from Statistics Netherlands covering all children born between 1995-2011 who completed the standardized test and received a teacher recommendation at the end of primary school, linked to records tracking educational and labor market outcomes through 2024, depending on cohort and age. Our identification strategy exploits within-family variation in the timing of parental separation relative to this high-stakes gateway and applies sibling fixed-effects models to control for time-invariant family-level characteristics. The comprehensive nature of the data allows us to precisely measure separation timing and long-term outcomes, while restricting analyses to families who separate mitigates specification concerns associated with comparing separated and intact families (Johnston et al., 2025; Laird et al., 2023; Sigle-Rushton et al., 2014).

This paper makes several contributions. First, we shift the focus from children's age at parental separation to the timing of parental separation relative to clearly defined educational thresholds. Prior research on age-at-separation predominantly focus on contexts with more flexible education systems, such as the Nordic states (e.g., Sweden in Björklund et al., 2007; Norway in Steele et al., 2009; Denmark in Laird et al., 2020) or United States (e.g., Anthony et al., 2024). In these settings, tracking plays a less central role in shaping students' educational trajectories and transitions are less sharply defined (Woessmann, 2009). These structural feature complicate isolating the consequences of parental separation timing relative to these educational transitions. By contrast, the Dutch early-tracking system provides a rigid institutional context that allows us to investigate whether separation occurring prior to the time of teacher recommendations and a pivotal high-stakes exam (OECD, 2016) has lasting effects for educational and labor market trajectories.

Second, we contribute to an emerging literature emphasizing that emotional distress shocks occurring near educational transitions are critical periods of sensitivity. Prior research demonstrates that shocks occurring prior to such transitions can have lasting effects on educational outcomes: Stans (2022) documents negative consequences of grandparental death prior to the Dutch primary-secondary school transition; Kristiansen (2021) shows similar timing-sensitive effects of parental health events at the lower-upper secondary transition in Norway; and Chen et al. (2025) find that parental separation during the transition to university in Taiwan shapes educational trajectories. While these studies

underscore that educational transitions can be sensitive periods, important gaps remain. We extend this work in several ways. We examine parental separation around a much earlier transition, where track placement has long-term implications, whereas Chen et al. (2025) study a later transition into higher education. We focus specifically on parental separation, a widespread but understudied form of family instability in timing-sensitive research, whereas Stans (2022) studies grandparental death. We provide evidence from a European early-tracking system, complementing existing work on other family shock timing from the Netherlands (Stans, 2022) as well as related work from Norway (Kristiansen, 2021) and Taiwan (Chen et al., 2025), thereby situating timing sensitivity across contrasting institutional settings. Finally, we move beyond educational outcomes by examining the longer-term implications of early parental separation for subsequent labor-market trajectories.

Our findings reveal that the timing of parental separation relative to an early high-stakes educational gateway might have lasting consequences. Children exposed to separation in the years leading up to the primary-secondary track-placement decision are more likely to perform worse on the standardized test, more often pushed toward vocational tracks, and ultimately more likely to obtain lower levels of secondary and tertiary education than their siblings whose parents separate later. Yet in the short term these children enter the labor market earlier and achieve higher early wages and employment rates. More broadly, these findings underscore how family instability occurring before pivotal educational transitions can fundamentally redirect children's educational and labor market trajectories. This mechanism is likely to operate in other systems featuring similarly consequential gateways, prompting critical questions about the design of educational institutions and their interaction with adverse family shocks.

The remainder of this paper is organized as follows. Section 2 describes the institutional context of the Dutch education system. Section 3 details our administrative data and sample construction. Section 4 presents our sibling fixed-effects methodology and discusses identification assumptions. Sections 5 and 6 discuss the main empirical results and robustness checks. Section 7 concludes.

Theoretical mechanisms and moderating hypotheses

We expect that parental separation occurring before an early key educational transition might be more disruptive for children's educational and labor-market trajectories than separations that take place afterward. This expectation aligns with research showing that distress prior to educational transitions can hinder children's educational outcomes. Several theoretical mechanisms help explain why the timing of parental separation relative to these transitions might matter. By outlining these pathways, we highlight why it is essential to consider not only whether parental separation occurs, but also when it occurs in relation to key educational decision points early in children's school careers

Resource mechanism. Parental separation often entails substantial losses in economic and social resources that are central to children's educational success (Keith & Finlay, 1988). Parental resource theory (Thomson et al., 1994) emphasize that parents provide not only financial support but also time, enabling both material support and parental involvement. Following separation, these inputs typically decline: custodial arrangements reduce daily contact with at least one parent, potentially weakening support and control (Bastaits & Mortelmans, 2017), while economic well-being commonly decreases (Leopold & Kalmijn, 2016). Attachment theory further emphasizes the importance of stable emotional bonds for children's capacity to cope with stress and developmental changes (Bowlby, 1969; Khadka, 2022). Parental separation might disrupt parent-child relationships and reduce family emotional closeness, particularly when one parent exits the household and daily routine interactions diminish (Lowenstein, 2010; Peters & Ehrenberg, 2008). Such relational disruptions are associated with poorer

children's socioemotional adjustment (Holdnack, 2008), which in turn is linked to lower academic achievement (Potter, 2010).

Empirical evidence shows that declines in both economic resources and parent-child relationships quality help explain associations between parental separation and children's school engagement (Havermans et al., 2014). Because school engagement is closely linked to academic performance (Estévez et al., 2021; Wong et al., 2024), losses in material and socioemotional resources that occur before a key educational transition are likely to hinder academic achievement and result in less favourable teacher recommendations. These mechanisms are also relevant in the Dutch context, where divorce has persistent financial consequences and joint physical custody remains relatively uncommon, potentially limiting access to both material resources and the emotional support of both parents (Poortman & van Gaalen, 2017; Spruijt & Duindam, 2009).

Teacher compensation mechanism. Teachers are often aware of the association between parental separation and children's reduced academic performance (Iqbal et al., 2021). Some evidence indicates that teachers might attempt to buffer such disadvantage by providing additional academic or emotional support (Mahony et al., 2014), although such compensatory action requires additional effort within an already demanding workload (Laletas & Khasin, 2021). In the Dutch context, teacher recommendations play a critical role in determining secondary-school placement, complemented by standardized test scores. When parental separation occurs before the primary-secondary school transition, teachers might perceive the child as disadvantaged. In response, they might adjust their recommendation upward to avoid penalizing the student for difficulties arising from the separation. Such compensatory behavior is more likely when the separation happens closer to the transition, when teachers are more likely to be aware of the separation. Parental separation that occurred longer ago might be less salient to teachers, particularly given yearly changes in classroom teachers. Nonetheless, compensation typically requires both awareness and additional time investment and is therefore unlikely to fully offset disadvantage. Moreover, recent Dutch research suggests that student attributes generally play a limited role in shaping teacher recommendations (Van Leest et al., 2024), implying that the scope for compensation might be modest. Thus, while teacher compensation is theoretically plausible, we expect its overall influence on track recommendations in this setting to be limited.

In addition to the mechanisms, we theorize and test the following hypotheses that might moderate the effect of the timing of parental separation, reflecting how individual and family characteristics can amplify or buffer the consequences of separation occurring prior to key educational transitions.

Vulnerability hypothesis. Children's vulnerability to the timing of parental separation might differ by gender. Prior research shows that boys tend to be more sensitive to family instability and school-related disadvantages, exhibiting higher risks of behavioural problems in schools and lower academic achievement (Autor et al., 2019; Boertien & Bernardi, 2022; Lei & Lundberg, 2021). Boys also appear to adjust more slowly to changes in family structure (Demo & Acock, 1988), and behavioral issues linked to separation often emerging during primary school and persisting over time (Gustavsen et al., 2025; Malone et al., 2004). In addition, boys have been shown to reduce their time spent in educational activities more than girls after separation, while increasing time spent in non-educational related activities (Cano & Gracia, 2022), potentially disadvantaging educational outcomes. However, evidence is mixed, with several studies reporting no significant gender differences in responses to parental separation (Steele & Kravdal, 2009). If gendered vulnerability does operate, we expect boys who experience parental separation before the transition from primary to secondary school to show larger declines in academic performance and less favorable track recommendations than girls.

Data

Sample construction

The empirical analysis uses administrative microdata from Statistics Netherlands (CBS), covering all individuals recorded in the Dutch population registers between 1995 and 2024. Municipalities are legally required to maintain continuously updated records of residents, recording births within three days and assigning each individual a unique identification number (Prins, 2017). This identifier enables longitudinal linkages across datasets and over time, allowing reconstruction of family structures from birth onward.

The population registers provide detailed demographic information, residential address histories, and legally defined relationship links (parent-child and partner). Using these links, we identify each child's biological parents and trace parental relationship trajectories. Partner status is recorded as marriage, registered partnership, or cohabitation, along with the partner identifier. In the Netherlands, registered partnerships are legally equivalent to marriage (European Union, 2025). Cohabitation is identified through joint tax filings or formal cohabitation contracts. Using these indicators, we observe the formation and dissolution of unions and distinguish the type of union in each year. Residential address histories complement these records by indicating whether the child and both biological parents are registered at the same address. We define parental separation as the first year in which the child is no longer co-resident with both biological parents and the parent's union status indicates they are no longer married, in a registered partnership, or cohabiting. This combined measure allows us to identify, on a year-by-year basis, whether children live with both parents, one parent, or a stepparent, enabling the reconstruction of children's family structures from birth through adulthood.

To examine how the timing of parental separation shapes children's educational and labor market outcomes, we focus on a subpopulation of children defined by both substantive considerations and the requirements of our identification strategy, which exploits within-family variation in the timing of parental separation. The sample construction proceeds in several steps. First, we identify all children born between 1995 and 2011 who had completed a standardized achievement test (e.g., CITO-test or an approved alternative) and had a teacher recommendation at the transition from primary to secondary education by our final observation year, 2024.² Applying these criteria yields 2,083,053 children with complete test score and teacher recommendation information.

We next limit the sample to individuals born into non-blended families, that is, those born to both biological parents and who are full siblings (85.6 percent of the original sample). This ensures that children are not exposed to complex family structures from birth.³ We further restrict the sample to families with at least two children (54.7 percent of the original sample), as our identification strategy relies on within-family variation in the timing of parental separation, requiring the presence of at least two siblings. Finally, we focus exclusively on families that experience parental separation and in which at least one sibling experiences separation before age 19 (11.1 percent of the original sample). This restriction is motivated by systematic differences between intact and separated families in characteristics such as maternal age, parental income, and family size at birth (Appendix Table A1), which may lead to model misspecification in sibling fixed-effects models if intact families are included

² Most children take this test between the age of 10-13, which is why we focus on those born between 1995 and 2011.

³ We exclude individuals with half-siblings at birth, as their family dynamics might be different, potentially being more complicated or stressful, due to a parent's previous separation (Tillman, 2008). However, including families where children are exposed to half-siblings yields consistent results.

(Sigle-Rushton et al. 2014). The age-19 cutoff reflects the fact that parental separation is identified via a combination of parental union status and the child’s registered residence relative to each parent’s address, which is information that is reliably observed only while children are registered at a parental household, typically through age 18.⁴ By restricting the sample to families in which separation is observed before age 19 for at least one sibling, we can accurately identify the year of separation at the family level and apply this timing consistently to all siblings within that family.

Our final sample consists of 233,593 children from 108,175 separated families, each with at least one sibling experiencing parental separation before age 19. Because child outcomes are measured at multiple developmental stages (e.g., school-age and early adulthood), the analytic sample varies by outcome depending on whether the relevant birth cohorts have reached the required age by the end of the observation window. Table 1 presents key descriptive statistics for the main analysis sample, providing an overview of control variables.

Table 1. Descriptive statistics

Final sample	Separated families (n = 233,593)
<i>Control variables</i>	
<i>Gender</i>	0.502 (0.50)
<i>Maternal age</i>	30.28 (4.40)
<i>Family size</i>	2.65 (0.91)
<i>Birth order</i>	1.79 (0.83)
<i>Generation immigrant (third generation)</i>	0.82 (0.38)
Father income at birth (log)	10.33 (1.87)
Mother income at birth (log)	8.36 (3.44)

Note: The sample includes children born between 1995 and 2011 who completed a standardized end-of-primary-school test and are followed through 2024 in administrative data from Statistics Netherlands. We restrict the analysis to non-blended, multi-child families that experienced parental separation with at least one sibling experiencing parental separation before age 19. Standard deviations are reported in parentheses.

Educational setting and variable construction.

In the Netherlands, students begin primary education around age 4 and undergo a critical educational transition at age 12, when they are tracked into distinct secondary school pathways upon completion of primary school. This initial track assignment shapes future educational and labor market trajectories (Borghans et al., 2020; van Elk et al., 2011), making this placement decision particularly consequential. While pathways for track mobility exist, they are rarely utilized, underscoring the system’s rigidity (van Leest et al., 2024).

⁴ About 95% of children in our sample have complete residential address information up to age 18, allowing the child’s residence relative to their parents to be observed. Additionally, excluding children with incomplete information yields the same results.

Track placement relies primarily on the teacher's recommendations made at the end of primary school, complemented by a standardized achievement test assessing language and math skills. Although participation in this test was not legally mandatory prior to the 2014-2015 schoolyear (Dijks et al., 2020), approximately 85% of schools administered it.⁵ Given its widespread adoption and its potential to prompt upward revisions of teacher recommendations (Kabatek & Perales, 2021; Kortlever & Lemmens, 2012), the test effectively functions in practice as a high-stakes assessment in the tracking process.

Because teacher recommendations and standardized tests jointly guide students' secondary school placement, and thus form a pivotal point in their educational trajectories, we define our key variable of interest, timing of parental separation, relative to this transition. We construct a binary indicator equal to 1 when parental separation occurs up to the year before the tracking decision, and 0 otherwise.⁶ Identification of the timing effects therefore comes from within-family differences in whether siblings experienced separation before or after the transition. To ensure that the identifying variation captures separations substantively close to the decision point, we restrict pre-transition separations to those occurring within five years prior to tracking. No restrictions are placed on separations occurring after the transition. Families in which separations occur entirely before or entirely after tracking remain in the sample; under the sibling fixed-effects specification, however, these families do not contribute to the estimation of the timing parameter.

To assess the impact of separation timing, we follow individuals into early adulthood and construct measures of educational and labor market outcomes. Educational outcomes include the standardized test score at the end of primary education.⁷ As teacher recommendation strongly influences track placement, we define binary indicators for recommendations toward each of the main secondary education tracks: pre-vocational secondary education (VMBO-MBO), general secondary education (HAVO) or pre-university education (VWO). Each track prepares students for distinct post-secondary opportunities. The general education and pre-university track prepare students for higher education: general education for universities of applied sciences and pre-university track for research universities. In contrast, the pre-vocational secondary education track primarily prepares students for the labor market, making continuation to higher education less likely. To capture actual track placement, we construct binary indicators for enrollment in each of these main tracks (VMBO-MBO, HAVO, VWO). These measures are based on the track in which a student first enrolls upon transitioning from primary to secondary school, reflecting the enrolled educational pathway rather than the recommended one.⁸

Furthermore, we construct a binary variable indicating whether an individual has graduated from high school at age 20. This variable takes the value 1 if the individual has successfully obtained a high school diploma at age 20, and 0 otherwise. Individuals coded as 0 include those who have not completed high school, and are not enrolled in any educational program in the subsequent year.⁹ We also include a

⁵ Restricting the sample to post-2014 cohorts yields estimates that are similar to the main results on test scores. This indicates that our findings are not driven by differences between schools that voluntarily administered the test before 2014 and those that did not.

⁶ We also conduct a robustness check in which we exclude children who experienced parental separation in the same calendar year as the test, since they are classified as 0 in our main specification, but might already be affected by the separation (e.g., due to parental conflict).

⁷ Standardized by test type and year to ensure comparability across cohorts and test types.

⁸ Students might also enroll in a mixed general and pre-university track (HAVO-VWO); however, as this track accounts for only about 1 percent of the sample, we do not consider it as a separate outcome.

⁹ Note that students who have repeated a grade and therefore remain in education beyond age 20 are not included in this measure. Their non-completion at age 20 does not imply no high school graduation, but simply

binary variable that captures whether the person was enrolled in university (covering both research universities and universities of applied sciences) at age 20, coded as 1 if enrolled and 0 if not.

For the analysis of labor market outcomes, we restrict the sample to individuals who are no longer enrolled in education. We examine whether their employment status and hourly wages at age 23 are affected. We define employment for salaried workers following the one-hour criterion of the International Labor Organization (ILO), which considers a person employed if they worked at least one hour for pay or profit during a short reference period of one week (ILO, 2016). Given the annual structure of our data, we adopt a slightly stricter definition: individuals are classified as employed if they worked, on average, at least one hour per week over the year (or 52 hours per year) and report positive annual gross wage income. Since hours worked cannot be observed for the self-employed, both for data-related and conceptual reasons, we classify them as employed if they report positive annual gross income from self-employment. This limitation also explains why the hourly wage analysis is restricted to salaried workers as we do not observe hours (and thus cannot compute hourly wages) for the self-employed. Hourly wages are defined as gross annual wage income divided by the total number of hours worked during the year. For individuals who are unemployed or inactive, hourly wages are coded as zero.

Control variables. In our sibling fixed-effects models, time-invariant family-level characteristics are absorbed. However, we include several individual-level and time-varying family characteristics to account for variation between siblings. At the individual level, we control for the child's sex, coded as 1 for male and 0 for female. Prior research argues that males tend to underperform relative to girls in educational settings (Legewie & Diprete, 2012). We also include birth order, constructed as a discrete variable indicating the chronological position in which the child was born relative to their full siblings. We do so as first-born children tend to outperform their later-born siblings in terms of educational attainment (Iacovou, 2008). Additionally, we control for birth year to account for cohort effects, such as changes in grading practices, which might influence children's educational outcomes (Sigle-Rushton, 2014). Lastly, we account for time-varying family characteristics by including continuous variables for the gross annual income of both the mother and the father at the time of the child's birth. To reduce the influence of extreme values and skewness in the income distribution, we use the logarithm of these income variables. Socioeconomic status has been shown to be moderately associated with academic achievement (Liu et al., 2022). These values may differ across siblings, particularly when there is a larger age gap.

Methodology

We aim to examine how experiencing parental separation before a key educational transition point influences children's educational and labor market trajectories. A central concern in this context, however, is selection bias. Prior research shows that children whose parents separate often differ systematically from those in intact families due to pre-existing family characteristics (e.g., socioeconomic status or parental mental health) that influence both the likelihood of separation and long-term outcomes (Björklund & Sundström, 2006; Björklund et al., 2007). Although our administrative data include a rich set of observable family characteristics, some relevant pre-existing differences are likely unobserved. As a result, comparing children who experience parental separation

that they have not yet graduated. Including them would bias our interpretation of high school completion by prematurely classifying them as non-completers.

before a key educational transition point to those who do not (either because their parents never separate or separate afterwards) might yield biased estimates due to unobserved confounding.

To address concerns about unobserved family-level confounding, we employ a sibling fixed-effects approach that exploits within-family variation in the timing of parental separation. Specifically, we compare siblings who differ in whether separation occurred before or after the secondary school track-placement decision, thereby controlling for all observed and unobserved time-invariant family characteristics. This is particularly important given that many confounding factors identified in the divorce literature operate at the family rather than the individual level (Grätz, 2015). Appendix A, Table A2 provides empirical evidence on the importance of family-level confounding: whereas an OLS model compares children exposed to early separation with all other children (including those whose parents never separate or separate later), the sibling fixed-effects model substantially increases the R-squared and attenuates the estimated coefficient, indicating that much of the OLS association reflects unobserved family-level factors.

A key implication of this design is that the parental separation timing effect is identified only by families in which siblings differ in timing of exposure, that is, families where at least one sibling experiences separation before the educational transition and another after. Families in which parents never separate, or in which all siblings experience separation either entirely before or entirely after the transition, do not contribute to identifying the timing effect. However, these uniform-timing families still provide within-family variation in characteristics such as birth order and birth year, which can improve the precision of the estimated coefficients for these covariates, even though they do not identify the timing parameter itself.

This is one of the reasons why we restrict the sample to families that experience separation. Including intact families would not only add no identifying information but could also introduce model misspecification if the relationship between covariates and outcomes differs systematically between intact and separated families (Johnston et al., 2025; Laird et al., 2023; Sigle-Rushton et al., 2014). Unless such heterogeneity is explicitly modeled (e.g., through interaction terms), estimates might be biased. Given limited evidence that these relationships are stable across family types, we focus exclusively on families that experience a separation. Prior studies have shown, for instance, that socioeconomic status interacts with parental separation in shaping educational outcomes (Guetto et al., 2022), and that the impact of separation varies with parental and child characteristics (Bernardi & Ghirardi, 2025; Brand et al., 2019; Nilsen et al., 2020). As shown in Table A1 in Appendix A, separated families also differ systematically from intact families in several observable characteristics. To avoid model misspecification and to ensure internal validity, we therefore limit the sample to separated families.

We estimate the following sibling fixed-effects model:

$$Y_{ij} = \beta_0 + X_{ij}\beta_1 + Z_{ij}\theta + \alpha_j + \varepsilon_{ij}$$

where Y_{ij} denotes the outcomes variables of child i in family j , capturing educational and labor market outcomes. X_{ij} is a binary indicator equal to 1 if the child experienced parental separation before secondary track placement, and 0 otherwise. The coefficient of β_1 is the variable of interest and captures the effect of experiencing separation before, rather than after, the transition. Z_{ij} denotes a series of control variables that vary between siblings, such as individual-level and time-varying family characteristics. The term α_j represents the sibling fixed-effects, controlling for all observed and unobserved characteristics shared by siblings. Standard errors are clustered at the sibling level to account for potential within-family correlation in the error term. Under this specification, the estimate

of β_1 is identified exclusively from multi-child families in which at least one sibling experiences parental separation before the age of 19.

The internal validity of our design relies on the assumption that, conditional on sibling fixed-effects and observed time-varying controls, the timing of parental separation relative to the tracking transition at the end of primary school is as good as random. Table 2 shows that, among separating families, observable pre-treatment characteristics of children whose parents separated before transition are highly similar to those whose parents separated afterwards. With the exception of modest differences in variables such as birth order, which we explicitly control for in our empirical model, standardized mean differences remain well below 0.1, a conventional threshold for meaningful imbalance. This pattern of balance strengthens the assumption that the timing of separation is not driven by observable child or family characteristics.

Table 2. Descriptive statistics: kids from separated families by timing of separation relative to high-stakes assessments at the transition primary-secondary school

Groups	Divorce after standardized test and recommendation (n = 67,744)	Divorce before standardized test and recommendation (n = 165,856)	Standardized mean differences
Characteristics			
<i>Gender</i>	0.50 (0.50)	0.50 (0.50)	-0.01
<i>Maternal age</i>	30.16 (4.23)	30.32 (4.47)	-0.04
<i>Family size</i>	2.66 (0.91)	2.64 (0.91)	0.02
<i>Birth order</i>	1.63 (0.82)	1.85 (0.84)	-0.27
<i>Generation immigrant (third generation)</i>	0.83 (0.38)	0.82 (0.38)	0.02
<i>Father income at birth (log)</i>	10.37 (1.88)	10.32 (1.87)	0.03
<i>Mother income at birth (log)</i>	8.16 (3.63)	8.45 (3.34)	-0.08

Note. We report standardized mean differences (SMDs) rather than t-tests, as SMDs are not influenced by sample size and provide a more reliable measure of group imbalance (Austin, 2009). This allows us to assess differences in characteristics between children from separated families who experienced divorce before versus after the standardized test and teacher recommendation. An SMD below 0.1 indicates minimal imbalance, while values above 0.1 suggest meaningful differences between these groups of children.

Despite these strengths, our identification strategy faces potential challenges related to unobserved factors and the precise timing of exposure. First, unobserved parental behavioral issues (e.g., alcohol problems) might influence both the likelihood and timing of separation relative to a child's educational milestones (Björklund & Sundström, 2006; Ernisch & Francesconi, 2001; Grätz, 2015; Sigle-Rushton et al., 2014). If such problems emerge between siblings' assessments, a younger sibling might be exposed to both the behavioral issue and the separation before the assessment, thereby facing additional stress and instability beyond the separation itself, while an older sibling remains unaffected. In this case, our estimates might partly reflect the effect of these underlying shocks rather than separation timing alone. Second, idiosyncratic child-level factors (e.g., disabilities or behavioral difficulties) could similarly affect separation timing and children's educational performance. If a younger child's condition contributes to a separation occurring before that child's assessment, while the older sibling has already completed theirs, the resulting estimate might conflate the effects of the condition with those of the separation. Because sibling fixed-effects cannot account for such unshared, unobserved

individual-level confounders, this could bias the estimates effects (Björklund & Sundström, 2006; Ermisch & Francesconi, 2001). A third concern relates to the potential strategic timing of parental separation. Although the balance tests in Table 2 show no evidence that separation timing varies systematically with observed child or family characteristics, parents might still delay separation for reasons that are not captured in administrative data, particularly given the high-stakes nature of the primary-to-secondary transition. For example, parents might postpone separation until an older sibling has completed the transition, while not applying the same delay for a younger sibling. In such cases, children classified as experiencing separation after the assessment might nonetheless have been exposed to separation-related conflict beforehand. This would bias our estimates toward zero rather than generate spurious effects (Amato & Anthony, 2014; Grätz, 2014; Johnston et al., 2025). Finally, because the high-stakes assessment at the end of primary school occurs only once, we lack repeated pre-treatment outcome measures that would allow us to test for within-family pre-existing trends. As a result, we cannot empirically verify whether siblings would have followed similar academic trajectories in the absence of parental separation.

We therefore rely on a set of complementary sensitivity analyses to evaluate the plausibility of our identifying assumptions. First, we sequentially restrict our analytical sample to sibling pairs with maximum age gaps of 5, 4, 3, and 2 years (see Appendix C, Table C1). Siblings who are closer in age are more likely to share similar developmental stages and family environments during the relevant educational transition period (Buchanan et al., 2021; Lewandowska Walter & Blazek, 2022; Whiteman et al., 2011). Restricting the age gap thus provides a meaningful robustness check, as it reduces the risk that our estimates are influenced by strategic separation timing, idiosyncratic child-level factors or time-varying parental shocks that might disproportionately affect siblings further apart in age. Although this approach cannot rule out all sources of unobserved confounding, stability across age-restricted samples increases confidence in our findings. Second, to further address concerns about strategic timing and pre-separation conflict, we exclude cases in which separation occurs shortly after the high-stakes assessment (i.e., within the same calendar year as the test). Persistence of the results after excluding these cases would suggest that anticipatory conflict is unlikely to be driving our estimates.

Results

Educational and labor market outcomes

This section presents our main results on how the timing of parental separation timing before the high-stakes primary-to-secondary school transition is associated with later educational and labor market trajectories. Across all outcomes, the inclusion of birth year fixed-effects substantially reduces the estimated associations, indicating meaningful differences across cohorts. Adding further controls for gender, parental income, and birth order do not meaningfully change the coefficients. Appendix B (Tables B1) reports the full regression specifications for the outcomes guiding secondary school track placement, incrementally adding each set of controls.

Table 3 presents the results for standardized test scores and teacher recommendations. Our findings indicate that, within families and controlling for birth order and other shared characteristics, experiencing parental separation prior to high-stakes educational gateways is significantly associated with lower test scores. Specifically, children who experienced parental separation before these secondary track placement decision appear to score, on average, 0.10 standard deviations lower than their siblings whose parents separated afterward. On the original 550-point scale, this corresponds to a decline of roughly 20 points. This is substantial given that typical scores range between 501 and 550

(Dijks et al., 2020), a range that plays a decisive role in placement into vocational, general, or pre-university tracks.

Building on the observed decline in test performance, our results also suggest a meaningful shift in teacher recommendations toward vocational tracks. The likelihood of receiving a vocational track recommendation increases by 5 percentage points (an 11.1% increase relative to baseline), while recommendations for more academically demanding tracks decline. General education and pre-university recommendations fall by 2 and 3 percentage points, respectively (7.6% and 11% relative decreases). Although teachers might attempt to compensate for adverse circumstances as suggested by the teacher compensation hypothesis, the observed declines in recommendations for higher tracks indicate that any compensatory behavior is insufficient to offset the negative impact of parental separation on children's academic achievement and subsequent placement.

Table 3. Impact of timing of parental separation relative to secondary track placement on educational outcomes at the transition of primary to secondary school

	<i>Test results</i>		<i>Teacher recommendations</i>	
	Test scores (SD)	Vocational Track	General Track	Pre-university Track
Divorce Timing (β_1)	-0.104*** (0.01)	0.051*** (0.00)	-0.016*** (0.00)	-0.035*** (0.00)
Male	-0.011** (0.00)	-0.007** (0.00)	-0.009*** (0.00)	0.011*** (0.00)
Father income	-0.003 (0.00)	0.002 (0.00)	-0.001 (0.00)	-0.000 (0.00)
Mother income	0.002 (0.00)	-0.002** (0.00)	0.002* (0.00)	0.000 (0.00)
Birth order	-0.106*** (0.01)	0.044*** (0.00)	-0.003 (0.00)	-0.040*** (0.00)
Covariates	Yes	Yes	Yes	Yes
Birthyear FE	Yes	Yes	Yes	Yes
Obs.	225,581	225,581	225,581	225,581
Mean of outcome	0	0.45	0.27	0.26

Note. Table 3 presents the estimated effects from our sibling fixed-effects model, focusing on whether parental separation occurred before or after secondary track placement. The analysis is restricted to separated families who divorce before at least one of the children is 19 years old. Test scores are standardized (mean = 0, SD = 1) to allow comparison across outcomes; on the original scale, the mean was 425 and the SD was 186. Standard errors are clustered at the full sibling level and reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.001$.

These patterns are reflected in actual enrollment changes shown in Table 4, Columns 1-3. Children who experience parental separation before high-stakes decision points at the end of primary school seem to enroll significantly more in vocational tracks by about 2 percentage points (2.8% relative increase), alongside decreases of 1.6 and 0.5 percentage points in pre-university and general education enrollment (20% and 16% relative decreases). These results indicate that separation before a key educational transition can alter children's educational trajectories through its effects on test performance, teacher recommendations, and subsequent track placement.

This shift in educational pathways appears to have lasting consequences that extend beyond initial track placement. Within separated families, children who experience parental separation before track placement decision points are about 1 percentage point less likely to complete high school by 20 (2.8 decrease relative to baseline) compared to their siblings who experience separation later. This aligns with the lower completion rates typical for vocational tracks (OECD, 2023). Thus, separation prior to this early transition not only channels children into vocational tracks but is also associated with lower graduation rates, highlighting a qualitative disadvantage among those who pursue the vocational path. We also find that children exposed to parental separation prior to the early tracking placement

decision experience a statistically significant 4-percentage point reduction in the likelihood of enrolling in college (10.6% decline relative to baseline). This is consistent with the earlier shift toward vocational pathways, which are less oriented toward continued academic study. Taken together, these results show that the timing of parental separation before an early key educational gateway can have long-lasting implications for children's educational trajectories.

Beyond educational trajectories, we also examine labor market outcomes at age 23, which approximately corresponds to the average age of bachelor's graduates or equivalent graduates in the Netherlands. Children who experienced parental separation before the high-stakes educational transition appear to be about 4 percentage points more likely to be employed and earn approximately 5 percentage points more per hour than their siblings (Table 4, Columns 6-7) (relative increase of about 3.7% and 3.3%, respectively).¹⁰ This pattern aligns with earlier findings: siblings exposed to separation before the educational gateway are more likely to enter vocational pathways, which promote earlier labor market entry and the accumulation of practical skills and work experience. These factors likely contribute to higher short-term employment probabilities and wages, in line with human capital theory. However, vocationally educated workers tend to engage in less on-the-job learning immediately after graduation, as they have already acquired work-specific skills during their education, while general education provides broader foundational skills that might foster continued skill development over the career (Tobback et al., 2024). As a result, although vocational pathways may yield short-term labor market advantages, individuals in general or higher-education tracks may benefit from stronger long-term returns. Although they might initially experience delayed entry into stable employment and lower early wages, due to prolonged schooling, more limited job opportunities and limited work experience, tertiary education is associated with higher long-term market returns (Hampf & Woessmann, 2017). Thus, while parental separation before an early high-stakes transition is associated with relatively better short-term labor market outcomes, these advantages are unlikely to persist as in the longer run educational returns materialize.

¹⁰ According to the OECD (n.d.), the average age of bachelor's or equivalent graduates in the Netherlands is 23.3 years. We also conducted a robustness check at age 24, when a larger share of higher-education graduates is expected to have entered the labor market. However, because only a small number of individuals in our sample have reached 24 yet in the year 2024 (limited to sibling pairs born between 1995 and 2000), the sample size was limited, and the results should be interpreted with caution. Nonetheless, the direction of the effects pointed in the same direction.

Table 4. Impact of timing of parental separation relative to the standardized test on educational outcomes at the start of secondary schooling and labor market outcomes

	General track enrollment	Pre-university Enrollment	Vocational track enrollment	Highschool Acquisition (20y)	University enrolment (20y)	Employment (23y)	Hourly wages (23y)
Divorce Timing (β_1)	-0.008*** (0.00)	-0.016*** (0.00)	0.024*** (0.00)	-0.055*** (0.01)	-0.041*** (0.01)	0.032* (0.02)	0.084* (0.05)
Male	-0.003** (0.00)	0.009*** (0.00)	-0.009*** (0.00)	-0.073*** (0.00)	-0.111*** (0.00)	-0.021** (0.01)	-0.010 (0.02)
Father income	-0.000 (0.00)	-0.001** (0.00)	0.002** (0.00)	-0.000 (0.00)			
Mother income	0.000 (0.00)	0.000 (0.00)	-0.000 (0.00)	0.001 (0.00)			
Birth order	0.002 (0.00)	-0.021*** (0.00)	0.018*** (0.00)	-0.096*** (0.01)	-0.056*** (0.00)	0.007 (0.02)	0.025 (0.05)
Covariates	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	225,036	225,036	225,036	107,638	107,638	9,872	8,495
Mean of outcome	0.05	0.08	0.86	0.35	0.39	0.86	2.57

Note. Table 4 presents the estimated effects from our sibling fixed-effects model, examining the timing of parental separation, specifically whether it occurred before or after the high-stakes gateways at the end of primary school, on educational outcomes at the end of secondary schooling and labor market outcomes, for the subsample of families with divorced parents. Sample sizes vary across columns: for instance, a large portion of the sample has not yet reached certain ages. For instance, some cohorts are excluded because they have not yet reached age 19. The dependent variables are listed at the top of each column. Some covariates are omitted due to perfect collinearity with family fixed-effects. Standard errors are clustered at the full sibling level and reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.001$

Moderating Analyses

To assess whether the parental timing effects vary by gender, we interact divorce timing with gender in our sibling fixed-effects model. The interaction term captures whether the effect of parental timing differs between boys and girls. Table 5 provides partial support for gender heterogeneity in sensitivity to parental separation timing (*gender vulnerability hypothesis*). Boys appear to experience a significantly larger decline in test scores when separation occurs before the high-stakes transition. The gender difference amounts to roughly one-third of the girls' effect. However, for all subsequent educational outcomes, we find no statistically or substantively meaningful gender differences. Overall, while boys appear slightly more academically sensitive to parental separation during high-stakes testing, this early disadvantage does not translate into systematically different educational trajectories compared with girls.

Table 5. Gender heterogeneity in the impact of parental separation timing relative to the tracking placement decision

	<i>Test results</i>	<i>Teacher recommendation</i>			<i>Track enrollment</i>		
	Test scores (SD)	Vocational Track	General Track	Pre-university Track	Vocational Track	General Track	Pre-university Track
Divorce Timing (β_1)	-0.092*** (0.01)	0.050*** (0.01)	0.018*** (0.01)	-0.032*** (0.01)	0.019*** (0.00)	-0.008*** (0.00)	-0.011*** (0.00)
Male	0.008 (0.01)	-0.013*** (0.00)	-0.006 (0.01)	0.016*** (0.00)	-0.011*** (0.00)	-0.003 (0.00)	0.011*** (0.00)
Divorce Timing x Male	-0.030*** (0.01)	0.005 (0.01)	-0.004 (0.01)	-0.005 (0.01)	0.001 (0.00)	0.000 (0.00)	-0.003 (0.00)
Covariates	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birthyear FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	180,630	180,630	180,630	180,630	179,932	179,932	179,932

Sensitivity analysis

Our empirical analysis has identified a significant association between parental separation occurring before an early high-stakes educational transition and children's educational and labor market trajectories within a highly tracked system. To assess the robustness of these findings and the plausibility of our identifying assumptions, we conduct several sensitivity analyses.

First, the estimated effects might be influenced by child-specific factors or parental behaviors that differ across siblings, or by strategic timing of separation around children's educational transitions. To address this concern, we implement several checks. We begin by systematically narrowing the sample to siblings closer in age, who are more similar in developmental stage and exposed to comparable family environments. This reduces within-family heterogeneity unrelated to the timing of parental separation. Table C1 in Appendix C presents the results using maximum sibling age gaps of two to five years. If sibling-specific differences or strategic timing were driving our findings, we would expect substantial variation across these specifications. Instead, the estimates remain remarkably stable. For the two key outcomes guiding secondary track placement, test scores and teacher track recommendation, the effects are consistently negative, statistically significant, and fall within a narrow range (-0.10 to -0.11 SD for test scores; 0.049 to 0.060 for vocational-track recommendation). The slightly smaller estimates in the two-year age-gap sample for both outcomes are consistent with a modest attenuation that could arise if such biases exist, but the changes are modest and do not meaningfully alter the trajectories of subsequent educational outcomes. This is further supported by

the fact that the remaining outcomes display the same stability across the different age-gap restrictions.

To further address concerns about strategic timing and pre-separation conflict, we exclude cases in which separation occurs shortly after the high-stakes placement (i.e., within the same calendar year). The persistence of our results (Table C3 in Appendix C) suggests that neither anticipatory conflict nor strategic timing are primarily driving our findings. While effect sizes increase somewhat, indicating that pre-separation conflict might play a modest role, the overall pattern and interpretation remain unchanged.

Second, one might argue that our estimates capture age-specific vulnerability to parental separation rather than timing relative to the high-stakes educational gateways. Prior research shows substantial heterogeneity in children's sensitivity to separation across ages (e.g., Anthony et al., 2014; Laird et al., 2020; Lansford, 2009; Le Forner, 2020; Steele et al., 2009; Sigle-Rushton et al., 2014). To assess this, we implement an age-gradient test designed to determine whether proximity to the transition, rather than age *per se*, drives the observed effects.

We fix the older sibling's maximum age at separation (14, 15, or 16 years) and gradually lower the younger sibling's age at separation, creating windows such as 9-14, 8-14, 7-14 and their counterparts for ages 15 and 16. This inherently reflects different distances from the educational transition for each window. If age-specific vulnerability were affecting our findings, coefficients should vary systematically within and across these fixed-age samples. The results (Table C2 in Appendix C) reveal two patterns: (1) effects are somewhat larger in the age-14 sample than in the age-15 or age-16 samples; and (2) within each age group, coefficients are more negative when separation occurs within two years of the transition. Despite this heterogeneity, the conclusion remains unchanged: across all specifications, children experiencing parental separation before the primary-secondary school transition perform worse than siblings who experience it afterward. Timing relative to the transition therefore appears more salient than age *per se*, although we cannot rule out the age-specific vulnerability.

The observed heterogeneity is informative. Larger effects when the younger child experiences parental separation within two years prior to the educational gateway, while the older sibling experiences separation only after the transition, are consistent with short-term disruption mechanisms in which impacts are strongest immediately after the separation and fade as families adjust (Amato, 2000). When separation occurs earlier, children might have partly recovered from the emotional and structural disruptions associated with divorce (Tebeka et al., 2016), even if longer-run effects persist. Smaller effects in the age-15 and age-16 samples reflect their proximity to a later, non-selective transition to upper-secondary school, where grades do not restrict track choice. This pattern reinforces that it is not separation before any transition that matters, but separation before a high-stakes educational gateway, one that shapes subsequent educational and labor-market trajectories. In our case, the primary-to-secondary transition is a decisive, selective gateway that sets off a chain of downstream consequences for subsequent education and labor market outcomes.

Conclusion

This paper leverages sibling fixed-effects and rich Dutch administrative data to examine how parental separation occurring prior to the primary-secondary school transition affects children's educational and short-term labor market outcomes. Our analysis shifts the focus from age-at-separation to the timing of disruptions relative to pivotal educational moments in shaping educational and labor market trajectories, thereby addressing a critical gap in the literature.

Our findings underscore the critical role of parental separation timing. Children whose parents separate before the primary-secondary school gateway score, on average, 0.10 standard deviations lower on standardized tests than their siblings who experience separation afterward. This aligns with prior research documenting negative associations between parental separation and academic achievement (e.g., Anthony et al., 2014; Tartari, 2015), possibly through diminished psychosocial well-being (Potter, 2010). This is also associated with an increase of about 5 percentage points in vocational track recommendations and about 2 percentage points in vocational track, and with a reduction of approximately 1 percentage point in the likelihood of completing high school. Because vocational tracks rarely lead to higher education, college enrollment is about 4 percentage points lower among children who experience separation before the educational gateway, who tend to be more likely to enter the labor market directly. Interestingly, earlier parental separation relative to the high-stakes transition is also associated with higher short-term hourly wages and employment, likely reflecting earlier vocational training and workforce entry. This pattern is consistent with human capital theory, where early specialization in vocational skills yield immediate labor market benefits, whereas investment in higher education provides delayed but potentially higher long-term returns. We caution that these short-term advantages might not persist, as the well-documented higher returns to higher education could reverse these patterns over time, potentially widening disparities later in life. Overall, our results suggest that the timing of parental separation triggers a chain of unintended consequences across children's educational and early labor market trajectories.

Although our sibling fixed-effect design substantially reduces confounding by controlling for all time-invariant family characteristics, we cannot claim full causality. Concerns remain regarding unobserved time-varying parental factors, idiosyncratic child-level characteristics, or strategic separation timing. Nevertheless, our comprehensive sensitivity analyses consistently demonstrate the robustness of the findings across a wide range of specifications, lending considerable confidence to the validity of our estimates and suggesting that any causal effect would likely align with our results. This approach rigorously identifies the average treatment effect on the treated, focusing on children from separating families with at least two siblings. The external validity remains limited, as the sibling fixed-effects model cannot empirically verify the effect for one-child or families without sibling variation.

Our findings illustrate that parental separation occurring before an early pivotal educational moment can have lasting consequences. While we study the rigid early-tracking system of the Netherlands, it is structurally similar to systems in countries such as Belgium and Hungary (Woesmann, 2009). Comparable patterns might therefore emerge around other key educational transitions in different contexts, although the magnitude is likely to vary with institutional features. Evidence from other high-stakes educational settings support this notion. Chen et al. (2021), for instance, examine parental separation around Taiwan's national college entrance exam, a decisive gateway that directly determines university access, and show that separation prior to the exam reduces children's likelihood of university admission. Although the Taiwanese system differs from the Dutch one, where university access depends primarily on the acquisition of a secondary school degree rather than a score on a single exam, both studies highlight the importance of timing and the vulnerability of students at key

educational junctures. Importantly, our results suggest that it is not parental separation before any transition that matters, but separation before a high-stakes educational gateway, one that shapes subsequent educational and labor-market trajectories. Future research should examine longer-term labor-market outcomes, as our current findings primarily capture short-term patterns, and explore whether similar timing effects arise around other early key defining educational transitions in different institutional contexts.

These results have important policy implications. First, policymakers should consider targeted interventions to buffer the disruptive effects of parental separation prior to key educational transitions, by providing for example enhanced academic and psychological support for children experiencing parental separation. More broadly, our findings underscore the need for institutional responsiveness to ensure that the timing of parental separation does not exacerbate inequalities in children's educational and later-life opportunities.

Second, our findings also contribute to the debate on whether highly tracked educational systems reinforce educational inequality, particularly in the context of parental separation as a common form of family instability. Teacher recommendations are often viewed as valuable because teachers know their students over time and can take multiple dimensions of performance into account (OECD, 2016). However, research also shows that recommendations tend to be biased against students from disadvantaged backgrounds (Batrach et al., 2023). High-stakes tests are intended to provide a more transparent, objective and efficient counterbalance to such subjective judgments, and they play an important role in tracking decisions. Yet test results themselves are shaped by socioeconomic and racial inequalities (Knoester & Au, 2015; White et al., 2016). While improved test performance can sometimes lead to upward revisions of teacher recommendations, potentially resulting in fairer placements (Inchino et al., 2026), this suggests that the potential to account for broader life circumstances does not necessarily translate into compensatory decisions. Children from divorced families often face more challenging life circumstances, and our results suggest that in such systems, parental separation occurring before key educational transitions might unintentionally amplify existing inequalities, not because parental separation is inherently adverse for all children, but because its timing influences the educational trajectory to which children are assigned. To mitigate this, policymakers might consider more flexible tracking mechanisms or opportunities for later mobility, which could help ensure that early family disruptions do not disproportionately shape long-term educational opportunities.

Appendix A

Data and Methodology

Table A1. Descriptive statistics: kids from intact families versus separated families

Groups	Separated families (n = 233,600)	Intact families (n = 913,289)	Standardized mean differences
Characteristics			
<i>Gender</i>	0.502 (0.50)	0.506 (0.50)	0.01
<i>Maternal age</i>	30.28 (4.40)	31.1 (4.27)	0.19
<i>Family size</i>	2.65 (0.91)	2.80 (1.16)	0.15
<i>Birth order</i>	1.79 (0.83)	1.90 (1.00)	0.11
<i>Generation immigrant (third generation)</i>	0.82 (0.38)	0.82 (0.39)	-0.02
<i>Father income at birth (log)</i>	10.33 (1.87)	10.36 (2.03)	0.02
<i>Mother income at birth (log)</i>	8.36 (3.44)	7.95 (3.86)	-0.11

Note. We report standardized mean differences (SMDs) rather than t-tests, as SMDs are not influenced by sample size and provide a more reliable measure of group imbalance (Austin, 2009). This approach allows us to assess differences in characteristics between kids from separated and intact families. An SMD below 0.1 indicates minimal imbalance, while values above 0.1 suggest meaningful differences between these groups of children.

Table A2. Comparison of OLS and sibling fixed-effects estimates and model fit

	OLS	Sibling FE
Divorce Timing		
β_1	-0.23*** (0.00)	-0.13*** (0.01)
Controls	Yes	Yes
R-squared adjusted	0.024	0.389
R-squared	0.024	0.665
Observations	1,146,889	1,146,889

Note. The table shows the effect of experiencing a divorce before the standardized tests and teacher recommendation at the end of primary school on test scores. Column 1 corresponds to the analysis with an OLS, while column 2 corresponds to the analysis with sibling FE. Standard errors are clustered at the full sibling level. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Appendix B

Table B1. Impact of parental separation timing relative to key educational transition at the end of primary to secondary school

	Test scores (in SD)		Teacher recommendation					
			Vocational	Vocational	General	General	Pre-university	Pre-university
Divorce Timing (β_1)	-0.11*** (0.01)	-0.11*** (0.01)	0.04*** (0.00)	0.04*** (0.00)	-0.01* (0.00)	-0.01* (0.00)	-0.04*** (0.00)	-0.04*** (0.00)
Gender		-0.01** (0.00)		-0.01** (0.00)		-0.01*** (0.00)		0.01*** (0.00)
Father income		-0.00 (0.00)		0.00 (0.00)		-0.00 (0.00)		-0.00 (0.00)
Mother income		0.00 (0.00)		-0.00** (0.00)		0.00* (0.00)		0.00 (0.00)
Birth order		-0.10*** (0.01)		0.04*** (0.00)		-0.00 (0.00)		-0.04*** (0.00)
Covariates	No	Yes	Yes	Yes	No	Yes	No	Yes
Birthyear FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	233,598	233,598	226,953	226,953	226,953	226,953	226,953	226,953
Mean	0	0	0.45	0.45	0.27	0.27	0.26	0.26

Note. Table B1 presents the estimated effects from our sibling fixed-effects mode on standardized test scores and teacher recommendations, focusing on whether parental separation occurred before or after the high-stakes assessments at the end of primary school. The analysis is restricted to separated families who divorce before the child is 19 years old. Test scores are standardized (mean = 0, SD = 1) to allow comparison across outcomes; on the original scale, the mean was 425 and the SD was 186. Standard errors are clustered at the full sibling level and reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.001$.

Appendix C

Table C1. Estimated effects of parental separation timing on educational outcomes across sibling pairs with varying maximum age differences

	2 years	3 years	4 years	5 years
Test scores	-0.10*** (0.00)	-0.119*** (0.00)	-0.109*** (0.00)	-0.11*** (0.01)
Teachers advice (VMBO)	-0.049*** (0.01)	-0.060*** (0.01)	-0.062*** (0.01)	-0.057*** (0.01)
Teachers advice (HAVO)	-0.035*** (0.01)	-0.027*** (0.01)	-0.027*** (0.01)	-0.022*** (0.01)
Teachers advice (VWO)	-0.018*** (0.01)	-0.032*** (0.01)	-0.032*** (0.01)	-0.036*** (0.00)
Post CITO Enr. (VMBO)	0.023*** (0.00)	0.026*** (0.00)	0.026*** (0.00)	0.021*** (0.00)
Post CITO Enr. (HAVO)	-0.015** (0.01)	-0.016** (0.00)	-0.016** (0.00)	-0.005* (0.00)
Post CITO Enr. (VWO)	-0.009** (0.00)	-0.011*** (0.00)	-0.011*** (0.00)	-0.016*** (0.00)
Observations	34532	83604	119937	

Note: the range of distance corresponds to the range to which most of the individuals fall into. The same for the age range.

Table C2. Estimated effects of parental separation timing on test scores, based on sibling pairs selected by minimum and maximum age at divorce

Max. Window	Range	Observations	Test scores
0-2	12-14	8,116	-0.19*** (0.00)
	12-15	17,586	-0.18*** (0.03)
	12-16	27,988	-0.17*** (0.02)
0-3	11-14	19,191	-0.16*** (0.01)
	11-15	30,291	-0.12*** (0.02)
	11-16	41,330	-0.12*** (0.02)
0-4	10-14	32,416	-0.16*** (0.01)
	10-15	44,124	-0.11*** (0.01)
	10-16	55,381	-0.13*** (0.01)
0-5	9-14	47,014	-0.12*** (0.01)
	9-15	59,038	-0.12*** (0.01)
	9-16	70,410	-0.12*** (0.01)
0-6	8-14	62,550	-0.12*** (0.00)
	8-15	74,708	-0.13*** (0.01)
	8-16	86,094	-0.12*** (0.00)

Table C3. Impact of parental separation timing relative to high-stakes transition on educational outcomes, excluding separation occurring shortly after the transition

	Full sample, excl. separations occurring shortly after the transition
Reported coefficient	Divorce Timing (β_1)
Test scores (obs. 201,959)	-0.12*** (0.01)
Vocational advice (obs. 201,959)	0.055*** (0.00)
General education advice (obs. 201,959)	-0.015*** (0.00)
Pre-university advice (obs. 201,959)	-0.040*** (0.00)
Vocational enrollment (obs. 201,463)	0.030*** (0.00)
General education enrollment (obs. 201,463)	-0.008*** (0.00)
Pre-university enrollment (obs. 201,463)	-0.019*** (0.00)
High school acquisition (obs. 96,299)	-0.075*** (0.01)
University enrollment (obs. 96,299)	-0.057*** (0.01)

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SESSION 10

Ideology, Beliefs, and Education

16 September, 16.25–17.40

Causes of Economic Differences: When Internal Locus Meets External Controllability

Franco Bastias

When Identities Coexist: Education Policy and Minority Identity Integration

Laura Howells

Fair Chances, Fair Outcomes? Educational Opportunities and Meritocratic Beliefs in Europe

Triin Lauri

Causes of economic differences: When Internal Locus Meets External Controllability

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Attribution theory is one of the most widely used theoretical frameworks for understanding how people explain economic differences. However, through a systematic review, we found that most research has been built upon the idea that perceived causes reside either within (internal to) or outside (external to) the economically disadvantaged person. In the case of economic inequality, this distinction may be limiting, as factors that appear to lie “within the person” may nevertheless fall outside individual agency. Educational attainment and skills illustrate this issue. Although their locus may be considered internal, it is strongly shaped by conditions beyond the individual’s control. Motivated by the distinction between locus and controllability, in a subsequent study we sought to examine the relationship between these dimensions in the context of economic differences. Our survey conducted across different countries reinforces this conceptual distinction: judgments about who causes economic inequality differ substantially from judgments about who could and should reduce it. Structural actors, particularly governments, are assigned responsibility more frequently than they are identified as causal agents, while actors perceived as contributing to inequality are not necessarily expected to address it. Overall, the evidence shows that causal attributions and responsibility judgments are related but non-equivalent dimensions, at least in the case of economic inequality.

When Identities Coexist: Education Policy and Minority Identity Integration

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ABSTRACT

How do nation-building policies shape minorities' identities? Existing scholarship predicts two zero-sum responses: assimilation into national identity at the expense of ethnic identity or retrenchment into ethnic identity at the expense of national identity. I introduce a conceptual framework systematizing minority identity responses to nation-building policy and develop a theory of identity compatibility to explain non-zero-sum responses. I theorize that contexts permitting dual identification, including when elite narratives and policies are more inclusive, enable national identity to grow without eroding ethnic attachments. Applying this framework to original panel survey, administrative, and qualitative data collected before and after Estonia's 2024 Russian-language schooling ban, I find that affected Russophone parents experienced a significant increase in national belonging while maintaining strong ethnic attachments. The policy also loosened perceived criteria for membership in the national community, making dual identification more feasible. These findings have implications for the study of integration, nation-building, and ethnic politics.

Fair Chances, Fair Outcomes? Educational Opportunities and Meritocratic Beliefs in Europe

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Rising economic inequality has not been matched by rising demand for redistribution. This puzzle is resolved once inequalities are understood as consequential only when perceived as unfair, with meritocratic beliefs among the central mechanisms legitimising unequal outcomes (Cavaillé, 2023; Mijs, 2021). While social position is known to shape such beliefs, less is known about how perceptions of educational opportunity feed into this relationship. As the first exploratory paper of the ERC-funded EDUMERIT project, we ask why education systems that reproduce inequality still tend to be perceived as fair. Using ESS9 Justice and Fairness data and survey-weighted generalised linear models with country fixed effects, we distinguish three dimensions of meritocratic legitimacy — descriptive meritocracy, prescriptive meritocracy, and belief in a just world — and test whether objective and subjective social position, and reflexive and non-reflexive evaluations of educational opportunity, shape and moderate one another. We find that social position alone predicts legitimacy beliefs more weakly than expected, while perceived educational opportunity is strongly linked to descriptive meritocracy, moderately to belief in a just world, and only weakly to prescriptive meritocracy, moderating social position's effect unevenly and reinforcing legitimacy most among already advantaged groups. Reflexive and non-reflexive evaluations of educational opportunity moderate this relationship differently across social classes: own educational opportunities reinforce descriptive meritocracy most among already advantaged groups, whereas societal educational opportunities reinforce belief in a just world most among less advantaged groups.