Preschool or Parenting? Helping disadvantaged minority children catch up in skills*

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Abstract

We investigate the contributions of preschool and parenting to early child development skills in disadvantaged Roma communities in Bulgaria. We present experimental evidence that combinations of information and monetary incentives increase preschool enrollment but also led to lower parental investments and thus lower child development after 1 year. To rationalize these results, we estimate a child development production function using experimental variation in inputs to identify its structural parameters. We find that the marginal product of parental investment is large even for the most disadvantaged Roma parents, in fact larger than the marginal product of preschool attendance. Our counterfactual calculations show that the interventions would have had large positive effects on child development absent the reduction in parental investment. Moreover, 69% of the observed gap in child development between Roma children and the majority Bulgarian children is explained by differences in parenting investments, whereas only 27% by differences in preschool participation. The strong contribution of parents to child development favors policies that promote combinations of preschool participation and parental stimulation, even when parents are extremely disadvantaged.

Keywords: Early child development, Preschool education, Parental investment, Human capital production function, Randomized control trial, Structural model

JEL classification codes: C93, I21, I24, I26, I28, J13, J24, 015

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1 Introduction

There are well-documented disparities in early childhood development between socioeconomically advantaged and disadvantaged children. These gaps are widespread and exist in both developed (Pillas et al. 2014; Bradley et al. 2002; Kelly et al. 2011; Waldfogel et al. 2011) and developing countries (Lu et al. 2020; López Boo 2016; Schady et al. 2015). Disparities emerge in the first two years of life (Fernald et al. 2012), widen between ages 3 and 5 (Kelly et al. 2011), and persist throughout adolescence into adulthood (Attanasio, Lopez-Boo, et al. 2024). The development penalty for disadvantaged children does not dissipate once they enter school (Schady et al. 2015), but expands over time, leading to a wide range of poor socioeconomic outcomes in adulthood (Grantham-McGregor et al. 2007).

Preschool is often promoted as a promising intervention to improve early child development, especially for disadvantaged children to help them catch up to more advantaged children (L. M. Richter et al. 2018). However, the evidence on the impact of preschool on child development is decidedly mixed.[1] There are several potential reasons for this, the most well documented being variation in preschool quality and the way teachers (do not) support disadvantaged children (Jackson et al. 2014; Goldhaber et al. 2015; Andrew et al. 2024). However, the literature has not paid much attention to another potential reason, which is that the impact of preschool participation diminishes if parents view preschool as a substitute for parenting, that is, their own investment in child development at home.[2] How substituting preschool for parenting impacts child development depends on their relative marginal productivities and the extent to which they are substitutes or complements in the production of early childhood skills.

This paper investigates how parenting and preschool shape early child development in Bulgaria, a country with one of Europe's largest Roma minority populations. Roma are the

[1] Preschool programs such as Head Start, Perry, and Carolina Abecedarian have shown high returns in the United States (Ludwig et al. 2007; J. J. Heckman et al. 2010; J. L. García et al. 2017; J. Heckman et al. 2013) as well as similar programs that have a positive impact in Denmark (Rossin-Slater et al. 2020), Argentina (Berlinski, Galiani, et al. 2009), Spain (Felfe et al. 2015), Germany (Hermes et al. 2024), Ivory Coast (Yeo et al. 2024), and Mozambique (Bassi et al. 2025). However, preschool does not always improve child development; studies show that preschool did not improve subsequent educational outcomes in Norway (Drange et al. 2016), France (Goux et al. 2010), Denmark (Gupta et al. 2010), Canada (Baker et al. 2008), Cambodia (Bouguen et al. 2018), and Italy (Fort et al. 2020).

[2] There is a large body of literature that highlights the crucial role of parenting in child development. See Schwartz et al. 2024, P. R. Britto et al. 2017 and Attanasio, Cattan, and Meghir 2021 for literature reviews

largest ethnic minority in Europe, with population estimates of around 10-12 million, most of whom live in nine European countries (Lecerf 2025). The vast majority live in marginalized conditions as 80% of Roma live in poverty compared to 17% of non-Roma.[3] There is also a striking disparity in education. Roma have substantially lower educational attainment, and the education gap starts early. Only 53% of Roma children attend preschool, less than half the share of the general population and well below the 95% EU target.

The first part of this study investigates how the provision of information to parents and the removal of financial barriers to preschool impact preschool participation, parental investment, and early childhood development skills using a large-scale cluster randomized field experiment in marginalized communities with large concentrations of Roma. The interventions include (i) information and promotion campaign, (ii) elimination of kindergarten fees, (iii and iv) two additional levels of financial incentives for parents, and (v-vii) combinations of the information and promotion campaigns with the 3 levels of financial incentives plus (viii) a control group. The design was originally intended to generate experimental variation to estimate the demand for preschool and how information shifts this demand function.

The experiment randomized 236 marginalized communities with substantial Roma populations into one of the 8 study arms. The study population included both minority Roma and majority ethnic Bulgarian families living in these same marginalized communities with access to the same preschools. The study sample included 5,772 children aged 3-6 years, of which 77% were Roma. One year later, 4,863 (84%) were resurveyed. We measured the one-year impact on three key outcomes: (i) preschool participation (enrollment and attendance), (ii) parental stimulation activities at home (reading books, telling stories, singing, playing with toys, naming, drawing and counting), and (iii) child development skills (language, numeracy, socio-emotional, and motor). Child development skills were measured directly using Save the Children's International Development and Early Learning Assessment (IDELA), which consists of 22 directly observed exercises that the child completes in person.

We find that the interventions significantly increased preschool participation among children who had not previously been enrolled. Across all treatment groups, enrollment rates exceeded the control group by 26 percentage points (pp), and attendance rates by 0.40 stan-

[3] https://fra.europa.eu/en/publication/2016/second-european-union-minorities-and-discrimination-survey-roma-selected-findings.

dard deviations. Notably, we find similar treatment effects across different combinations of interventions (information campaigns, free access, and additional financial incentives), suggesting not only that addressing any single barrier was sufficient to improve participation but also that the demand curve is inelastic at lower prices.

However, there were also negative treatment effects on development skills among children who had not been previously enrolled. Across all treatment groups, children scored 0.14 standard deviations lower in numeracy and, although not statistically significant, they also showed decreases of 0.08 and 0.12 standard deviations in literacy and socio-emotional skills, respectively.

These findings raise a critical question: why did increased preschool participation not improve development and possibly lead to lower levels of development? Additional findings reveal a possible explanation. Although the interventions increased preschool participation, they also led to a 0.25 standard deviation decrease in parental investment in stimulative activities at home, suggesting that parental investments at home were being substituted for preschool participation. Child development can be negatively impacted both directly through the reduction in parental investments, and indirectly if parents are not reinforcing preschool activities at home, thus reducing the marginal productivity of preschool.

Although the experiment targeted all families in the selected marginalized communities, there may have been differential effects on Roma versus ethnic majority children. There are a number of reasons why preschool might have a different effect on development for Roma children. First, Roma parents may reduce parenting more than Bulgarian parents. Second, the marginal productivity of schooling may be lower for disadvantaged children because (i) language or cultural differences that could make it difficult for Roma children to benefit from school activities, (ii) Roma children may need specific help that teachers may not be able or willing to provide, and (iii) teachers and majority students might discriminate against Roma children, and (iv) Roma parents may be less likely to reinforce school lessons at home because they have lower levels of education and educational aspirations for their children.

In fact, we find that the intervention significantly reduced development outcomes for Roma children but had no significant impact on majority children. Specifically, the interventions reduced the aggregate skill index by 0.18 standard deviations more for Roma. However, there

were no significant differences in the effects on preschool participation or levels of parenting involvement, suggesting that differences in the effects on development are likely driven by differences in marginal productivity.

To investigate differences in productivity and, more generally, contributions of parenting and preschool to child development, we estimate a structural production function of child development skills with preschool participation and parenting activities as inputs. We identified the parameters using the variations in these inputs induced by the experiment. Specifically, we non-parametrically estimate the expected levels of preschool attendance and parental investment conditional on treatment assignment, age, and gender, and then estimate the production function taking a control function approach using the estimated conditional expectations of the inputs as instruments.

The results show that for all skills the marginal product of school attendance is greater for majority than for Roma children, but that the marginal product of parental investment is greater for Roma. For the median ethnic Bulgarian majority child, a one-standard deviation increase in parental investment has approximately the same marginal product as a one-standard deviation increase in school attendance, whereas for the median Roma child, a one-standard deviation increase in parental investment has a larger marginal product than a one-standard deviation increase in school attendance. These results help to explain why the interventions differentially affect Roma and majority children. They are also important by themselves, as it means that even extremely disadvantaged parents can make a large contribution to their child's development.

Moreover, our results reject the perfect substitution between parents and preschools, so the productivity of each input increases when the other input increases. This result implies that interventions that promote preschool at the expense of parental investment may deteriorate child development, both through the first order effect of reduced parental investment and through the indirect effect of reducing the marginal productivity of schooling.

We also use the production function estimates to conduct counterfactual exercises to explain the observed differences in child development skills between Roma and majority children. These results show that closing the gap in parental investment between Roma and majority children would reduce the observed difference in child development by 65%,

whereas closing the gap in school attendance would reduce it by only 27%. Moreover, absent a reduction in parental investment, the increase in preschool participation induced by the interventions would have produced large positive average treatment effects on child development of 0.19 standard deviations overall. The reduction in parental investment is therefore responsible for the disappointing effect on child development and not the lack of quality of preschools. The implication is that the best policy to foster the development of disadvantaged children is a combination of access to formal preschool education and parenting support, a combination that is rarely promoted together.

This paper makes several important contributions. First, we contribute to the literature on the demand for education. This literature already documents the separate effects of price and information on the demand for education (on price Baker et al. 2008; Duflo et al. 2015a; Duflo et al. 2021; Giacobino et al. 2024; S. García et al. 2022; Lucas et al. 2012, on information Jensen 2010). We advance this literature by analyzing how price and information interact across multiple price points, including both positive and negative values, to influence preschool demand. Our findings yield two novel insights. First, while confirming that eliminating direct preschool costs helps close the participation gap between disadvantaged and advantaged children, we provide the first empirical evidence that the information campaign and free access act as substitutes rather than complements. This finding points to the importance of building proximity and togetherness between schools and minority parents who may feel distant and discriminated in the education system. Second, we demonstrate that negative prices through conditional cash transfers to parents do not further stimulate demand once free access is provided and parents have been proactively informed about preschool enrolment and its potential benefits.

Our second contribution enriches the literature on child development production functions. Recent work highlights the interactions among children's health, cognitive and socio-emotional skills, and parental investments (Agostinelli et al. 2025; Attanasio, Cattan, Fitzsimons, et al. 2020; Attanasio, Bernal, et al. 2020; Cunha et al. 2010; Attanasio, Meghir, et al. 2020; Del Boca et al. 2014; Berlinski, Ferreyra, et al. 2024). We extend this research by providing the first structural estimation of a production function that incorporates experimental variations in both preschool attendance and parental investment. Our analysis yields

a crucial insight: parents and preschools are complementary inputs in producing child outcomes, which adds to the evidence that increasing one input may be ineffective if it reduces another (Duflo et al. 2015b; Beasley et al. 2017; Andrew et al. 2024). This complementarity carries important policy implications: effective early childhood interventions may simultaneously need to promote both parental involvement and preschool participation to raise child development skills. Our estimates of the relative productivity of parents and preschools complement the experimental findings of Özler et al. (2018), who show that improving classroom quality alone does not raise child outcomes without parallel increases in parental inputs.

Finally, our findings contribute to the vast literature on the importance of parents in early child development. While a strong consensus supports the effectiveness of parenting programs (P. R. Britto et al. 2017; Attanasio, Cattan, and Meghir 2021), our findings reveal a crucial insight: disadvantaged parents substantially contribute to their children's human capital formation even without formal education or outside parenting support. This finding aligns with recent research showing that disadvantaged parents often underestimate the returns to educational investment, which adversely affects their investment decisions (Attanasio, Cunha, et al. 2019; Attanasio, Boneva, et al. 2019; Attanasio, Cattan, and Meghir 2021). Our results challenge conventional assumptions about parental capacity in disadvantaged communities: rather than viewing disadvantaged parents primarily as barriers to their children's development, policy should recognize them as essential contributors to human capital formation and actively encourage their involvement, also among extremely disadvantaged parents.

2 Institutional Context and Experimental Design

In Bulgaria, 86% of Roma lived below the poverty line compared to 22% of the general population (EU-MIDIS 2017). In 2011, the year with the most recent data on preschool enrollment before the start of this study, 45% of Roma children aged 3-5 years were enrolled in preschool compared to 75% of the general population (The World Bank 2012). The vast majority attend a full-day of public preschool. The quality of school is in line with European standards: the average class size is around 20 pupils with two well qualified teachers, most of whom have a Masters' or a Bachelor degree. Children benefit from structured learning

activities in the morning. They receive a nutritional snack in the morning, lunch, and then another snack in the afternoon. In the afternoon they first take a nap and then play until 5pm. Preschool funding is shared between the central government, local governments, and families.The fees paid by families are determined by local governments and collected directly by preschools.

2.1 The Springboard for School Readiness (SSR) Interventions

SSR is a set of demand side interventions designed to address three main reasons why children may not enroll and regularly attend preschool: (1) parents may lack awareness around the benefits that preschool may provide around early stimulation of children and later success at school, or lack awareness around more practical issues such as enrollment procedures, fees, or the nature of the curriculum; (2) parents may feel that they are not be able to afford the preschool fees; and (3) parents may be reluctant to enroll their children for other reasons such as concerns for discomfort, a preference to keep the child at home, etc. The specific interventions are described below.

Information and mediation The information campaign consisted of five public community meetings of 45 to 90 minutes each for a total of at least 6 hours over a 10 month period. The meetings were held at local preschools. The meetings were advertised by social workers and posters. The campaign provided parents with information on the benefits of preschool in an effort to raise awareness about its importance for their children's subsequent education and professional life. The campaign also tried to help parents feel more comfortable sending their children to school by addressing the concern that cultural differences and stigma can undermine school participation, especially for minorities. One session was a presentation by the teachers and another session was an "open house" where parents were invited to class. The sessions also promoted interaction between parents and kindergarten officials. The concept was thus both a mediation and an information campaign. The meetings did not address home-learning environments and activities. The design and content of the information sessions are discussed in detail in Appendix Table A1.

Free full-day preschool The full cost of preschool is paid directly to the school by the program implementing agency, so that the cost is not a barrier for enrollment and attendance.

The cost includes enrollment and attendance fees, food and supplies, and laboratory tests (stool and urine) required for enrollment.

Free full-day preschool + small incentive A small financial incentive is added to the free preschool. The incentive is a monthly bonus offered to the family on the condition that the child attended full-day preschool daily with the exception of absences as a result of illness. School attendance was monitored through administrative records and administrative records were audited with 3 random visits to the preschool by the implementing agency. The monthly bonus was small at BNG 7 (approximately Euro 3.5), which represented 20% of the child benefit allowance.

Free full-day preschool + large incentive A large financial incentive is added to the free preschool. The monthly bonus was BNG 20 (approximately Euro 10), which represented 60% of the child benefit allowance. Again, the bonus was paid conditional on attendance.

2.2 Study Population

The study targeted communities with large Roma populations identified using a 2007 community listing prepared by the Open Society Institute (OSI). The list contained all Bulgarian settlements with at least 10 households considered Roma by both experts and local authorities. From this list, the study selected all communities that satisfied the following criteria: (i) have at least 75 households and 25 children age 3 to 6 by September 2014; (ii) children should have to walk no more than 30 min to school unless free public transportation was provided; and (iii) there should be space available for at least 15 additional children in the preschool. Of the 700 listed by OSI, these criteria were met by 236 communities.

In the selected communities 60% of households self-identified as Roma, 23% as ethnic Bulgarian, and the remaining 17% as ethnic Turkish.Turkish are another minority in Bulgaria that lag behind in terms of socioeconomic outcomes compared to majority Bulgarian households. Many Roma are Muslim, speak Turkish, and self-identify as Turkish(Carlsson 2023). In the study, we pool together Roma and Turkish households and refer to this group as Roma for the sake of simplicity. We test for, and mostly reject, significant differences in baseline socio-economic characteristics between Roma and Turkish households.

In April 2014, in each community OSI identified 25 children who would be aged 3-5 at

the start of the September 2014 school year, regardless of their background. If there were more than 25 children in a given community, OSI randomly selected 25 using a random walk from five randomly chosen GPS points. If there were fewer than 25 eligible children, all were selected. All participants provided informed consent before joining the study. Altogether 5,772 children were selected. Figure 1 summarizes the selection procedure.

2.3 Random Assignment

A public lottery to assign the interventions to communities was organized on June 30, 2014 in the presence of representatives of the Ministry of Education, the National Association of Municipalities in Bulgaria, mayors, directors of preschools, and NGOs. Using information from the baseline survey, the random assignment was stratified by the implementing NGO and minimal distance in the number of available spots at preschool. Each stratum contains eight communities.

Within each stratum, we implemented a two-step randomization. First, two communities were randomly assigned to one of four financial conditions: free preschool, free preschool + BGN 7 bonus conditional on attendance, free preschool + BGN 20 bonus conditional on attendance, and no financial intervention. Second, within each pair of communities assigned to a financial condition, one community was assigned to the information campaign and not the other one. This resulted in eight experimental groups of 29 or 30 communities each, as represented in Figure 2.

Figure 3 shows the geographical distribution of the financial interventions across communities on a map of Bulgaria. It does not represent the allocation of the information campaign across the communities, which was equally distributed to half of the communities within each financial intervention. One color stands for one financial intervention: yellow for control communities, blue for free access communities, green for free access + BGN 7 incentive communities, and red for free access + BGN 20 incentive communities. Four communities in which TSA carried out a pilot study during 2013-2014 (and for that reason are excluded from this evaluation) are displayed as orange stars.

3 Data

3.1 Data Sources

A baseline survey was carried out in April-May 2014 to collect information on the communities, the preschools, and the households. In each community, the mayor, the preschool director, and a community leader were interviewed, as well as the 5,772 sampled households. The baseline survey captured information on demographics, education, literacy, numeracy, and employment of household members, as well as information on child rearing and interaction practices, and attitudes toward parenting and education. It also included information on assets and dwelling characteristics. There were 427 refusals (7%).

The endline survey was conducted by OSI in April-May 2015 and provided complete information from both parents and children for 4,863 of the 5,772 original sample of children, representing a response rate of 84%. In general, attrition was due to the fact that households and/or children were not available or not at home at the time the interviewer visited them. In addition to repeating baseline survey questions, the endline survey also included direct measures of child development using the International Development and Early Learning Assessment (hereafter, IDELA) developed by Save the Children. IDELA consists of 22 small exercises to assess four developmental areas: motor, literacy, numeracy, and socio-emotional development. The questionnaire was administered at home by a trained enumerator. The original questionnaire was written in Bulgarian, but enumerators adjusted to children's preferred language. Save the Children provided training to the enumerators.[4]

In addition to attrition, there are missing values or record mistakes for some of the responses to the baseline survey. Instead of dropping these observations we used a multiple imputation by chained equations algorithm. The method consists of assuming missing observations take the median value, then regressing all observations on the remaining observables and finally, replace the median imputations by the predictions that the resulting model produces.

[4]Save the Children conducted in depth quantitative analysis of item functioning, internal consistency, inter-rater reliability and construct validity. With testing and input from multiple country teams, the tool has resulted in 2015 in a 22-item assessment that balances psychometric rigor, feasibility, and international applicability. As a result, IDELA is easily translated and administered in varied cultural contexts, and has strong reliability and validity. See IDELA's website https://idela-network.org/ for more information on the tool used for this project.

Finally, three unannounced attendance checks were carried out by OSI at the preschools during April-May 2015. During these checks, someone from the OSI team would make an unannounced visit to the preschool and verify which children were present and which children were not. Given the strategic nature of attendance in some treatment groups as well as the risk of social desirability, relying on an objective measure from unannounced visits was necessary to guarantee unbiased attendance estimates.

3.2 Variables of Interest

Preschool participation: We consider two measures of preschool participation: enrollment and attendance. These measures were constructed combining data collected during the baseline and endline surveys as well as records from the unannounced visits to the schools and administrative data on enrollment provided by the Bulgarian authorities. At baseline, enrollment is self-reported by parents, while at endline we also had access to administrative data.[5] Since enrollment is a minimal notion of school participation, we favor preschool attendance in our analyses, using the unannounced visits to schools. There were three visits during the intervention, thus, the number of times each child was found ranges from 0 to 3. To facilitate comparison with measures of parental investment, we divided the attendance count by its standard deviation. This count of visits is the main measure of school participation throughout the study.

Parental investment: We measure parental investment using questions from surveys related to the interactions between the child and the parents. Each question asked whether in the past three days the parents had performed certain activities with their children. The specific activities were reading books, telling stories, singing, playing with toys, and naming, drawing and counting; the answer to each question was binary. To aggregate all the answers in a single summary index, we took the sum of all the replies as the outcome of interest and divided it by its standard deviation. This variable was constructed using the exact same procedure and variables at baseline and endline.

[5]Naturally, there are some discrepancies between the self-reported and administrative data, In our final sample, there is no response to the enrollment question for 1.3% of the children, 3% declared not to be enrolled but were found in the school records and 7% reported to be enrolled but were not found in the administrative data. Despite this discrepancies, we found no substantial differences when using one or the other variable in our analyses.

Parental investment: To measure developmental outcomes we used the IDELA tests administered at endline, designed to measure literacy, numeracy, socioemotional and motor skills. This tool is composed of 22 exercises and provides a simple way to measure the four skills of interest by calculating the score that each child obtained in the associated portion of the test. To facilitate comparison without ignoring the relative difficulty of each question, we divided all the scores by their sample standard deviation.

Socioeconomic variables: Socio-demographic covariates were also collected on the household and household members, such as gender, age, employment status, income, an index of durable goods and amenities, parental expectations, and the educational attainment of parents. These variables are all constructed from the baseline survey and remain fixed throughout the study to guarantee that they are uncorrelated with treatment assignment. Parental expectations is the ideal age to stop education as well as a dummy indicating that parents expect their child to complete secondary education, because in our data most of the variation concentrates at this level of education. Similarly, for parental education, we distinguish between parents who completed only preschool and parents who completed secondary education and those who did not. Table A2 presents a summary of our main variables and their measurement.

4 The Gap Between Roma and Bulgarian Children

4.1 Development Skills and Inputs

Table 1 presents descriptive statistics at baseline and reports differences in means between minority (mostly Roma) and majority (ethnic Bulgarian) children.[6] As our sample is composed of households living in communities with at least 10 households considered as Roma, we should also keep in mind that the Bulgarian households in the sample are likely more disadvantaged than the general Bulgarian population. To account for the multiplicity of hypotheses we implement the bootstrap based method of Romano et al. (2005) using the

[6]The minority Roma group includes not only Roma (77%) but also Turkish (23%). Appendix Table A4 presents the means of characteristics separately for Turkish and Roma children showing no difference between the groups. Contrary to the majority-minority comparison, most p-values are not significant when we compare Turkish and Roma, suggesting that these two groups share similar characteristics and can reasonably be grouped together.

Stata 16 command rwolf (see Clarke et al. 2020) to test the hypothesis that the means of the groups are equal.

Panel A shows the means of child development outcomes including literacy, numeracy, socio-emotional, motor and an aggregate skills index at endline in the control group. We find significant differences in all four outcomes with the biggest difference concerning literacy: majority children scored on average 1.14 standard deviations, whereas minority children 0.85 standard deviations (0.87 for Roma and 0.78 for Turkish), which means a sizable gap of almost a third of a standard deviation. The majority-minority gaps in numeracy, socio-emotional skills, and motor skills amounted to, respectively, 23, 13, and 22 percent of a standard deviation. Majority children thus clearly outperformed minority children at endline in the control group.

Panel B repeats the same exercise for baseline differences using all treatment and control groups. In terms of child development inputs, we find a significantly lower preschool enrollment rate for minority children (61% compared to 78% among Bulgarian), as well as consistently lower levels of parental investment in stimulative activities. The majority-minority gap in the summary index of parental investment is 0.31 standard deviations. The biggest difference is in reading books, which only 41% of minority parents reported having done in the last three days compared to 71% of majority parents. Therefore, both school participation and parental investment were highly differential according to ethnicity.

4.2 Socio-economic Characteristics

We find several plausible explanations for the differences preschool participation and parental investments. One is that minority parents have lower educational attainment: only 12% completed secondary education compared to 48% of Bulgarian parents. Minority parents also report lower expectations regarding the educational accomplishment of their offspring, with 76% expecting their child to complete secondary compared to 90% of majority parents. We also find large differences in income and in the assets and dwelling index, amounting to respectively 41% and 159% of a standard deviation. Our results illustrate the multiplicity of dimensions in which Roma and Turkish children experience disadvantages compared to Bulgarian.

These descriptive statistics also provide evidence that majority households in our sample are more disadvantaged than the general population in Bulgaria. In fact, only 48% of Bulgarian parents in our sample completed secondary education, compared to 74% in the total population aged 25 or more at the time of the survey in 2014.[7] Unemployment is also much more prevalent in our sample, 30% of Bulgarian households unemployed, compared to 11% in the general population in Bulgaria in 2014.[8] In our study, Bulgarian parents were thus also highly disadvantaged compared to the average household in Bulgaria, which should be kept in mind for the interpretation of our following analyses.

4.3 Explaining Differences

We next investigate the extent to which socio-demographic and parental characteristics account for the majority-minority gap in developmental inputs. We do this by estimating the following equation using a linear regression model:

$$y_{icpga} = \mu_{rt} + \beta X_{ipc} + \mu_g + \mu_a + \epsilon_i \tag{1}$$

In this equation, y_{ipcga} represents the resp. input (baseline enrollment or baseline parental investments) for child i of parents p in community c whose gender and age are g and a respectively. The term μ_{rt} is a Roma-Turkish (rt) minority fixed effect while μ_g and μ_a are gender and age fixed effects respectively. The matrix X_{ipc} entails parental characteristics. The term ϵ_i captures the remaining unobserved variation. As there is no guarantee that ϵ_i is uncorrelated with the regressors, our results merely shed light on correlations and should not be interpreted as causal relations.

Table 3 shows the results from estimating multiple versions of equation 1 by ordinary least squares. Columns 1-5 focus on the determinants of baseline enrollment. Column 1 only includes the Roma dummy while leaving out all other controls, while columns 2-5 successively add controls. Column 1 shows that Roma children are 17% less likely to be enrolled, while Column 2 shows that this difference is not attributable to demographics (age and gender). Columns 3 and 4 show that both income and parental expectations are highly correlated with

[7] https://data.worldbank.org/indicator/SE.SEC.CUAT.UP.ZS?locations=BG
[8] https://www.macrotrends.net/global-metrics/countries/BGR/bulgaria/unemployment-rate

enrollment and capture about 7 percentage points of the observed Roma-majority difference, while unemployment is not. Column 5 shows that, conditional on income and parental expectations, parental education is not significantly associated with enrollment. Next, Columns 6-10 focus on baseline parental investments. Columns 6 and 7 show that Roma children receive 0.31 less standard deviations of parental investment and that this difference is not linked to demographics either. Columns 8, 9 and 10 show that household income, labor participation, parental expectations, and parental education partially account for the parental investment gap. In total, all observed parental characteristics account for about half of the majority-minority gaps in developmental inputs, with differences in parental expectations accounting for a large share of the gap.

5 Average Treatment Effects

5.1 Estimation

The experimental design allows us to estimate the average treatment effects of the interventions on developmental inputs (preschool participation and parental investments) by comparing these outcomes in the control group and the different treatment groups. Table A3 provides evidence that we cannot reject the null that the baseline characteristics of each treatment group are statistically identical to those of the control group. To increase estimation precision, we estimate treatment effects adjusted for baseline covariates (age, gender, parental characteristics) using machine learning techniques to approximate an additively separable, potentially non-linear nuissance function following the approach developed by Chernozhukov et al. (2018) known as double/debiased machine learning. The outcomes of interest and treatment dummies are defined by the following two equations:

$$y_{icpga} = D_{it}\theta_t + g_0(X, a, g, rt) + \varepsilon_i, \quad . \tag{2}$$

$$D_{it} = m_0(X, a, g, rt) + \nu_i, \quad , \tag{3}$$

Where D_{it} indicates that child i was assigned to treatment t, and $g_0()$ and $m_0()$ are nuisance functions that we allow to depend on observable characteristics such as age, gender,

ethnicity, parental expectations, parental educational attainment, income and employment status, as well as missing value indicators for all the variables included in our analysis. The terms ϵ_i and ν_i are assumed to have mean zero conditional on the treatment assignment and the components of the nuisance functions. To estimate the partially linear model described by equations 2 and 3, we use the double/debiased machine learning algorithm of Chernozhukov et al. 2018 as implemented by the Stata 16 package *pdslasso* developed by Ahrens et al. 2020. Since the randomization varies across communities rather than households, we cannot rule out potential unobserved correlation between outcomes for children within the same community so all the reported standard errors and inference results are obtained using cluster robust procedures at the community level.

Finally, the interventions are obviously more likely to affect children who were not enrolled at baseline. Children already enrolled at baseline should not react to the interventions except for those at risk of dropout whom the interventions may help stay in preschool. Since we do not expect many dropouts, we hypothetize that the treatment effects should concentrate on the non-enrolled and perform the analysis separately on children not enrolled at baseline survey and on those who were already enrolled.

5.2 Preschool

Table 4, columns 1-4 present estimation results for the average treatment effects of the interventions on preschool enrollment and attendance. Panel A shows the *pooled* treatment effect, *i.e.*, the treatment effect that results from comparing the control group to all the treated observations regardless of their intervention. As expected, we did not find any impact on children who were enrolled in at baseline. However, we find a significant increase of 26 percentage points in enrollment among children that were not enrolled (a 43% increase over the control group) and a 0.40 standard deviation increase in attendance. Panel B of Table 4 reports the average effect of each specific treatment arm. We find consistent increases in enrollment and attendance across all treatment types.

How did the intervention influence preschool participation decisions? The monetary incentives work through prices and the information intervention may have changed parental beliefs about the value of preschool and perceptions about the child feeling welcomed at

school. Each of the monetary incentives arms covered the fees collected from the parents by the kindergartens. The average annual per child amount collected by full-day kindergartens - attended by approximately 92% of all children - was estimated BGN 183 in 2014, or approx. 18 BGN per month, according to official data, and covered infrastructure maintenance, as well as part of the running non-wage operating costs such as food, transportation, materials and similar items (in comparison, the average per child central governmental financing of full-day kindergartens was BGN 1655 in 2014). With self-reported net income at 273 BGN per month for Roma and 412 BGN per month for majority households, many parents in our sample may have considered the fees to be a substantial barrier. That the addition of extra transfers conditional on attending did not systematically raise participation further points to non-financial barriers and may help explain why the information arm was similarly effective. As Table A7 shows, the interventions changed some perceptions for parents whose child was not already enrolled at baseline. First, across all treatments the interventions increased perceived respect toward Roma and Turkish children at school, both by the other children and by teachers. Second, the interventions increased awareness about the benefits of preschool for secondary education completion (the coefficient is also positive for primary education, but somewhat smaller and thus not significant). Broken down by intervention, we see significant effects for the information arm across each of these four indicators. These findings clearly indicate that parents in the treatment group perceived preschool as both more welcoming and more beneficial for their child than parents in the control group. The interventions thus led parents to perceive preschool as more productive in child development, which might have led them to believe that there was lower value of their own investment.

5.3 Parental Investment

Table 4, columns 5 and 6 present estimation results for the average treatment effects of the interventions on parental investment. In contrast to the preschool results, parents of children not enrolled at baseline reduced their investment by 0.25 standard deviations. There was no effect on parents of children already enrolled. Panel B of Table 4 reports the average effect of each specific treatment arm. We find that the reduction in parental investment concentrated in the free access treatments as well as the ones that included 7 BGN and 20

BGN plus information. However, when we test the equality of all treatment arms, p-values are always greater than 0.10 so we cannot reject the null that all treatments had similar effects on developmental inputs.

The reduction in the parental investment index is decomposed activity by activity in Table A7. Panel A shows that, on average, all activities were reduced (reading, telling stories, singing, playing, and naming). These reductions are larger for children who were not enrolled at baseline. They are not independently statistically significant except for singing, which was reduced by 47 percent of a standard deviation for children who were not enrolled at baseline, as well as for playing, which was reduced by 21 percent of a standard deviation for children already enrolled and by 37 percent for children not enrolled at baseline. Panel B of Table A7 shows that many of the treatment-specific effects on the different activities were large and negative.

One mechanism to explain the negative effects is that parents view preschool as a substitute for parenting activities. An alternative explanation is that preschool attendance may have reduced the time that children have to interact with their parents, crowding out parenting activities. However, this story is at odds with patterns in the descriptive statistics. Table 1 shows that majority children received more parental investment while at the same time participating more in preschool, compared to minority children. Therefore, the reduction in parental investment is not a mechanical response to preschool attendance.

Further, we can also reject the hypothesis that increased labor market participation of caregivers reduced parenting activities. As Table A8 shows, the intervention had no effect on income or income from labor, while labor participation marginally increased: the likelihood of being unemployed was reduced by only 1 percentage point from a basis of 40 percent among parents whose children were not enrolled at baseline. Such a small change in labor participation cannot explain the large reduction in parental investment. In addition, we do not find that employment by itself limits parenting activities to begin with: parents who are employed and thus have less time than unemployed parents actually invest *more* in activities with their child. Table 1 shows that majority households are less likely to be unemployed and parental investment is significantly larger, compared to minority parents. And, Table 3 also shows that, conditional on other parental characteristics, children whose household head

is unemployed receive less parental investment on average.

5.4 Child Development

Table 5 reports estimates for the effect of the intervention on child development. In Panel A, we find a significant 0.14 standard deviation reduction in numeracy among children who were not enrolled at baseline, and a significant increase in motor skills among children who were already enrolled. For children who were not enrolled at baseline, for whom participation in preschool increased significantly, literacy and socioemotional skills did not improve—the coefficients are negative and non-significant, respectively -0.08 and -0.12 standard deviations. Dis-aggregating the effects across treatment arms in Panel B reveals a similar pattern, with some marginally significant reductions in numeracy and literacy ranging between -0.14 and -0.17 standard deviations for children not enrolled at baseline, as well as some increases in motor skills among children already enrolled that range from 0.16 to 0.20 standard deviations.

These results imply that either the observed gains in preschool participation have reduced child development or the observed decline in parental investments have, or both. The first is unlikely as low preschool quality does not appear to be an issue in our sample. Baseline data indicate that average class sizes range from 18 to 21 students, with two teachers per class, resulting in small to modest pupil-to-teacher ratios. All teachers are female, typically around 50 years old, with 20–24 years of professional experience. Their educational attainment is high: 48% hold a Master's degree or higher, 31% have a Bachelor's degree, and only 21% possess less than a Bachelor's degree. Children are provided with snacks and lunch, and the curriculum includes four hours of structured learning in the morning followed by a nap and playtime—all consistent with international best practices. To generate more precise answers, we next carry out a structural estimation of a child production function, taking advantage of the experimental variation in parental investments and preschool attendance to get causal estimates of their marginal productivities and degree of substitutability/complementarity.

6 The Child Development Production Function

To investigate the relative contributions of parental investment and preschool attendance to child development, we estimate a production function of developmental skills. We specify a separate production function for each of the four developmental outcomes (literacy, numeracy, socioemotional, and motor skills), which we treat as outputs of the production function.

6.1 The Model

We assume that the production function of developmental skills belongs to the Constant Elasticity of Substitution (hereafter, CES) class. We choose this parametrization because it allows us to be flexible about the technical substitution between inputs without the need to include higher order terms or additional transformation of the input variables, which would increase the number of endogenous variables in the model.

We allow child productivity to depend on observable parent and child characteristics such as parental education and aspirations or child age and gender as well as on unobservable characteristics such as child's intellectual ability or grit, or child-parent interaction quality. We assume that total factor productivity is a function of these observable and unobservable characteristics. Thus, the production function is described by the following equation:

$$y^d_{igap} = exp\Big(\alpha^d_{ag} + \gamma^d X_{ip} + \eta^d_{ip}\Big)\Big(\beta^d\big(I^d_{ip}\big)^\rho + (1-\beta^d)\big(S^d_{ip}\big)\Big)^{\frac{1}{\rho^d}} \tag{4}$$

Where $d \in \{Numeracy, Literacy, Motor, Socioemotional\}$ denotes the developmental skill of interest. The outcome for child i whose gender is g, is a years old and has parents p is y_{igap}. The first term represents a Hick-neutral productivity term which we specify as a function of an age-gender fixed effect α_{ag}, parent observable characteristics (X_{ip}) including the education level and expectations of parents as well as baseline inputs and ethnicity, plus an unobserved component η^d_{ip}.

Parental investment (I) and preschool attendance (S) enter the production function through the second term. The parameter β^d determines how intensive developmental skills are in each of the two inputs. Values of β^d close to one imply a larger contribution of parental investments while values close to zero represent a production function that is inten-

sive in preschool attendance. We assume constant returns to scale (*i.e.* $\beta^d \in [0,1]$). The degree of complementarity between both inputs in the production of d is dictated by the parameter ρ^d which takes values between $-\infty$ and 1. As ρ^d tends to infinity, both inputs become stronger complements, while as ρ^d tends to 1 the production function tends toward perfect substitution between inputs. For reference, note that as ρ approaches 0 the CES converges to the Cobb-Douglas production function.

Taking logarithm on both sides of equation 4 and rearranging yields:

$$ln\ \ y^d_{igap} = \alpha^d_{ag} + \gamma^d X_{ip} + \frac{1}{\rho^d} ln\Big(\beta^d \big(I^d_{ip}\big)^\rho + (1-\beta^d)\big(S^d_{ip}\big)\Big) + \eta^d_{ip} \tag{5}$$

It is plausible that unobserved productivity η^d_{ip} is correlated with preschool attendance and parental investment. For example, parents whose children benefit more from preschool (i.e. have a high productivity parameter) might be more likely to enroll their children and, given the larger return, might also be more likely to spend time with them. On the other hand, it could be that parental investment is used as a remedial mechanism for less productive children, and thus, it is negatively correlated with unobserved productivity. To account for the potential endogeneity of inputs with respect to unobserved productivity, we leverage the exogenous variations in preschool attendance and parental investments that arise from the seven randomized interventions.

Parental investment and preschool attendance levels are chosen by parents before the IDELA child development test is administered. This means that parents and children choose inputs before y^d_{igap} is realized. Thus, we assume that η^d_{ip} is only partially observed by parents. Formally, we decompose η^d_{ip} as follows:

$$\eta^d_{ip} = \nu_i + \nu_p + \varepsilon^d_{ip} \tag{6}$$

Where ν_i and ν_p respectively represent heterogeneity in children and parents' productivity that is common across developmental outcomes and observed by parents before the IDELA test is administered but not by the econometrician. ε_{ip} accounts for the remaining heterogeneity that is unobserved by both parents and researchers at the time that investment and attendance choices are made. We assume that inputs are independent from ε_{ip}, which is con-

sistent with the assumption that parents cannot systematically predict productivity shocks that have not been realized at the time inputs are chosen.

Parents choose input levels based on productivity as well as their own time and budget constraints and preferences. Thus, we model parental investment and preschool attendance as functions of socio-demographic characteristics (which are likely to affect the constraints, productivity and preferences of children and parents), unobserved productivity ν_i and ν_p, and the experimental intervention the parent was assigned to, which, as we documented in the previous section, affected the preferences for preschool attendance and parental investment as well as the constraints they face. Formally:

$$I_{ip} = \gamma^I_{ag} + \kappa^I X_{ip} + g^I\big(D_{ip}\big) + \phi^I \nu_i + \psi^I \nu_p + \xi^I_{ip} \tag{7}$$

$$S_{ip} = \gamma^S_{ag} + \kappa^S X_{ip} + g^S\big(D_{ip}\big) + \phi^S \nu_i + \psi^S \nu_p + \xi^S_{ip} \tag{8}$$

For $L = I, S$ the term γ^L_{ag} represents a gender-age fixed effect, X_{ip} comprises observed determinants of productivity from the production function, and ν_i and ν_p account for the unobserved determinants that only parents observe. ξ^L_{ip} accounts for remaining unobserved preferences for inputs which we assume to be uncorrelated with age, gender, X_{ip}, ν_i and ν_p.

To identify the model we proceed in two steps. First, we use equations 7 and 8 to recover $\phi^I \nu_i + \psi^I \nu_p + \xi^I_{ip}$ and $\phi^S \nu_i + \psi^S \nu_p + \xi^S_{ip}$. Then, we use these terms to construct a valid control function for the unobserved heterogeneity in equation 4. This control function allows us to recover the structural parameters β^d, ρ^d, and the productivity parameters α^d_{ag} and γ^d. We provide a detailed identification argument in Appendix B.

To assess the effectiveness of different hypothetical policies, we are interested in the effect of increasing parental investment or preschool attendance on child development under different counterfactual scenarios and how these differ between Roma and majority Bulgarian children. From equation 4 we can obtain an analytical expression for the marginal product of each input, which we can evaluate at different input and productivity levels to approximate the distribution of marginal products in our sample.

6.2 Endogeneity of Inputs

To identify the model, we need variations in parental investment and preschool attendance that are independent from observed and unobserved productivity. By construction, assignment to the eight different experimental arms is uncorrelated with observable and unobservable child and parent baseline characteristics. Furthermore, as we show in the previous section, the intervention affected both preschool attendance and parental investment. However, while the treatments are significantly correlated with both preschool attendance and parental investment, we find that the F statistic for the null hypothesis that the intervention had no effect is not larger than 10; this implies that the instruments are weak and finite sample estimates of the model might be biased (see Staiger et al. 1994 for the first formulation of this problem and Andrews et al. 2005 or Stock et al. 2005 for detailed summaries). Second, finite sample bias due to weak correlation between inputs and the different treatment types might be exacerbated if we used indicators of all eight experimental groups as instruments due to the many weak instruments problem (Bekker 1994, Angrist et al. 1999).

To address these concerns, we construct two internal instruments derived from the interaction between the eight experimental groups dummies with age and gender indicators. Specifically, we estimate the expectation of both parental investment I and preschool attendance S conditional on age-gender-treatment cells, which we denote $\mu^I_{a,g,t}$ and $\mu^S_{a,g,t}$. Then, we use these conditional expectations as instruments for both inputs. Since all observed age-gender combinations are included in the production function and assignment to treatment is random, $\mu^I_{a,g,t}$ and $\mu^S_{a,g,t}$ are valid instruments for preschool attendance and parental investment conditional on observable child and parent characteristics. This claim is further confirmed by the fact that, as we showed in the previous section, age and gender are balanced both across treatment groups and between majority Bulgarian and Roma children; thus, they are plausibly uncorrelated with unobserved differences in productivity. The approach we take follows papers that have proposed using derived non-parametric instruments to address the many instruments problem (Bekker 1994, Hansen et al. 2008) as well as classical papers such as Amemiya 1974, Chamberlain 1987 and Newey 1990 that propose using the conditional expectation as an instrument and show that, in the linear case (which in our setting would correspond to a Cobb-Douglas production function), this instrument is asymptotically

optimal in the sense of minimizing mean-squared error.

Thus, we replace $g^I(D_{ip})$ and $g^S(D_{ip})$ in equations 7 and 8 with estimates for $\mu^I_{a,g,t}$ and $\mu^S_{a,g,t}$ which, since age, gender, and treatment assignment are all categorical variables, can be obtained using a saturated linear regression and interpreted as non-parametric estimates for the corresponding conditional expectations. To account for potential estimation errors introduced by potential finite sample errors in the estimation of $\mu^I_{a,g,t}$ and $\mu^S_{a,g,t}$ or estimation of $\phi^I\nu_i + \psi^I\nu_p + \xi^I_{ip}$ and $\phi^S\nu_i + \psi^S\nu_p + \xi^S_{ip}$, we obtained Bootstrap confidence intervals and p-values for all our production function estimates. We conducted 250 Bootstrap replications clustering at the community level.

The results are shown in table A10. We find that our two constructed instruments are highly correlated with their associated endogenous input, with F-statistics large enough to ward against finite sample bias (33 and 41 for I and S respectively). Note also that instruments have coefficients that are not statistically different from unity, which supports the interpretation of the other coefficient estimates in this equation as deviations from the expected treatment response within age-gender cells.

6.3 Productivity Parameters

The results from estimating the production function are first presented in Table 7 showing the productivity parameters associated to observable socio-demographic child and household characteristics.

The first rows show the coefficients that correspond to the different age-gender combinations in our sample. Unsurprisingly, we find that as age increases the developmental skills of children improve. Besides, we find that girls at age 3 have a lower TFP than boys for numeracy and for socioemotional skills, whereas a higher TFP for motor skills, albeit non-significant in all cases. At age 4 and 5, girls become as productive as same-age boys in numeracy and socioemotional skills—coefficients on the interaction terms compensate their initial disadvantage.

Second, children whose parents expect them to complete secondary education or whose parents completed secondary education are more productive in the case of literacy and motor skills. However, children whose parents expect them to complete secondary education exhibit

lower productivity in socioemotional skills. Moreover, we find that after controlling for demographics and background characteristics, including ethnicity, parental expectations and education completion, children who were enrolled at baseline or had higher levels of parental investment at the start of the study are less productive. This highlights the potential of policies promoting access to preschool and parental investment to alleviate the disadvantages that some children face.

Finally, we find that even after controlling for demographics and background characteristics as well as initial input levels, there are significant differences in productivity between Roma and majority Bulgarian children for all skills except motor skills. This finding suggests the existence of additional obstacles that Roma children and parents face, which are not captured by our data and structural specification. These obstacles may be rooted in broader systemic disadvantages that demographic, economic, and parental background factors are not sufficient to explain.

6.4 Factor Intensity, Substitution, and Marginal Products

The top rows of Table 7 present the estimations of the factor intensity and substitution parameters of the production function. We find that the relative contribution of both inputs is approximately the same: the parameter β that dictates the relative contribution of parental investment ranges from 0.47 for motor skills to 0.58 for socioemotional skills. Moreover, parental investment and preschool attendance exhibit a high degree of substitutability: the substitution parameter ρ is between 0.42 and 0.5, statistically different from 0, which implies the production function exhibits less complementarity between inputs than a Cobb-Douglas production function. Nonetheless, we reject perfect substitution (*i.e.*, $\rho = 1$). Therefore, the productivity of S increases when I increases and *vice versa*. These results confirm that both inputs play a crucial role in early child development and that interventions that promote one at the expense of the other are unlikely to have a significant positive effect.

Further, the bottom rows in Table 9 show the unobserved heterogeneity terms that we recover from equations 7 and 8. We find a positive correlation between inputs and unobserved productivity in literacy, meaning that the most productive children in literacy are the ones who receive high parental investment or are enrolled. The correlation is also positive

and significant between parental investment and unobserved productivity in motor skills, but negative between school attendance and unobserved productivity in numeracy and socioemotional skills. These results suggest that the relationship between inputs and unobserved productivity is not systematic and difficult to anticipate.

Table 9 reports the median marginal products first for parental investments followed by preschool attendance, as well as total factor productivity (TFP), separately for Roma and majority Bulgarian children. The marginal products of parental investment and school attendance may differ between Roma and majority Bulgarian children for three main reasons. First, the ethnicity specific productivity parameters may differ across groups, as shown in Table 7. Second, because inputs are not perfect substitutes, the lower baseline input levels among Roma children imply smaller gains from complementarities. Third, lower baseline input levels also increase marginal productivity due to the diminishing marginal returns property of the CES production function. Given these offsetting forces, it is not immediately clear whether the marginal products of inputs are larger or smaller for Roma children relative to majority Bulgarian children.

The results show that the median marginal product of parental investment is similar for Roma and majority Bulgarian children in literacy (the opposing forces described above roughly offset one another); an increase by one standard deviation in parental investments (from the median levels) raises literacy by resp. 0.3 and 0.31 standard deviations for majority and for Roma children. However, the marginal product of parental investments is significantly larger for Roma children in other developmental skills. Indeed, although TFP in literacy is lower for the median Roma child than for the median majority Bulgarian child, TFP is similar or higher for the median Roma child in the other skill domains. Combined with diminishing marginal returns, this pattern explains why marginal products of parental investment are higher for Roma children in numeracy, socioemotional, and motor skills.

In contrast, the median marginal product of preschool attendance is lower for Roma than for majority Bulgarian children, with the difference being statistically significant for all skills except motor skills. Given that TFP in numeracy and socioemotional skills is higher and that baseline school attendance is lower among Roma children, we would expect higher marginal products of school attendance for Roma children. The lower observed marginal product

of school attendance therefore likely reflects the lower baseline level of parental investment among Roma children, which reduces the gains from input complementarities.

These complementarity gains are further illustrated in Figure 4 depicting the marginal product of preschool attendance as a function of parental investment levels and *vice versa* for the aggregate skills index. The blue curve represents Bulgarian children, while the red dotted curve represents Roma children. Each curve is obtained by holding fixed the productivity determinants and observed preschool attendance levels for every child in our sample and calculating the marginal product of preschool attendance at every possible level of parental investment. We see that the marginal products of both inputs increase substantially when the levels of the other input increases. The colored dotted lines indicate the mean levels observed in our data, while the gray horizontal line represents the marginal product minority children would exhibit if their input levels where equalized to those of their majority Bulgarian peers. For all skills but literacy, we find that the marginal product of each input would be larger for Roma than for Bulgarian children would they receive the same level of the other input. This is due to diminishing returns and the fact that Roma children are not less productive than their peers in these skills. In contrast, for literacy, even at similar levels of the other input, each input would benefit less to Roma than it does to Bulgarian children, due to lower TFP for Roma than Bulgarian children in that skill.

Finally, it is important to note that the marginal product of parental investment exceeds that of preschool attendance for Roma children. This suggests that, at observed levels of productivity parameters and baseline inputs, Roma children would benefit relatively more from an increase in parental investment than from an equivalent increase in preschool attendance. Overall, these findings highlight the importance of promoting parental investment: it not only directly enhances child development for both majority Bulgarian and Roma children, but also increases the effectiveness of policies that aim to improve child skills through preschool participation.

6.5 Output and marginal product gaps decomposition

Our estimates of the production function allow us to better understand the difference in output and productivity between Roma and majority children. In a first counterfactual

exercise, we decompose the observed output difference into three components: differences in productivity, differences in preschool attendance, and differences in parental investment. Each difference comes from asking: what would the realized input for Roma children if the associated component was exogenously shifted from its observed values to the observed Majority mean, keeping all else constant? We confirm that most of the gap throught all four developmental outcomes is explained by differences in parental investment.

To define this decomposition, let S and S' denote two different levels of preschool attendance. We define as first order effect the change in developmental outcomes that would result from switching attendance from S to S' while keeping parental investment and all the remaining covariates constant at some values I and X. We approximate this quantity by multiplying the difference $S' - S$ by the marginal product of preschool attendance evaluated at (S, I, X). Formally:

$$\Delta_{Att}(S, S'|I, X) = (S' - S)F_S(S, I, X) \tag{9}$$

Where $F_S(S, I, X)$ denotes the first derivative of the production function with respect to S. An analogous definition and approximation apply to the first order effect of parental investment.

Using the same logic we can calculate the effect on developmental outcomes that would result from switching productivity. First we note that the total output can be expressed as $F(S, I, X) = A(X)f(S, I)$, then, if the productivity changes from $A = A(X)$ to $A' = A(X')$, output would change by $(A' - A)f(S, I)$. This is the total effect of a change in productivity. Since the production function is linear in the productivity parameter this exercise is exact and not a first order approximation.

To obtain the final decomposition, we separately calculate each of the first order effects and combine them into a first order approximation:

$$F(S', I', X') - F(S, I, X) \approx \underbrace{(S' - S)F_S(S, I, X)}_{\textit{Preschool attendance diff.}} + \underbrace{(I' - I)F_S(S, I, X)}_{\textit{Par. Investment diff.}} + \underbrace{(A' - A)f(S, I)}_{\textit{Productivity diff.}} \tag{10}$$

Where S' and I denote the average attendance and parental investment and $A = A(X)$ the estimated productivity among Majority children with evaluated at their median demographics and parental characteristics X. S, I and A' correspond to the same values for their Roma counterparts.

The results are shown in Table 8. The first column shows the mean output differences between Roma and Bulgarian children in our data, while the second column shows the mean differences that our structural model predicts. Predicted differences are reasonably similar to the observed differences. The decomposition exercise shows that 27% of the predicted difference in the aggregate development score is attributable to the first order effec of preschool attendance (Column 3), while 65% to the first order effect of parental investment (Column 4). Looking at each developmental skill separately confirms that, for all skills, the fraction of the gap that results from differences in parental investment is considerably larger than the fraction explained by preschool attendance. These findings provide evidence that the developmental gap between Roma and Bulgarian children is mostly explained by differences in parental investment rather than preschool attendance.

We then use the model to decompose differences in marginal productivity, i.e. the causes why, holding all else constant, increasing an input has a different effect for Roma children than majority children. We consider three main components that affect how effective a marginal increase in the outputs can be: First, the total factors productivity which affects all inputs equally and depends on the child and parents' characteristics. Second, the initial own-input levels. This component captures how children with high levels of initial outputs benefit less from increasing their input levels due to diminishing returns. On the other hand, small increments can be hihgly effective for children with zero or low levels of baseline attendance or parental investment. Finally, we account for complementarity between both inputs. Increasing school attendance will lead to higher output levels for children with high levels of parental investment, and *vice versa*.

For this decomposition we take a first order approximation to the marginal products of preschool attendance and parental investment. Recall that the marginal products of preschool attendance and parental investment are given by the derivatives $F_S(S, I, X)$ and $F_S(S, I, X)$. The goal is to understand how these derivatives change as S, I and X change from the Roma

averages to the Majority averages.

The effect on the marginal product of parental investment that increasing each input separately would have is given by the cross derivatives with respect to preschool attendance and parental investment denoted $F_{I,S}(S,I,X)$ and $F_{I,I}(S,I,X)$ respectively. Thus, an approximation to the effect of changing preschool attendance from S to S' is given by $(S'-S)F_{I,S}(S,I,X)$. Analogously, the effect of changing parental investment from I to I' can be approximated by $(I-'I)F_{I,I}(S,I,X)$. The first component captures complementarity between inputs and, for a C.E.S. production function is weakly positive. If the production function is concave, the second, own-input, component is negative and represents diminishing returns.

Furthermore, the effect on the marginal product of parental investment of increasing productivity from A to A' is simply $(A'-A)f_S(S,I,X)$.

Thus, we decompose the marginal product as follows:

$$\begin{aligned} F_S(S,I,X) - F_S(S',I',X') = & \underbrace{(A'-A)f_S(S,I,X)}_{Productivity\ difference} \\ & + \underbrace{(S'-S)F_{I,S}(S,I,X)}_{Complementarity} + \underbrace{(I-'I)F_{I,I}(S,I,X)}_{Diminishing\ retturns.} \end{aligned} \tag{11}$$

Note that since this is a first order approximation, the decomposition might not necesarilly be exact.

We calculate this decomposition at both the mean and median values of inputs and covariates for majority and minority children. Thus S' and I' denote the mean or median attendance and parental investment and $A' = A(X')$ the estimated productivity among Majority children evaluated at their median inputs, demographics, and parental characteristics X. The variables S, I and A correspond to the same sample quantities but for their Roma counterparts.

Equivalent derivations hold for the marginal product of preschool attendance.

Among children that were not enrolled at baseline we find that the marginal product of preschool attendance is larger for those who come from households that identify as Majority. On the other hand, we find not significant statistical differences in the marginal product of

parental investment. The only exception is literacy, where we find that majority children exhibit a larger marginal productivity in both inputs.

Conditional on being enrolled or not enrolled, the difference in preschool attendance between Majority and Roma children are essentialy zero, thus, essentially the entire marginal product gap is explained by difference in productivity and parental investment.

We find that the differences in the marginal product of both parental investment and preschool attendance are mostly explained by the differences in parental investment which, for Majority children, enhance the effectiveness of increasing enrollment and attendance. The only exception is literacy where we find that difference in productivity explain most of the gap. This last finding might be explained by the fact that for Roma children are less likely to come from households were Bulgarian is the main language.

7 Conclusion

This paper investigates the contributions of preschool and parents to early child development in disadvantaged communities in Bulgaria. Using data collected from 236 disadvantaged communities across Bulgaria, we present experimental evidence that free preschool, free preschool plus monetary incentives, and an information and mediation campaign increased preschool enrollment by 26 percentage points and attendance by 0.40 standard deviations after one year among children that were not enrolled at baseline. We cannot reject the null that all treatments had similar effects. This research contributed to legal reforms in Bulgaria in 2020 and 2022, leading municipalities to remove attendance fees for full-day kindergartens, benefiting to at least 244,000 children annually (Volen and Laat 2021; Volen 2023).

Despite the increase in enrollment, we also find lower child development after 1 year among children that were not enrolled at baseline, with a significant 0.14 standard deviation reduction in numeracy and negative non-significant impact estimates on literacy, socio-emotional skills, and motor skills. Parents reduced their time investments by 0.25 standard deviations. To rationalize these results, we estimate a child development production function using experimental variation in inputs to identify its structural parameters. The estimated marginal products of both parental investments and preschool are positive and meaningful, and find

that for minority children, the marginal productivity of parental investment is higher than the marginal productivity of preschool attendance. Further, we find that the marginal productivity of preschool increases with parental investments, and vice versa, indicating some complementarity. Our counterfactual exercises show that the developmental gap between Roma and majority Bulgarian children is mostly explained by differences in parental investment rather than preschool attendance. Besides, the interventions would have increased child development by 0.19 standard deviations absent the decrease in parental investment, mostly due to the first order effec of increased school attendance. These results highlight the fact that preschool attendance is highly beneficial for children as long as parents do not decrease their own investment. These findings are consistent with other findings on the importance of parental stimulation for child development (Schwartz et al. 2024, P. R. Britto et al. 2017, and Attanasio, Cattan, and Meghir 2021). Supporting disadvantaged parents with parental investments alongside policies aimed at increasing preschool attendance has the highest chance of leading to increased child development outcomes.

This leaves the question of why parents reduced their parental investments following the interventions. We are able to rule out as possible explanations that the interventions may have increased labor participation and reduced the time that caregivers can dedicate to their children. Instead, we find some evidence that parents in the treatment group perceived preschool as both more welcoming and more beneficial for their child than parents in the control group. Might this increase in perceived preschool productivity have led minority parents to believe that there was lower value of their own investment?

References

Agostinelli, F. and Wiswall, M. (2025). "Estimating the Technology of Children's Skill Formation". In: *Journal of political Economy* 133.3, pp. 846–887.

Ahrens, A., Hansen, C. B., and Schaffer, M. E. (2020). "lassopack: Model selection and prediction with regularized regression in Stata". In: *The Stata Journal* 20.1, pp. 176–235.

Amemiya, T. (1974). "The nonlinear two-stage least-squares estimator". In: *Journal of econometrics* 2.2, pp. 105–110.

Andrew, A., Attanasio, O. P., Bernal, R., Sosa, L. C., Krutikova, S., and Rubio-Codina, M. (2024). "Preschool quality and child development". In: *Journal of Political Economy* 132.7, pp. 2304–2345.

Andrews, D. and Stock, J. H. (2005). "Inference with weak instruments". In.

Angrist, J. D., Imbens, G. W., and Krueger, A. B. (1999). "Jackknife instrumental variables estimation". In: *Journal of Applied Econometrics* 14.1, pp. 57–67.

Attanasio, O., Bernal, R., Giannola, M., and Nores, M. (2020). *Child development in the early years: Parental investment and the changing dynamics of different dimensions*. Tech. rep. National Bureau of Economic Research.

Attanasio, O., Boneva, T., and Rauh, C. (2019). *Parental beliefs about returns to different types of investments in school children*. Tech. rep. National Bureau of Economic Research.

Attanasio, O., Cattan, S., Fitzsimons, E., Meghir, C., and Rubio-Codina, M. (2020). "Estimating the production function for human capital: results from a randomized controlled trial in Colombia". In: *American Economic Review* 110.1, pp. 48–85.

Attanasio, O., Cattan, S., and Meghir, C. (2021). "Early Childhood Development, Human Capital, and Poverty". In: *Annual Review of Economics* 14.

Attanasio, O., Cunha, F., and Jervis, P. (2019). *Subjective parental beliefs. their measurement and role*. Tech. rep. National Bureau of Economic Research.

Attanasio, O., Lopez-Boo, F., Perez-Lopez, D., and Reynolds, S. A. (2024). "Inequality in the early years in LAC: A comparative study of size, persistence, and policies". In: *LACIR Series* 132.

Attanasio, O., Meghir, C., and Nix, E. (2020). "Human capital development and parental investment in India". In: *The Review of Economic Studies* 87.6, pp. 2511–2541.

Baker, M., Gruber, J., and Milligan, K. (2008). "Universal child care, maternal labor supply, and family well-being". In: *Journal of political Economy* 116.4, pp. 709–745.

Bassi, M., Besbas, B., Diaz, L. I. D., Ravindran, S., and Reynoso, A. (2025). *From Access to Achievement: The Primary School-Age Impacts of an At-Scale Preschool Construction Program in Highly Deprived Communities*. Tech. rep. National Bureau of Economic Research.

Beasley, E. and Huillery, E. (2017). "Willing but unable? Short-term experimental evidence on parent empowerment and school quality". In: *The World Bank Economic Review* 31.2, pp. 531–552.

Bekker, P. A. (1994). "Alternative approximations to the distributions of instrumental variable estimators". In: *Econometrica: Journal of the Econometric Society*, pp. 657–681.

Berlinski, S., Ferreyra, M. M., Flabbi, L., and Martin, J. D. (2024). "Child care markets, parental labor supply, and child development". In: *Journal of Political Economy* Forthcoming.

Berlinski, S., Galiani, S., and Gertler, P. (2009). "The effect of pre-primary education on primary school performance". In: *Journal of public Economics* 93.1-2, pp. 219–234.

Bouguen, A., Filmer, D., Macours, K., and Naudeau, S. (2018). "Preschool and parental response in a second best world evidence from a school construction experiment". In: *Journal of human Resources* 53.2, pp. 474–512.

Bradley, R. H. and Corwyn, R. F. (2002). "Socioeconomic status and child development". In: *Annual review of psychology* 53.1, pp. 371–399.

Britto, P. R., Lye, S. J., Proulx, K., Yousafzai, A. K., Matthews, S. G., Vaivada, T., Perez-Escamilla, R., Rao, N., Ip, P., Fernald, L. C., et al. (2017). "Nurturing care: promoting early childhood development". In: *The Lancet* 389.10064, pp. 91–102.

Carlsson, N. (2023). "Boundaries and Belonging Among Settled Minorities and Refugees in Bulgaria". In: *Nationalities Papers* 51, pp. 1123–1142.

Chamberlain, G. (1987). "Asymptotic efficiency in estimation with conditional moment restrictions". In: *Journal of econometrics* 34.3, pp. 305–334.

Chernozhukov, V., Chetverikov, D., Demirer, M., Duflo, E., Hansen, C., Newey, W., and Robins, J. (2018). *Double/debiased machine learning for treatment and structural parameters*.

Clarke, D., Romano, J. P., and Wolf, M. (2020). "The Romano–Wolf multiple-hypothesis correction in Stata". In: *The Stata Journal* 20.4, pp. 812–843.

Cunha, F., Heckman, J. J., and Schennach, S. M. (2010). "Estimating the technology of cognitive and noncognitive skill formation". In: *Econometrica* 78.3, pp. 883–931.

Del Boca, D., Flinn, C., and Wiswall, M. (2014). "Household choices and child development". In: *Review of Economic Studies* 81.1, pp. 137–185.

Drange, N., Havnes, T., and Sandsør, A. M. (2016). "Kindergarten for all: Long run effects of a universal intervention". In: *Economics of Education Review* 53, pp. 164–181.

Duflo, E., Dupas, P., and Kremer, M. (2015a). "Education, HIV, and early fertility: Experimental evidence from Kenya". In: *American Economic Review* 105.9, pp. 2757–97.

— (2015b). "School governance, teacher incentives, and pupil–teacher ratios: Experimental evidence from Kenyan primary schools". In: *Journal of public Economics* 123, pp. 92–110.

— (2021). *The impact of free secondary education: Experimental evidence from Ghana*. Tech. rep. National Bureau of Economic Research.

Felfe, C., Nollenberger, N., and Rodríguez-Planas, N. (2015). "Can't buy mommy's love? Universal childcare and children's long-term cognitive development". In: *Journal of population economics* 28.2, pp. 393–422.

Fernald, L. C., Kariger, P., Hidrobo, M., and Gertler, P. J. (2012). "Socioeconomic gradients in child development in very young children: Evidence from India, Indonesia, Peru, and Senegal". In: *Proceedings of the National Academy of Sciences* 109.supplement_2, pp. 17273–17280.

Fort, M., Ichino, A., and Zanella, G. (2020). "Cognitive and noncognitive costs of day care at age 0–2 for children in advantaged families". In: *Journal of Political Economy* 128.1, pp. 158–205.

García, J. L., Heckman, J. J., Leaf, D. E., and Prados, M. J. (2017). *The life-cycle benefits of an influential early childhood program*. Tech. rep. National Bureau of Economic Research.

García, S. and Saavedra, J. (2022). "Conditional Cash Transfers for Education". In.

Giacobino, H., Huillery, E., Michel, B., and Sage, M. (2024). "Schoolgirls, not brides: Education as a shield against child marriage". In: *American Economic Journal: Applied Economics* 16.4, pp. 109–143.

Goldhaber, D., Lavery, L., and Theobald, R. (2015). "Uneven playing field? Assessing the teacher quality gap between advantaged and disadvantaged students". In: *Educational researcher* 44.5, pp. 293–307.

Goux, D. and Maurin, E. (2010). "Public school availability for two-year olds and mothers' labour supply". In: *Labour Economics* 17.6, pp. 951–962.

Grantham-McGregor, S., Cheung, Y. B., Cueto, S., Glewwe, P., Richter, L., Strupp, B., Group, I. C. D. S., et al. (2007). "Developmental potential in the first 5 years for children in developing countries". In: *The lancet* 369.9555, pp. 60–70.

Gupta, N. D. and Simonsen, M. (2010). "Non-cognitive child outcomes and universal high quality child care". In: *Journal of Public Economics* 94.1-2, pp. 30–43.

Hansen, C., Hausman, J., and Newey, W. (2008). "Estimation with many instrumental variables". In: *Journal of Business & Economic Statistics* 26.4, pp. 398–422.

Heckman, J., Pinto, R., and Savelyev, P. (2013). "Understanding the mechanisms through which an influential early childhood program boosted adult outcomes". In: *American Economic Review* 103.6, pp. 2052–86.

Heckman, J. J., Moon, S. H., Pinto, R., Savelyev, P. A., and Yavitz, A. (2010). "The rate of return to the HighScope Perry Preschool Program". In: *Journal of public Economics* 94.1-2, pp. 114–128.

Hermes, H., Lergetporer, P., Peter, F., and Wiederhold, S. (2024). "Application barriers and the socioeconomic gap in child care enrollment". In: *Journal of the European Economic Association* forthcoming.

Jackson, C. K., Rockoff, J. E., and Staiger, D. O. (2014). "Teacher effects and teacher-related policies". In: *Annu. Rev. Econ.* 6.1, pp. 801–825.

Jensen, R. (2010). "The (perceived) returns to education and the demand for schooling". In: *The Quarterly Journal of Economics* 125.2, pp. 515–548.

Kelly, Y., Sacker, A., Del Bono, E., Francesconi, M., and Marmot, M. (2011). "What role for the home learning environment and parenting in reducing the socioeconomic gradient in child development? Findings from the Millennium Cohort Study". In: *Archives of disease in childhood* 96.9, pp. 832–837.

Lecerf, M. (2025). *Briefing: Understanding EU action on Roma inclusion*. Tech. rep.

López Boo, F. (2016). "Socio-economic status and early childhood cognitive skills: A mediation analysis using the Young Lives panel". In: *International Journal of Behavioral Development* 40.6, pp. 500–508.

Lu, C., Cuartas, J., Fink, G., McCoy, D., Liu, K., Li, Z., Daelmans, B., and Richter, L. (2020). "Inequalities in early childhood care and development in low/middle-income countries: 2010–2018". In: *BMJ Global Health* 5.2, e002314.

Lucas, A. M. and Mbiti, I. M. (2012). "Access, sorting, and achievement: The short-run effects of free primary education in Kenya". In: *American Economic Journal: Applied Economics* 4.4, pp. 226–53.

Ludwig, J. and Miller, D. L. (2007). "Does Head Start improve children's life chances? Evidence from a regression discontinuity design". In: *The Quarterly journal of economics* 122.1, pp. 159–208.

EU-MIDIS, I. (2017). "Second European Union Minorities and Discrimination Survey Main results". In: *Luxembourg, Publications Office of the European Union*.

Newey, W. K. (1990). "Efficient instrumental variables estimation of nonlinear models". In: *Econometrica: Journal of the Econometric Society*, pp. 809–837.

Özler, B., Fernald, L. C., Kariger, P., McConnell, C., Neuman, M., and Fraga, E. (2018). "Combining pre-school teacher training with parenting education: A cluster-randomized controlled trial". In: *Journal of Development Economics* 133, pp. 448–467.

Pillas, D., Marmot, M., Naicker, K., Goldblatt, P., Morrison, J., and Pikhart, H. (2014). "Social inequalities in early childhood health and development: a European-wide systematic review". In: *Pediatric research* 76.5, pp. 418–424.

Richter, L. M., Desmond, C., Behrman, J., Britto, P., Daelmans, B., Devercelli, A. E., Gertler, P., Hoddinott, J., Fawzi, W., Fink, G., et al. (2018). "G20's initiative for early childhood development". In: *The Lancet* 392.10165, pp. 2695–2696.

Romano, J. P. and Wolf, M. (2005). "Exact and approximate stepdown methods for multiple hypothesis testing". In: *Journal of the American Statistical Association* 100.469, pp. 94–108.

Rossin-Slater, M. and Wust, M. (2020). "What is the added value of preschool for poor children? Long-term and intergenerational impacts and interactions with an infant health intervention". In: *American Economic Journal: Applied Economics* 12.3, pp. 255–86.

Schady, N., Behrman, J., Araujo, M. C., Azuero, R., Bernal, R., Bravo, D., Lopez-Boo, F., Macours, K., Marshall, D., Paxson, C., et al. (2015). "Wealth gradients in early childhood cognitive development in five Latin American countries". In: *Journal of Human Resources* 50.2, pp. 446–463.

Schwartz, K., Michael, D., Torossian, L., Hajal, D., Yoshikawa, H., Abdulrazzak, S., Youssef, J., Sloane, P., Hashwe, S., Foulds, K., et al. (2024). "Leveraging Caregivers to Provide Remote Early Childhood Education in Hard-to-Access Settings in Lebanon: Impacts From a Randomized Controlled Trial". In: *Journal of Research on Educational Effectiveness*, pp. 1–31.

Staiger, D. O. and Stock, J. H. (1994). *Instrumental variables regression with weak instruments*.

Stock, J. and Yogo, M. (2005). "Asymptotic distributions of instrumental variables statistics with many instruments". In: *Identification and inference for econometric models: Essays in honor of Thomas Rothenberg* 6, pp. 109–120.

The World Bank (2012). *Toward an equal start: Closing the early learning gap for Roma children in Eastern Europe*. World Bank.

Volen, E. (2023). "Now that kindergarten is free of charge: laying the foundations for future pre-school policy change in Bulgaria". In: *Frontiers in Education*, pp. 1–5.

Volen, E. and Laat, J. de (2021). "Building Evidence for Pre-school Policy Change in Bulgaria". In: *Frontiers in Public Health* 9, pp. 1–8.

Waldfogel, J. and Washbrook, E. (2011). "Early years policy". In: *Child development research* 2011.

Yeo, A., Maiga, S., and Michel, B. (2024). *Should LMICs Build Preschools or Improve Primary Education? Experimental Evidence from Côte d'Ivoire*. Tech. rep. HAL.

Figures

Figure 1: Sample selection procedure

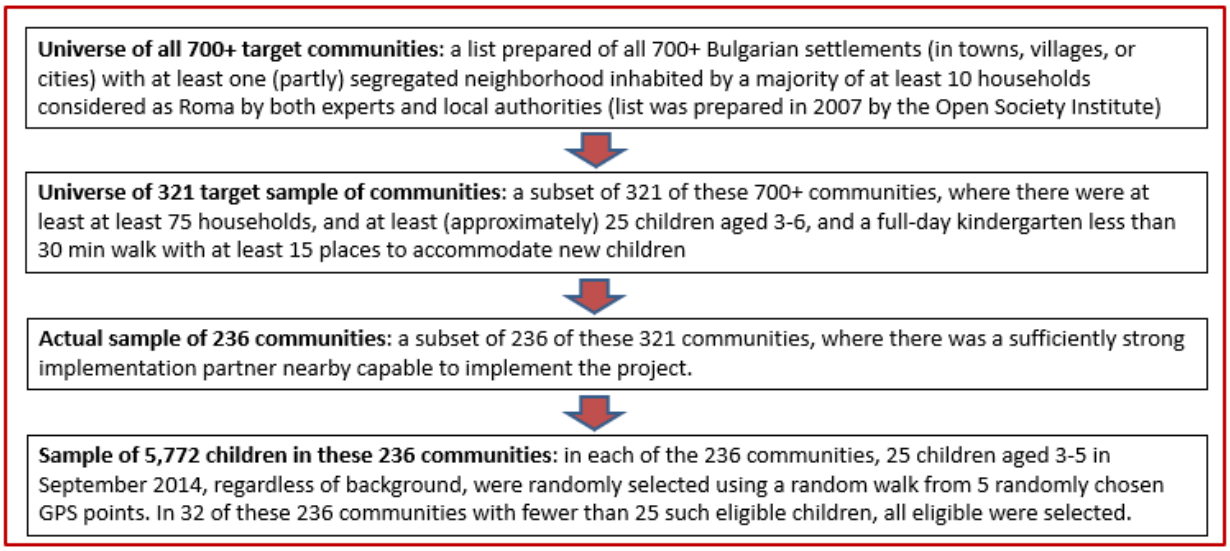
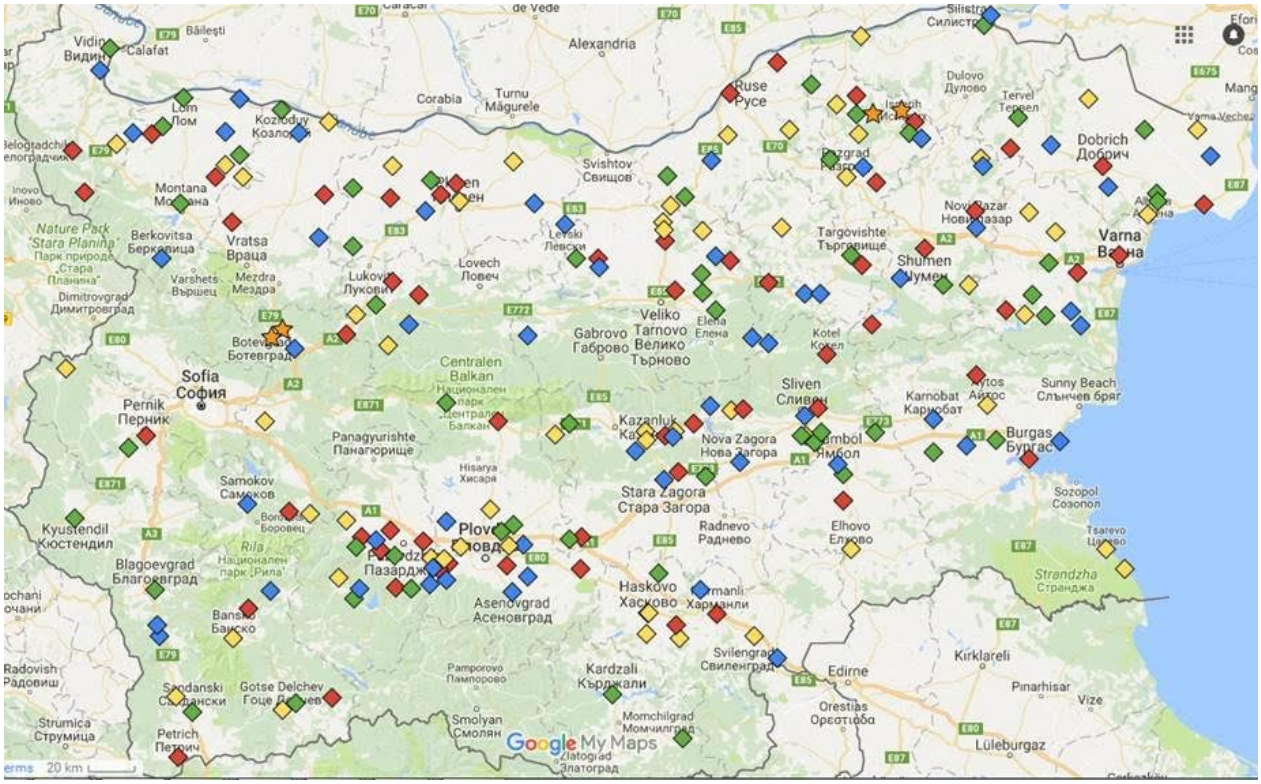


Figure 2: Distribution of treatment arms across selected communities

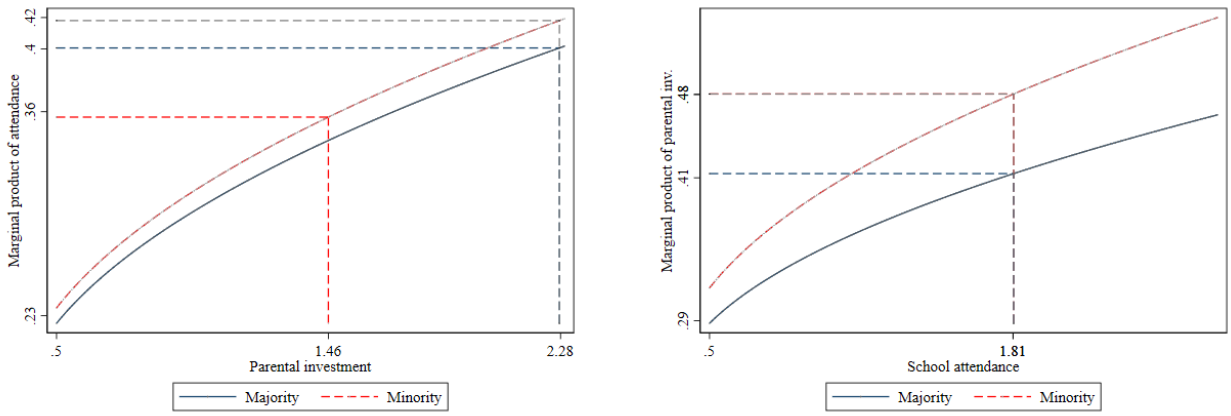
Intervention	No financial intervention	Free access to preschool	Free access + 7 lev conditional on attendance	Free access + 20 lev conditional on attendance
No meeting	30 communities	29 communities	30 communities	29 communities
Information and mediation meetings	29 communities	30 communities	29 communities	30 communities

Figure 3: Geographical distribution of the 236 communities, by financial condition



Notes: The map represent the 236 communities included in the study, distributed all over the country. Each color corresponds to a financial condition: yellow for control communities, blue for free access communities, green for free access + BGN 7 incentive communities, and red for free access + BGN 20 incentive communities.

Figure 4: Marginal product of preschool attendance and parental investment for minority and majority children



(a) Pre-school attendance.

(b) Parental investment

Notes: These four figures depict the marginal product of preschool attendance and parental investment for Bulgarian (Majority) and Roma or Turkish (Minority) children for the aggregate skills index (wich averages literacy, numeracy, socioemotional and motor skills). The figure at the left is obtained by holding fixed the productivity determinants and observed preschool attendance levels for every child in our sample and calculating the marginal product of preschool attendance at every level of parental investment observed in our data. The red line corresponds to minority children and the blue line to majority. The colored dotted lines indicate the mean levels observed in our data while the gray horizontal line represents the marginal product minority children would exhibit if their parental investment levels where equalized to those of their majority peers. The figure to the right repeats the excercise but now holding fixed parental investment and calculating its marginal product at every level of pre-school attendance.

Tables

Table 1: Descriptive Statistics – Comparison of Majority and Minority Households

	(1)	(2)	(3)	(4)	(5)
	Majority	Roma	H_0: Majority=Roma		
			F-statistic	p-value	RW p-value
Panel A: Child Development Outcomes (Control Group at endline)					
Literacy	1.14	0.85	13.53	<0.01	0.01
Numeracy	1.67	1.44	9.82	<0.01	0.01
Socioemocional skills	1.47	1.33	4.85	0.04	0.01
Motor skills	1.12	0.9	6.82	0.01	0.01
Summary index	1.35	1.13	11.29	<0.01	0.01
Observations per ethnicity	148	483			
Total	631				
Panel B: School enrollment, Parental Investment and Household Characteristics (Baseline for All Households)					
	(1)	(2)	(3)	(4)	(5)
	Majority	Roma	H_0: Majority=Roma		
			F-statistic	p-value	RW p-value
Panel B: Baseline differences in enrollment, parental investment and household characteristics					
Kindergarden enrollment					
Enrolled at baseline	0.78	0.61	37.8	<0.01	0.01
Parental investment					
Read books	0.71	0.41	119.63	<0.01	0.01
Told story	0.79	0.62	38.9	<0.01	0.01
Sang	0.78	0.71	6.04	0.01	0.11
Played	0.79	0.74	3.56	0.06	0.17
Draw	0.78	0.64	24.67	<0.01	0.01
Summary Index	1.77	1.46	37.39	<0.01	0.01
Demographics					
Female	0.48	0.48	0.06	0.81	0.94
Age	4.76	4.75	0.09	0.77	0.94
Household characteristics					
H. Head Unemployed	0.3	0.42	18.41	<0.01	0.01
H. Size	4.49	4.69	6.64	0.01	0.11
Income	6.02	5.61	59.49	<0.01	0.01
Assets and Dwell. Ind.	1.22	-0.37	112.75	<0.01	0.01
Parental education					
Attended preschool	0.2	0.37	183.04	<0.01	0.01
Completed Secondary	0.48	0.12	157.78	<0.01	0.01
Parental aspirations					
Age to stop education	21.73	19.31	116.53	<0.01	0.01
Expects child to complete secondary	0.9	0.76	61.85	<0.01	0.01
Observations per ethnicity	1,101	3,762			
Total	4,863				

Notes: This table reports observed differences between Bulgarian (Majority) and Roma or Turkish (Roma) children. The first two columns report sample averages for each group and the last two report F-statistics and p-values for the null hypothesis that the observed differences are attributable to chance. To account for the multiplicity of hypotheses being tested we use the adjustment and inference procedures from Romano et al. 2005. The developmental outcomes are measured as average z-scores of IDELA items related to literacy, numeracy, socioemotional and motor skills. Demographics, household characteristics, school attendance , parental involvement, parental education and parental aspirations are calculated using the baseline survey. See table A2 for a detailed description and definition of all the variables.

Table 2: Correlates of School Enrollment and Parental Investment at Baseline

	(1)	(2)	(3)	(4)	(5)	(8)	(9)	(10)	(11)	(12)
	Baseline enrollment					Baseline parental investment				
Roma	-0.17***	-0.17***	-0.15***	-0.10***	-0.09***	-0.31***	-0.31***	-0.26***	-0.18***	-0.16***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
log income			0.05***	0.04***	0.03***			0.06***	0.05***	0.04**
			(0.01)	(0.01)	(0.01)			(0.02)	(0.02)	(0.02)
HH unemployed			0.00	0.01	0.01			-0.17***	-0.15***	-0.15***
			(0.02)	(0.02)	(0.02)			(0.04)	(0.04)	(0.04)
Parents expect secondary completion				0.17***	0.16***				0.26***	0.23***
				(0.02)	(0.02)				(0.04)	(0.04)
Household h. completed secondary					0.04					0.24***
					(0.03)					(0.05)
Constant	0.78***	0.53***	0.24***	0.22**	0.19**	1.77***	1.75***	1.40***	1.36***	1.19***
	(0.02)	(0.04)	(0.09)	(0.09)	(0.09)	(0.05)	(0.07)	(0.14)	(0.14)	(0.14)
Age and Gender FE	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Mean of the dependent variable	0.649	0.649	0.649	0.649	0.649	1.532	1.532	1.532	1.532	1.532
Observations	4,863	4,863	4,863	4,863	4,863	4,863	4,863	4,863	4,863	4,863
R-squared	0.02	0.02	0.02	0.02	0.02	0.06	0.06	0.06	0.06	0.06

Notes: This table reports observed correlations between baseline developmental inputs (school enrollment and parental investment) and observable child and household characteristics. The estimates are obtained from an OLS regression. Columns 1 and 6 report the uncontrolled difference, Columns 2 and 7 add age and gender indicators as controls, Columns 3 and 8 include log of income, Columns 4 and 9 add an indicator for the parents expecting their child to complete secondary, and Columns 5 and 10 add an indicator of the household head completing secondary. Standard errors are clustered at the community level.

Table 3: Correlates of School Quality at Baseline

	(1)	(2)	(3)	(4)	(5)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Children per group			Tuition			Children respected by peers			Children respected by teachers		
Roma	1.19***	1.17***	1.20**	0.18***	0.18***	0.10***	0.04	0.04	0.02	0.04	0.04	0.02
	(0.42)	(0.42)	(0.49)	(0.03)	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
log income			0.23			-0.04***			-0.01			-0.01
			(0.16)			(0.01)			(0.01)			(0.01)
HH unemployed			-0.03			0.00			0.02			0.02
			(0.41)			(0.02)			(0.02)			(0.02)
Household h. completed secondary			-0.15			-0.17***			-0.04***			-0.04***
			(0.41)			(0.02)			(0.01)			(0.01)
Constant	24.57***	24.24***	22.89***	0.22***	0.46***	0.79***	0.09***	0.11***	0.19***	0.09***	0.12***	0.20***
	(0.40)	(0.51)	(1.17)	(0.02)	(0.04)	(0.09)	(0.02)	(0.03)	(0.06)	(0.02)	(0.03)	(0.06)
									—			
Age and Gender FE	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Mean of the dependent variable	25.48	25.48	25.48	0.361	0.361	0.361	0.117	0.117	0.117	0.121	0.121	0.121
Observations	4,863	4,863	4,863	4,863	4,863	4,863	4,863	4,863	4,863	4,863	4,863	4,863
R-squared	0.01	0.01	0.01	0.02	0.07	0.10	0.00	0.00	0.01	0.00	0.00	0.01

Notes:

Table 4: Treatment effects on school participation and parental investment

Panel A: Pooled treatment effect

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	Enrolled in KG		Attendance		Parental investment	
Enrolled at baseline	Yes	No	Yes	No	Yes	No
Treated	0.04	0.26***	0.06	0.40***	-0.09	-0.25**
	(0.03)	(0.07)	(0.12)	(0.14)	(0.08)	(0.12)
Control group mean of dep. var.	0.91	0.60	1.85	0.99	1.58	1.36
Observations	3,156	1,707	3,156	1,707	3,156	1,707

Panel B: Individual treatment arm effects

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	Enrolled in KG		Attendance		Parental investment	
Enrolled at baseline	Yes	No	Yes	No	Yes	No
Information	0.04	0.24***	-0.22	0.32*	-0.01	-0.20
	(0.04)	(0.09)	(0.18)	(0.18)	(0.12)	(0.17)
Free access	0.07**	0.22**	0.15	0.45**	-0.18	-0.46***
	(0.04)	(0.09)	(0.15)	(0.21)	(0.12)	(0.13)
Fre access+ Info.	0.05	0.31***	0.08	0.42**	-0.07	-0.31**
	(0.04)	(0.10)	(0.14)	(0.18)	(0.12)	(0.16)
7 lev	0.07*	0.34***	0.10	0.57***	-0.05	-0.28**
	(0.04)	(0.09)	(0.19)	(0.18)	(0.10)	(0.14)
7 lev + Info	0.03	0.21**	0.04	0.25	-0.08	-0.08
	(0.04)	(0.08)	(0.14)	(0.17)	(0.11)	(0.18)
20 lev	0.02	0.25***	0.09	0.43**	-0.13	-0.17
	(0.04)	(0.08)	(0.15)	(0.19)	(0.11)	(0.15)
20 lev + Info	0.04	0.22**	0.12	0.37*	-0.08	-0.32**
	(0.04)	(0.09)	(0.15)	(0.21)	(0.12)	(0.15)
Control group mean of dep. var.	0.91	0.60	1.85	0.99	1.58	1.36
Observations	3,156	1,707	3,156	1,707	3,156	1,707
$\boldsymbol{H_0}$: Equality of all treatment arms						
F-statistic	5.46	3.60	4.98	3.89	2.30	9.96
p-value	0.49	0.73	0.55	0.69	0.89	0.13

Notes: This table reports estimates for the average treatment effects on school participation and parental investment. Enrollment at KG is measured as a dummy variable, while attendance and parental investment as average z-scores. The treatment effects were calculated using the Double Machine Learning method with LASSO regression as the learner method. The experiment consisted of 7 treatment arms plus a control group. Panel A reports coefficients pooling all treatment interventions. Panel B reports the average effect across all individual treatment arms. All the reported standard errors and inference results are obtained using cluster robust procedures at the community level.

Table 5: Treatment effects on child development

Panel A: Pooled treatment effect

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent variable	Literacy		Numeracy		Socioemotional skills		Motor skills		Aggregate skills	
Enrolled at baseline	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Treated	0.03	-0.08	-0.06	-0.14**	0.02	-0.12	0.13*	-0.01	0.03	-0.10
	(0.05)	(0.08)	(0.04)	(0.07)	(0.05)	(0.08)	(0.07)	(0.08)	(0.04)	(0.07)
Control group mean of dep. var.	1.01	0.65	1.53	1.12	1.42	1.13	1.13	0.80	1.27	0.92
Observations	3,156	1,707	3,156	1,707	3,156	1,707	3,156	1,707	3,156	1,707

Panel B: Individual treatment arm effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent variable	Literacy		Numeracy		Socioemotional skills		Motor skills		Aggregate skills	
Enrolled at baseline	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Information	-0.00	0.05	-0.11	-0.08	-0.03	-0.04	0.08	0.03	-0.02	-0.02
	(0.07)	(0.09)	(0.07)	(0.08)	(0.07)	(0.09)	(0.09)	(0.09)	(0.06)	(0.06)
Free access	-0.02	-0.11	-0.18***	-0.16*	-0.05	-0.07	0.11	-0.03	-0.04	-0.10
	(0.06)	(0.10)	(0.06)	(0.08)	(0.07)	(0.09)	(0.08)	(0.11)	(0.06)	(0.09)
Fre access+ Info.	0.06	-0.13	-0.05	-0.17*	0.05	-0.19**	0.17*	-0.08	0.06	-0.15
	(0.06)	(0.11)	(0.06)	(0.09)	(0.07)	(0.10)	(0.09)	(0.12)	(0.06)	(0.10)
7 lev	0.05	-0.12	0.06	-0.15	0.07	-0.18*	0.11	0.00	0.07	-0.13
	(0.07)	(0.09)	(0.06)	(0.10)	(0.08)	(0.10)	(0.09)	(0.10)	(0.06)	(0.09)
7 lev + Info	0.07	-0.08	-0.03	-0.09	0.05	-0.12	0.16*	0.03	0.06	-0.07
	(0.07)	(0.10)	(0.05)	(0.08)	(0.06)	(0.09)	(0.10)	(0.10)	(0.06)	(0.08)
20 lev	0.03	-0.05	-0.02	-0.14*	0.05	-0.06	0.10	-0.02	0.04	-0.08
	(0.06)	(0.10)	(0.05)	(0.08)	(0.06)	(0.10)	(0.09)	(0.10)	(0.05)	(0.08)
20 lev + Info	0.01	-0.08	-0.06	-0.14	0.01	-0.17	0.20**	-0.02	0.04	-0.11
	(0.06)	(0.11)	(0.05)	(0.09)	(0.06)	(0.10)	(0.09)	(0.11)	(0.05)	(0.09)
Control group mean of dep. var.	1.01	0.65	1.53	1.12	1.42	1.13	1.13	0.80	1.27	0.92
Observations	3,156	1,707	3,156	1,707	3,156	1,707	3,156	1,707	3,156	1,707
$\boldsymbol{H_0}$: Equality of all treatment arms										
F-statistic	3.20	8.20	14.3	2.65	5.03	7.21	4	1.58	5.96	4.20
p-value	0.78	0.22	0.026	0.85	0.54	0.30	0.68	0.95	0.43	0.65

Notes: This table reports estimates for the average treatment effects on school participation and parental investment. Enrollment at KG is measured as a dummy variable, while attendance and parental investment as average z-scores. The treatment effects were calculated using the Double Machine Learning method with LASSO regression as the learner method. The experiment consisted of 7 treatment arms plus a control group. Panel A reports coefficients pooling all treatment interventions. Panel B reports the average effect across all individual treatment arms. All the reported standard errors and inference results are obtained using cluster robust procedures at the community level.

Table 6: Pooled treatment effects on pre-school attendance and development outcomes by ethnicity

Panel A: Pooled treatment effect on inputs

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	Enrolled at KG		Attendance		Parental Investment	
Enrolled at baseline	Yes	No	Yes	No	Yes	No
Treated	-0.00	0.27***	-0.27*	0.34	-0.11	-0.17
	(0.02)	(0.10)	(0.14)	(0.23)	(0.11)	(0.15)
Treated#Roma	0.06	-0.03	0.45***	0.04	0.02	-0.11
	(0.04)	(0.11)	(0.16)	(0.25)	(0.10)	(0.18)
Roma	0.00	0.00	0.00	0.00	0.00	-0.01
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.17)
H_0: ATE ROMA=0						
p-value	0.15	0.0010	0.16	0.012	0.29	0.031
Control group mean of dep. var.						
Roma	0.90	0.60	1.83	1	1.51	1.32
Majority	0.96	0.60	1.89	0.93	1.76	1.60
Observations	3,156	1,707	3,156	1,707	3,156	1,707

Panel B: Pooled treatment effect on development outcomes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent variable	Literacy		Numeracy		Socioemotional		Motor		Aggregate	
Enrolled at baseline	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Treated	0.02	0.06	-0.02	0.03	0.11*	0.01	0.08	0.08	0.06	0.03
	(0.06)	(0.08)	(0.06)	(0.09)	(0.06)	(0.07)	(0.10)	(0.12)	(0.05)	(0.07)
Treated#Roma	-0.00	-0.17*	-0.06	-0.22**	-0.12*	-0.18*	0.06	-0.12	-0.04	-0.17*
	(0.07)	(0.10)	(0.06)	(0.10)	(0.07)	(0.10)	(0.09)	(0.15)	(0.06)	(0.09)
Roma	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.23	-0.01	0.17*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.07)	(0.00)	(0.00)	(0.14)	(0.06)	(0.09)
H_0: ATE ROMA=0										
p-value	0.70	0.19	0.12	0	0.74	0.05	0.05	0.65	0.81	0.073
Control group mean of dep. var.										
Roma	0.93	0.62	1.47	1.10	1.37	1.10	1.09	0.80	1.21	0.90
Majority	1.23	0.81	1.72	1.29	1.57	1.29	1.24	0.81	1.44	1.05
Observations	3,156	1,707	3,156	1,707	3,156	1,707	3,156	1,707	3,156	1,707

Table 7: Production Function Parameters

	(1)	(2)	(3)	(4)	(4)
	Literacy	Numeracy	Socioemotional	Motor	Aggregate
Elasticity and factor shares					
ρ (substitution parameter)	0.49	0.50	0.42	0.45	0.46
	[<0.01]	[<0.01]	[<0.01]	[<0.01]	[<0.01]
β (PI share)	0.5	0.56	0.58	0.47	0.54
	[<0.01]	[<0.01]	[<0.01]	[<0.01]	[<0.01]
Productivity parameters					
A (Constant)	0.29	-0.11	0.09	-0.76	-0.17
	[<0.01]	[0.14]	[0.21]	[<0.01]	[0.04]
A_f (Female FE)	0.34	-0.12	-0.07	0.11	-0.08
	[0.41]	[0.09]	[0.28]	[0.18]	[0.23]
A_{A4} (Age=4 FE)	0.21	0.23	0.16	0.26	0.18
	[<0.01]	[<0.01]	[0.01]	[<0.01]	[<0.01]
A_{A5} (Age=5 FE)	0.41	0.56	0.41	0.66	0.48
	[<0.01]	[<0.01]	[<0.01]	[<0.01]	[<0.01]
A_{A6} (Age=6 FE)	0.48	0.80	0.63	1.03	0.75
	[<0.01]	[<0.01]	[<0.01]	[<0.01]	[<0.01]
$A_{f,A4}$ (Age=4#Female FE)	0.09	0.16	0.09	0.02	0.12
	[0.26]	[0.03]	[0.22]	[0.77]	[0.09]
$A_{f,A5}$ (Age=5#Female FE)	0.35	0.15	0.1	0.07	0.13
	[0.23]	[0.07]	[0.12]	[0.49]	[0.03]
$A_{f,A6}$ (Age=6#Female FE)	0.41	0.08	0.02	-0.03	0.06
	[0.4]	[0.29]	[0.77]	[0.7]	[0.38]
A_{RT} (Roma or Turkish FE)	-0.19	-0.09	-0.06	-0.04	-0.08
	[<0.01]	[<0.01]	[0.02]	[0.35]	[<0.01]
A_{PI} (Enrolled at Baseline)	0.28	-0.20	-0.27	-0.21	-0.23
	[<0.01]	[<0.01]	[<0.01]	[<0.01]	[<0.01]
A_{PI} (Baseline Parent. Inv.)	0.33	-0.04	-0.07	-0.07	-0.06
	[0.16]	[0.02]	[<0.01]	[<0.01]	[<0.01]
A_{PEd} (Parents completed sec.)	0.12	-0.01	-0.01	0.05	0.01
	[<0.01]	[0.78]	[0.7]	[0.14]	[0.7]
A_{PEx} (Parents expect sec. ed.)	0.34	0	-0.02	0.02	-0.01
	[0.23]	[0.99]	[0.4]	[0.66]	[0.76]
Control functions					
ν_{Sc} (Parental investment)	0.12	-0.01	-0.01	0.05	0.01
	[<0.01]	[0.78]	[0.7]	[0.14]	[0.7]
First stage F-statistic	33	33	33	33	33
ν_{Pi} (School attendance)	0.34	0	-0.02	0.02	-0.01
	[0.23]	[0.99]	[0.4]	[0.66]	[<0.01]
First stage F-statistic	41	41	41	41	41
Observations	4,863	4,863	4,863	4,863	4,863

Notes: This table reports estimates for the main parameters of the production function of developmental skills. The first two rows report the substitution parameter ρ (which dictates the complementarity of inputs), and the relative contribution of parental investment to output β (which describes how intensive in parental investment the production function is). The second panel reports the contribution of the socio-demographic control variables to the total factor productivity in the production function. The last panel reports the effect of unobserved heterogeneity associated to parental investment and preschool attendance (control functions) and the first stage F-statistics for the endogenous inputs. All p-values in brackets were calculated by conducting 250 bootstrap replications clustered at the community level.

Table 8: Decomposition of observed developmental differences between Roma and Majority children

	(1)	(2)	(3)	(4)	(5)
	Observed difference	Predicted difference			
Developmental outcomes	Total	Total	School attendance	P. Investment	TPF
Literacy					
Average difference (sd)	-0.33	-0.37	-0.05	-0.1	-0.22
	(-0.26,-0.39)	(-0.45,-0.27)	(-0.06,-0.04)	(-0.12,-0.08)	(-0.08,-0.33)
			[15.2%]	[30.3%]	[66.7%]
Numeracy					
Average difference (sd)	-0.3	-0.37	-0.08	-0.2	-0.08
	(-0.25,-0.35)	(-0.44,-0.29)	(-0.09,-0.06)	(-0.23,-0.18)	(-0.18,-0.24)
			[26.7%]	[66.7%]	[26.7%]
Socioemotional					
Average difference (sd)	-0.25	-0.29	-0.08	-0.21	0.02
	(-0.19,-0.31)	(-0.37,-0.22)	(-0.09,-0.06)	(-0.24,-0.19)	(-0.19,-0.12)
			[32%]	[84%]	[-8%]
Motor					
Average difference (sd)	-0.18	-0.19	-0.06	-0.11	-0.01
	(-0.1,-0.25)	(-0.3,-0.09)	(-0.08,-0.05)	(-0.14,-0.09)	(-0.09,-0.12)
			[33.3%]	[61.1%]	[5.6%]
Aggregate					
Average difference (sd)	-0.26	-0.29	-0.07	-0.17	-0.04
	(-0.2,-0.31)	(-0.35,-0.22)	(-0.08,-0.06)	(-0.19,-0.15)	(-0.15,-0.17)
			[26.9%]	[65.4%]	[15.4%]
Observations					
Minority	1,101				
Majority	3,762				

Notes: This table reports our estimates for the difference in developmental skills between Bulgarian and Roma children along with a decomposition of such differences into the first and second order effects of preschool attendance and parental investment obtained from the structural model estimates. The first column reports the difference in average skill indices between Roma and Bulgarian children. The second column reports the skill difference that the estimated structural production function predicts. Then, we decompose the difference into four components: (i) the first order effec of school attendance, measured as the marginal product of school attendance for majority children multiplied by the observed difference in attendance levels between Roma and Bulgarian children; (ii) the first order effec of parental investment, which, as in the case of attendance, we measure as the marginal product of parental investment for Bulgarian children multiplied by the observed difference in parental investment levels between Roma and Bulgarian children; (iii) the indirect or second order effect of preschool attendance, which aims to capture how increasing preschool attendance increases the productivity of parental investment and we define as the estimated difference in the median marginal product of parental investment among Bulgarian children multiplied by the observed median difference in preschool attendance; and (iv) the indirect or second order effect of parental investment, which we measure as the difference in the median marginal product of preschool attendance for Bulgarian children multiplied by the median observed difference in parental investment). The decomposition is formally defined in Equation 9. P-values for all quantities are obtained from 250 boostrap replications clustered at the community level.

Table 9: Productivity

Panel A: Median inputs

	(4)	(5)	(6)	(7)	(8)	(9)
	Marginal product of preschool attendance					
	Roma	Majority	Difference	Decomposition		
				Prod.	Dim. Ret.	Comp.
Literacy	0.25 (0.19,0.29)	0.36 (0.27,0.45)	-0.12 (-0.17,-0.05)	-0.08 (-0.13,-0.02)	0.00 (0,0)	-0.03 (-0.04,-0.02)
Numeracy	0.39 (0.3,0.46)	0.46 (0.37,0.53)	-0.07 (-0.11,-0.02)	-0.02 (-0.06,0.03)	0.00 (0,0)	-0.06 (-0.07,-0.04)
Socioemotional	0.34 (0.28,0.41)	0.40 (0.33,0.48)	-0.05 (-0.1,-0.01)	0.00 (-0.04,0.04)	0.00 (0,0)	-0.06 (-0.07,-0.05)
Motor	0.28 (0.21,0.34)	0.33 (0.24,0.4)	-0.05 (-0.09,0)	-0.02 (-0.06,0.03)	0.00 (0,0)	-0.04 (-0.05,-0.02)
Aggregate	0.33 (0.26,0.38)	0.39 (0.3,0.46)	-0.06 (-0.11,-0.03)	-0.01 (-0.05,0.02)	0.00 (0,0)	-0.05 (-0.06,-0.04)

Panel B: Mean inputs

	(4)	(5)	(6)	(7)	(8)	(9)
	Marginal product of preschool attendance					
	Roma	Majority	Difference	Decomposition		
				Prod.	Dim. Ret.	Comp.
Literacy	0.28 (0.22,0.33)	0.37 (0.28,0.45)	-0.09 (-0.14,-0.06)	-0.08 (-0.12,-0.04)	0.00 (0,0)	-0.01 (-0.02,-0.01)
Numeracy	0.44 (0.36,0.5)	0.50 (0.41,0.59)	-0.07 (-0.11,-0.03)	-0.04 (-0.08,-0.01)	0.00 (0,0)	-0.02 (-0.03,-0.02)
Socioemotional	0.41 (0.34,0.48)	0.45 (0.37,0.53)	-0.04 (-0.07,-0.01)	-0.02 (-0.05,0.02)	0.00 (0,0)	-0.03 (-0.03,-0.02)
Motor	0.32 (0.25,0.38)	0.35 (0.27,0.43)	-0.04 (-0.07,0)	-0.02 (-0.05,0.02)	0.00 (0,0)	-0.02 (-0.02,-0.01)
Aggregate	0.38 (0.33,0.43)	0.43 (0.36,0.49)	-0.05 (-0.09,-0.02)	-0.03 (-0.06,0)	0.00 (0,0)	-0.02 (-0.03,-0.02)

Notes: The first two columns of this table report estimates for the marginal product of preschool attendance for Majority and Roma children respectively. The marginal products are evaluated at the observed median and mean values of the two inputs and covariates that determine the total factors productivity. Column 3 reports the estimated marginal productivity difference between both groups. In columns 4, 5, and 6, we decompose the difference in marginal productivity into three components: One corresponding to the difference attributable to differences in productivity, a second associated with differences in initial levels of attendance (own input), and a third associated with difference in parental investment (cross input). The second and third component respectively capture diminishing own-input returns and complementarity/substitution across inputs. Below every estimate we report 95% confidence intervals obtained from 250 boostrap replications clustered at the community level. For a formal description of the decomposition see sub-section 6.5 and equation 11.

Table 10: Productivity

Panel A: Median inputs

	(10)	(11)	(12)	(13)	(14)	(15)
	Marginal product of parental investment					
	Roma	Majority	Difference	Decomposition		
				Prod.	Dim. Ret.	Comp.
Literacy	0.28 (0.2,0.34)	0.33 (0.25,0.38)	-0.05 (-0.09,0.01)	-0.09 (-0.13,-0.03)	0.04 (0.02,0.05)	0.00 (0,0)
Numeracy	0.55 (0.46,0.63)	0.52 (0.45,0.6)	0.03 (-0.04,0.09)	-0.02 (-0.09,0.04)	0.07 (0.05,0.08)	0.00 (0,0)
Socioemotional	0.53 (0.45,0.61)	0.47 (0.41,0.55)	0.06 (-0.01,0.11)	0.00 (-0.06,0.06)	0.07 (0.06,0.09)	0.00 (0,0)
Motor	0.28 (0.2,0.35)	0.26 (0.19,0.32)	0.02 (-0.02,0.06)	-0.02 (-0.05,0.03)	0.05 (0.03,0.06)	0.00 (0,0)
Aggregate	0.44 (0.38,0.49)	0.41 (0.36,0.47)	0.03 (-0.02,0.07)	-0.02 (-0.07,0.02)	0.06 (0.05,0.07)	0.00 (0,0)

Panel B: Mean inputs

	(10)	(11)	(12)	(13)	(14)	(15)
	Marginal product of parental investment					
	Roma	Majority	Difference	Decomposition		
				Prod.	Dim. Ret.	Comp.
Literacy	0.30 (0.24,0.37)	0.37 (0.29,0.45)	-0.07 (-0.1,-0.04)	-0.09 (-0.12,-0.05)	0.02 (0.01,0.02)	0.00 (0,0)
Numeracy	0.61 (0.54,0.72)	0.64 (0.55,0.74)	-0.03 (-0.08,0.01)	-0.06 (-0.1,-0.01)	0.03 (0.02,0.03)	0.00 (0,0)
Socioemotional	0.61 (0.53,0.69)	0.61 (0.53,0.68)	0.00 (-0.04,0.05)	-0.03 (-0.07,0.03)	0.03 (0.02,0.04)	0.00 (0,0)
Motor	0.31 (0.22,0.39)	0.31 (0.23,0.39)	0.00 (-0.03,0.03)	-0.02 (-0.05,0.02)	0.02 (0.01,0.02)	0.00 (0,0)
Aggregate	0.50 (0.44,0.57)	0.51 (0.45,0.58)	-0.01 (-0.05,0.02)	-0.04 (-0.08,0)	0.03 (0.02,0.03)	0.00 (0,0)

Notes: The first two columns of this table report estimates for the marginal product of parental investment for Majority and Roma children respectively. The marginal products are evaluated at the observed median and mean values of the two inputs and covariates that determine the total factors productivity. Column 3 reports the estimated marginal productivity difference between both groups. In columns 4, 5, and 6, we decompose the difference in marginal productivity into three components: One corresponding to the difference attributable to differences in productivity, a second associated with differences in initial levels of párental investment (own input), and a third associated with difference in preschool attendance (cross input). The second and third components respectively capture diminishing own-input returns and complementarity/substitution across inputs. Below every estimate we report 95% confidence intervals obtained from 250 boostrap replications clustered at the community level. For a formal description of the decomposition see sub-section 6.5 and equation 11.

Appendix

A Additional Tables

Table A1: Content of the Information Intervention

Info session	Short description	Length	Time period of implementation	Leading the session	Attendees
1	Data on benefits of early learning, description of the project and logistics of enrolment in kindergarten.	60 minutes	July- beginning of September 2014	NGO representative	Parents from the whole community
2	Teacher's presentation on the setting and daily regime, curriculum and goals. NGO repeats logistics of enrolment in kindergarten.	50 minutes	September-October 2014	KG teacher and NGO representative	Parents from the whole community
3	Open house. Observation at the kindergarten of a celebration or a lesson open to the parents.	45 minutes	December 2014, March 2015 or May 2015	KG teacher and NGO representative – observing the children perform	Parents from the whole community
4	Teacher's presentation on children's progress. NGO training on parent-teacher-child effective communication.	70 minutes	February-March 2015	KG teacher and NGO representative	Parents from the whole community
5	Role model: community representative's presentation on importance of kindergarten for success in school and later on in life.	90 minutes	May-June 2015	NGO representative and Roma role-model	Parents from the whole community

Table A2: Measurement and variable construction

	(1)	(2)	(3)
Variable	Data source	Type	Construction
Developmental skills			
Literacy	IDELA test	Z-score	Standardized sum of the answers to the IDELA questions aimed at measuring literacy
Numeracy	IDELA test	Z-score	Standardized sum of the answers to the IDELA questions aimed at measuring numeracy
Socioemotional	IDELA test	Z-score	Standardized sum of the answers to the IDELA questions aimed at measuring socioemotional skills
Motor	IDELA test	Z-score	Standardized sum of the answers to the IDELA questions aimed at measuring motor skills
Aggregate skills	IDELA test	Z-score	Z-score of Literacy, Numeracy, Motor and Socioemotional skills indexes
School attendance			
Baseline enrollment	Baseline survey	Binary	Indicator of self reported enrollment
Enrollment	Kindergarden records	Binary	Indicator of appeareance in records
Attendance	Three unnanounced KG visits	Integer	Count of times the child was present
Parental investment			
Baseline investment	Baseline survey	Z-score	Standardized sum of indicators of the parents spending time reading, playing, naming, singing, telling stories and drawing with their kids
Endline investment	Baseline survey	Z-score	Standardized sum of indicators of the parents spending time reading, playing, naming, singing, telling stories and drawing with their kids
Parental characteristics			
H.H. Completed secondary	Baseline survey	Binary	Self reported
Parents expect secondary completion	Baseline survey	Binary	Self reported
Demographics			
Sex	Baseline survey	Binary	Self reported
Age	Baseline survey	Binary	Self reported
Roma	Baseline survey	Binary	Self reported (determined by surveyor when missing)

Table A2: Measurement and variable construction *(continued)*

	(1)	(2)	(3)
Variable	Data source	Type	Construction
Socio-economic characteristics			
Unemployed	Baseline survey	Binary	Self reported
Income from labor	Baseline survey	Numeric	Self reported
Income from other sources	Baseline survey	Numeric	Self reported
Assets and dwelling index	Baseline survey	Z-score	Standardized sum of indicators of households having multiple appliances and services.
Parental investment components			
Hours reading	Endline	Numeric	Self reported
Hours telling sotires	Endline	Numeric	Self reported
Hours singing sories	Endline	Numeric	Self reported
Hours singing	Endline	Numeric	Self reported
Hours naming thing	Endline	Numeric	Self reported
Perceived cost of preschool			
Perceived distance to school	Endline	Numeric	Self reported: Walking distance from settlement to preschoool?
Tuiton	Endline	Numeric	Self reported: How much does the kindergartten monthy tuition fee costs?
Lunch fee	Endline	Numeric	Self reported: How much does the kindergartten? monthy lunch fee costs?
Transport fee	Endline	Numeric	Self reported: How much does the kindergartten monthy transport fee costs?
Perceptions on diversity and importance of preschool			
School ethnic comp.	Endline	Categorical (1 to 5)	Self reported: What is the school ethnic composition?
Minority respected by staff	Endline	Binary	Self reported: Does kindergarden staff respects children from segregated communities?
Minority respected by children	Endline	Binary	Self reported: Do other children respect children from segregated communities?
Minority respected by teachers	Endline	Binary	Self reported: Do kindergarden teachers respect children from segregated communities?
KG importante for Prim. Ed.	Endline	Binary	Self reported: Do you believe that if [child] completes kindergarden will complete primary education?
KG importante for Sec. Ed.	Endline	Binary	Self reported: Do you believe that if [child] completes kindergarden will complete secondary education?

Table A3: Table of balance p-values

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Information	Free access	Free access + Info.	7 lev	7 lev + Info.	20 lev	20 lev + Info.
Developmental outcomes							
Literacy	0.75	0.31	0.64	1.00	1.00	0.66	0.63
Numeracy	1.00	1.00	0.99	1.00	1.00	1.00	0.97
Socioemotional sills	1.00	1.00	1.00	1.00	0.99	1.00	0.78
Motor skills	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Kindergarden enrollment							
Registered at baseline	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Parental investment							
Read books	0.89	1.00	0.97	1.00	1.00	0.83	1.00
Told story	0.89	0.98	1.00	1.00	1.00	0.76	0.95
Sang	0.99	1.00	1.00	1.00	1.00	1.00	1.00
Went out	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Played	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Draw	1.00	1.00	0.99	0.96	1.00	1.00	1.00
Summary index	0.99	1.00	1.00	1.00	1.00	1.00	1.00
Demographics							
Female	0.93	1.00	1.00	1.00	1.00	0.97	0.97
Age	1.00	1.00	0.96	1.00	1.00	0.99	1.00
Household characteristics							
H.Head unemployed	0.83	1.00	1.00	1.00	1.00	1.00	1.00
H. Size	0.42	1.00	0.90	0.99	0.99	1.00	0.49
Income	0.52	1.00	0.75	0.99	1.00	0.51	1.00
Assets and Dwell. Ind.	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Parental education							
Completed Kindergarden	0.90	1.00	0.98	1.00	1.00	1.00	1.00
Completed Secondary	1.00	1.00	0.74	0.99	1.00	1.00	0.84
Parental aspirations							
Age to stop education	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Expects child to complete secondary	0.83	1.00	0.98	1.00	0.92	1.00	0.93
School quality							
Children per group	1.00	1.00	1.00	1.00	1.00	1.00	0.93
Tuition	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Perceived teacher's respect	1.00	1.00	0.92	1.00	1.00	1.00	1.00
Perceived bullying	0.99	1.00	0.90	1.00	1.00	1.00	1.00
Treated children	547	625	619	641	620	579	601
Control children	631	631	631	631	631	631	631
Total observations	4863	4863	4863	4863	4863	4863	4863

Notes: This table reports Romano-Wolf p-values obtained from 100 boostrap replications for the null hypothesis that treatment arm means are equal to control group means. Each column correspond to an intervention arm and each row to a different baseline variable.

Table A4: Differences between Roma and Turkish children

Panel A: Control group differences in developmental outcomes

	(1)	(2)	(3)	(4)	(5)
	Majority	Roma	H_0: Majority=Roma		
			F-statistic	p-value	RW p-value
Literacy	0.87	0.78	1.49	0.23	0.13
Numeracy	1.44	1.46	0.05	0.82	0.36
Socioemocional skills	1.34	1.29	0.47	0.5	0.25
Motor skills	0.88	1	2.13	0.16	0.2
Summary index	1.13	1.13	0	1	0.36
Observations per ethnicity	84	399			
v	483				

Panel B: Baseline differences in enrollment, parental investment and household characteristics

	(1)	(2)	(3)	(4)	(5)
	Majority	Roma	H_0: Majority=Roma		
			F-statistic	p-value	RW p-value
Kindergarden enrollment					
Enrolled at baseline	0.59	0.68	4.85	0.03	1
Parental investment					
Read books	0.4	0.47	3.41	0.07	1
Told story	0.62	0.6	0.18	0.68	0.82
Sang	0.72	0.7	0.41	0.52	0.98
Played	0.73	0.8	3.44	0.07	0.89
Draw	0.63	0.66	0.28	0.6	1
Summary Index	1.45	1.5	0.54	0.46	1
Demographics					
Female	0.48	0.49	0.01	0.93	1
Age	4.76	4.72	0.74	0.39	1
Household characteristics					
H. Head Unemployed	0.43	0.37	2.35	0.13	1
H. Size	4.72	4.57	2.63	0.11	1
Income	5.57	5.74	7.09	0.01	1
Assets and Dwell. Ind.	-0.55	0.27	16.77	<0.01	0.8
Parental education					
Completed Kindergarden	0.38	0.31	19.64	<0.01	0.94
Completed Secondary	0.1	0.21	19.84	<0.01	1
Parental aspirations					
Age to stop education	19.12	19.99	8.06	<0.01	1
Expects child to complete secondary	0.74	0.83	11.08	<0.01	0.6
Observations per ethnicity	840	2,922			
Total	3,762				

Notes: This table reports observed differences within the Minority group in our sample, this is, between children from households that identify as Turkish and households that identify as Roma. The first two columns report sample averages for each group and the last two report F-statistics and p-values for the null hypothesis that the observed differences are attributable to chance. To account for the multiplicity of hypotheses being tested we use the adjustment and inference procedures from Romano et al. 2005. The developmental outcomes are measured as the average z-scores of IDELA items related to literacy, numeracy, socioemotional and motor skills. Demographics, household characteristics, school attendance , parental involvement, parental education and parental aspirations are calculated using the baseline survey. See table A2 for a detailed description and definition of all the variables.

Table A5: Treatment effect on parental investment components

Panel A: Pooled treatment effect

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent variable	Read		Tell stories		Sing		Play		Name	
Enrolled at baseline	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Treated	-0.04	-0.11	-0.06	-0.21	-0.11	-0.47***	-0.21**	-0.37**	-0.05	-0.25
	(0.10)	(0.19)	(0.09)	(0.14)	(0.11)	(0.12)	(0.11)	(0.15)	(0.11)	(0.16)
Control group mean of dep. var.	0.050	-0.23	0.018	-0.28	-0.11	-0.27	-0.11	-0.28	0.0058	-0.22
Observations	3,156	1,707	3,156	1,707	3,156	1,707	3,156	1,707	3,156	1,707

Panel B: Individual treatment arm effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent variable	Read		Tell stories		Sing		Play		Name	
Enrolled at baseline	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Information	0.06	-0.17	0.04	-0.17	-0.15	-0.47**	-0.02	-0.18	0.01	0.01
	(0.15)	(0.23)	(0.15)	(0.19)	(0.17)	(0.22)	(0.14)	(0.20)	(0.15)	(0.15)
Free access	-0.14	-0.36*	-0.19	-0.49***	-0.23	-0.70***	-0.19	-0.41**	-0.16	-0.47**
	(0.15)	(0.19)	(0.14)	(0.16)	(0.16)	(0.17)	(0.14)	(0.18)	(0.15)	(0.19)
Fre access+ Info.	0.01	-0.11	-0.04	-0.35**	-0.09	-0.56***	-0.21	-0.32	0.01	-0.33
	(0.15)	(0.22)	(0.12)	(0.17)	(0.15)	(0.20)	(0.16)	(0.21)	(0.15)	(0.20)
7 lev	-0.01	-0.14	-0.05	-0.25	-0.00	-0.42***	-0.34**	-0.46**	0.09	-0.21
	(0.13)	(0.20)	(0.13)	(0.16)	(0.13)	(0.14)	(0.15)	(0.19)	(0.14)	(0.19)
7 lev + Info	-0.04	0.18	0.00	-0.04	-0.17	-0.39*	-0.17	-0.17	-0.01	-0.11
	(0.13)	(0.24)	(0.12)	(0.20)	(0.15)	(0.20)	(0.15)	(0.20)	(0.15)	(0.23)
20 lev	-0.07	0.01	-0.09	-0.10	-0.17	-0.37**	-0.22	-0.44**	-0.17	-0.15
	(0.14)	(0.21)	(0.12)	(0.17)	(0.15)	(0.16)	(0.14)	(0.21)	(0.15)	(0.21)
20 lev + Info	-0.05	-0.19	-0.07	-0.16	0.02	-0.45**	-0.30*	-0.63***	-0.06	-0.36*
	(0.14)	(0.21)	(0.14)	(0.17)	(0.14)	(0.20)	(0.16)	(0.21)	(0.16)	(0.19)
Control group mean of dep. var.	0.050	-0.23	0.018	-0.28	-0.11	-0.27	-0.11	-0.28	0.0058	-0.22
Observations	3,156	1,707	3,156	1,707	3,156	1,707	3,156	1,707	3,156	1,707
$\boldsymbol{H_0}$: Equality of all treatment arms										
F-statistic	1.88	16	2.64	13.4	4.29	4.18	5.93	6.51	5.03	6.22
p-value	0.93	0.014	0.85	0.037	0.64	0.65	0.43	0.37	0.54	0.40

Notes: This table reports average treatment effects on each individual component of the parental investment index. Each component is obtained from standardizing a binary variable indicating the different activities that parents were asked if they perform with their children in the last three days. The treatment effects were calculated using the Double Machine Learning method with LASSO regression as the learner method. The experiment consisted of 7 treatment arms plus a control group. Panel A reports coefficients pooling all treatment interventions. Panel B reports the average effect across all individual treatment arms. All the reported standard errors and inference results are obtained using cluster robust procedures at the community level.

Table A6: Treatment effect on perceived respect toward minority children

Panel A: Pooled treatment effect

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent variable	KG staff respects children		Other parents respect children		Peers respect children		Teachers respect children		Teachers respect children	
Enrolled at baseline	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Treated	0.96	21.56**	28.32	66.58***	-29.68	34.83	-20.06	39.37	39.37	-16.30
	(18.62)	(9.03)	(25.82)	(18.94)	(32.73)	(43.04)	(36.12)	(43.14)	(43.14)	(17.93)
Control group mean of dep. var.	25.8	27.7	71.7	78.5	77.4	141	89.1	143	143	32.2
Observations	3,156	1,707	3,135	1,704	3,156	1,707	3,156	1,707	1,707	3,156

Panel B: Individual treatment arm effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(7)	(8)
Dependent variable	KG staff respects children		Other parents respect children		Peers respect children		Teachers respect children		Teachers respect children	
Enrolled at baseline	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Information	-3.73	-3.80	-10.40	-3.36	-33.06	18.80	-29.12	14.68	14.68	-29.50
	(20.54)	(4.64)	(25.67)	(13.86)	(35.90)	(52.22)	(40.48)	(52.33)	(52.33)	(20.47)
Free access	4.22	55.06*	42.57	104.29**	-17.13	44.66	-20.92	52.82	52.82	-24.81
	(22.17)	(28.12)	(36.58)	(51.48)	(38.46)	(55.17)	(40.80)	(53.65)	(53.65)	(19.14)
Fre access+ Info.	-7.72	25.74	26.01	37.58	-37.03	78.02	-37.71	88.40	88.40	-16.30
	(19.38)	(21.59)	(36.38)	(26.13)	(38.38)	(57.02)	(40.65)	(57.96)	(57.96)	(21.18)
7 lev	-4.26	8.92	3.02	108.07*	-24.85	27.85	-15.01	37.68	37.68	-4.94
	(19.37)	(8.23)	(26.85)	(63.36)	(36.47)	(53.16)	(40.23)	(52.56)	(52.56)	(19.99)
7 lev + Info	-2.51	3.74	31.39	24.60	-24.82	35.32	33.37	41.33	41.33	-11.00
	(22.19)	(8.09)	(36.92)	(17.47)	(37.47)	(54.94)	(60.24)	(56.63)	(56.63)	(22.32)
20 lev	15.95	52.06	79.43	160.71**	-20.49	54.84	-19.54	50.47	50.47	-9.29
	(27.48)	(37.34)	(52.79)	(72.17)	(38.39)	(61.97)	(41.71)	(59.87)	(59.87)	(23.77)
20 lev + Info	2.38	4.89	15.41	27.70	-49.94	-11.84	-49.68	-12.92	-12.92	-19.50
	(20.22)	(8.13)	(31.75)	(17.53)	(34.87)	(50.19)	(37.55)	(50.34)	(50.34)	(20.73)
Control group mean of dep. var.	25.8	27.7	71.7	78.5	77.4	141	89.1	143	143	32.2
Observations	3,156	1,707	3,135	1,704	3,156	1,707	3,156	1,707	1,707	3,156
$\boldsymbol{H_0}$: Equality of all treatment arms										
F-statistic	1.92	15.4	8.47	13.8	2.82	3.95	4.64	4.97	4.97	4.12
p-value	0.93	0.017	0.21	0.032	0.83	0.68	0.59	0.55	0.55	0.66

Notes: This table reports average treatment effects on the reported cost of attending pre-school. All four variables are reported by parents in the endline survey. The treatment effects were calculated using the Double Machine Learning method with LASSO regression as the learner method. The experiment consisted of 7 treatment arms plus a control group. Panel A reports coefficients pooling all treatment interventions. Panel B reports the average effect across all individual treatment arms. All the reported standard errors and inference results are obtained using cluster robust procedures at the community level.

Table A7: Treatment effect on the cost of attending pre-school

Panel A: Pooled treatment effect

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent variable	Total		Tuition fee		Lunch fee		Transport fee		Other fees	
Enrolled at baseline	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Treated	-13.36***	-15.59***	-12.85***	-15.72***	-0.24	-0.35*	0.62	0.25	-0.93	0.29
	(2.30)	(2.28)	(2.04)	(2.18)	(0.28)	(0.20)	(0.47)	(0.15)	(0.79)	(0.41)
Control group mean of dep. var.	17.7	16.6	15	14.9	0.29	0.26	0.98	0.27	1.48	1.05
Observations	3,156	1,707	3,156	1,707	3,156	1,707	3,156	1,707	3,156	1,707

Panel B: Individual treatment arm effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent variable	Tuition		Tuition		Lunch fee		Transport fee		Other fees	
Enrolled at baseline	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Information	-2.30	-5.46*	-1.45	-4.72	0.14	-0.25	-0.45	-0.09	-0.98	-0.98
	(3.59)	(3.03)	(3.28)	(2.90)	(0.33)	(0.24)	(0.30)	(0.09)	(0.89)	(0.89)
Free access	-11.78***	-11.37***	-11.81***	-12.91***	-0.38	-0.45**	0.51	0.28	-0.24	1.13
	(3.41)	(3.88)	(3.03)	(3.96)	(0.27)	(0.20)	(0.49)	(0.22)	(1.10)	(0.74)
Fre access+ Info.	-18.15***	-19.70***	-17.97***	-19.61***	-0.19	-0.31	0.44	0.31	-0.36	0.08
	(2.76)	(3.12)	(2.54)	(2.85)	(0.29)	(0.23)	(0.65)	(0.36)	(1.08)	(0.52)
7 lev	-14.67***	-16.57***	-14.10***	-17.24***	-0.37	-0.38*	0.77	0.62	-0.95	0.63
	(3.47)	(3.96)	(2.86)	(3.44)	(0.29)	(0.20)	(0.76)	(0.63)	(0.98)	(0.70)
7 lev + Info	-13.26***	-16.46***	-14.59***	-16.32***	-0.37	-0.40*	2.74	-0.03	-1.04	0.33
	(4.42)	(4.49)	(3.27)	(4.48)	(0.28)	(0.24)	(2.40)	(0.08)	(0.91)	(0.99)
20 lev	-18.66***	-21.57***	-17.10***	-21.53***	-0.21	-0.39*	-0.02	0.25	-1.17	0.23
	(3.09)	(3.56)	(2.90)	(3.31)	(0.30)	(0.22)	(0.33)	(0.29)	(0.93)	(0.80)
20 lev + Info	-12.89***	-16.12***	-11.23***	-15.69***	-0.28	-0.32	0.35	0.36	-1.71**	-0.24
	(3.20)	(4.13)	(3.07)	(4.00)	(0.29)	(0.22)	(0.42)	(0.38)	(0.80)	(0.42)
Control group mean of dep. var.	17.7	16.6	15	14.9	0.29	0.26	0.98	0.27	1.48	1.05
Observations	3,156	1,707	3,156	1,707	3,156	1,707	3,156	1,707	3,156	1,707
$\boldsymbol{H_0}$: Equality of all treatment arms										
F-statistic	25.1	25.2	29.1	30.5	10.8	2.62	11.1	7.09	6.74	5.59
p-value	¡0.05	¡0.05	¡0.05	¡0.05	0.09	0.85	0.08	0.31	0.35	0.47

Notes: This table reports average treatment effects on the reported cost of attending pre-school. All four variables are reported by parents in the endline survey. The treatment effects were calculated using the Double Machine Learning method with LASSO regression as the learner method. The experiment consisted of 7 treatment arms plus a control group. Panel A reports coefficients pooling all treatment interventions. Panel B reports the average effect across all individual treatment arms. All the reported standard errors and inference results are obtained using cluster robust procedures at the community level.

Table A8: Treatment effect on parental income and employment

Panel A: Pooled treatment effect

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	Income (%)		Labor income (%)		Unemployed	
Enrolled at baseline	Yes	No	Yes	No	Yes	No
Treated	-0.02	0.02	-0.08	-0.04	-0.00	-0.01***
	(0.07)	(0.10)	(0.07)	(0.11)	(0.00)	(0.00)
Control group mean of dep. var.	0.19	0.16	0.24	0.16	0.37	0.40
Observations	3,156	1,707	3,156	1,707	3,156	1,707

Panel B: Individual treatment arm effects

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	Income (%)		Labor income (%)		Unemployed	
Enrolled at baseline	Yes	No	Yes	No	Yes	No
Information	(0.09)	(0.13)	(0.09)	(0.13)	(0.01)	(0.01)
	-0.02	-0.02	-0.03	0.03	-0.00	-0.00
Free access	(0.10)	(0.12)	(0.13)	(0.15)	(0.00)	(0.00)
	-0.04	0.03	-0.16	-0.02	0.00	-0.00
Fre access+ Info.	(0.08)	(0.11)	(0.10)	(0.15)	(0.00)	(0.00)
	-0.05	0.01	-0.11	-0.07	-0.01	-0.02**
7 lev	(0.10)	(0.13)	(0.11)	(0.15)	(0.01)	(0.01)
	-0.01	0.14	-0.12	0.02	-0.01	-0.01
7 lev + Info	(0.09)	(0.11)	(0.12)	(0.14)	(0.01)	(0.01)
	-0.02	0.03	-0.00	-0.08	0.00	-0.01
20 lev	(0.09)	(0.15)	(0.10)	(0.16)	(0.00)	(0.01)
	-0.02	-0.08	-0.01	-0.09	0.00	-0.01
20 lev + Info	(0.08)	(0.11)	(0.09)	(0.12)	(0.00)	(0.01)
	3,156	1,707	3,156	1,707	3,156	1,707
Control group mean of dep. var.	0	0	0	0	0	0
Observations	0	0	0	0	0	0
$\boldsymbol{H_0}$: Equality of all treatment arms						
F-statistic	1	0.27	0.46	0.96	0.11	0.12
p-value	0.19	0.16	0.24	0.16	0.37	0.40

Notes: This table reports average treatment effects on households total income, income from labor, and an unemployment indicator. The income variables are defined as the difference between endline and baseline income divided by the average baseline level in the sample, thus, coefficients can be interpreted as percent changes. The treatment effects were calculated using the Double Machine Learning method with LASSO regression as the learner method. The experiment consisted of 7 treatment arms plus a control group. Panel A reports coefficients pooling all treatment interventions. Panel B reports the average effect across all individual treatment arms. All the reported standard errors and inference results are obtained using cluster robust procedures at the community level.

Table A9: Pooled treatment effects on pre-school attendance and development outcomes by age

Panel A: Pooled treatment effect on inputs

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	Enrolled at KG		Attendance		Parental Investment	
Enrolled at baseline	Yes	No	Yes	No	Yes	No
Treated	0.02	0.28***	-0.02	0.54***	-0.09	-0.23*
	(0.03)	(0.08)	(0.12)	(0.11)	(0.09)	(0.12)
Treated#Age < 5	0.06	-0.04	0.25*	-0.25	0.01	-0.04
	(0.05)	(0.10)	(0.15)	(0.17)	(0.07)	(0.08)
Age < 5	-0.07	0.00	-0.98*	0.00	-0.07	0.00
	(0.15)	(0.00)	(0.59)	(0.00)	(0.39)	(0.00)
H_0: (ATE Age < 5)=0						
p-value	0.14	0.14	0.15	0.15	0.37	0.37
Control group mean of dep. var.						
Age < 5	0.90	0.61	1.86	1.04	1.57	1.42
Age ≥ 5	0.92	0.60	1.84	0.93	1.58	1.28
Observations	3,156	1,707	3,156	1,707	3,156	1,707

Panel B: Pooled treatment effect on development outcomes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent variable	Literacy		Numeracy		Socioemotional		Motor		Aggregate	
Enrolled at baseline	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Treated	0.05	-0.07	-0.04	-0.17**	0.03	-0.12	0.17**	-0.01	0.05	-0.10
	(0.04)	(0.10)	(0.04)	(0.08)	(0.05)	(0.09)	(0.08)	(0.10)	(0.04)	(0.09)
Treated#Age < 5	-0.04	-0.02	-0.05	0.05	-0.04	-0.01	-0.10	0.00	-0.06	0.01
	(0.06)	(0.11)	(0.06)	(0.09)	(0.06)	(0.07)	(0.09)	(0.10)	(0.06)	(0.08)
Age < 5	-0.31	0.00	-0.46*	0.00	-0.38	0.00	-0.38	0.00	-0.39	0.00
	(0.28)	(0.00)	(0.26)	(0.00)	(0.27)	(0.00)	(0.32)	(0.00)	(0.24)	(0.00)
H_0: (ATE Age < 5)=0										
p-value	0.99	0.37	0.20	0.16	0.93	0.12	0.41	0.91	0.92	0.22
Control group mean of dep. var.										
Age < 5	0.68	0.51	1.19	0.95	1.15	0.99	0.82	0.63	0.96	0.77
Age ≥ 5	1.18	0.80	1.71	1.32	1.56	1.28	1.29	0.99	1.43	1.10
Observations	3,156	1,707	3,156	1,707	3,156	1,707	3,156	1,707	3,156	1,707

Table A10: Production function first stage

	(1)	(2)
Variables	Parental investment	School attendance
Roma	-0.08*	0.03
	(0.05)	(0.05)
Enrolled at baseline	0.13***	0.69***
	(0.04)	(0.04)
Baseline PI	0.23***	-0.00
	(0.03)	(0.03)
Female	0.13*	0.07
	(0.07)	(0.11)
Age=4	0.10	0.02
	(0.07)	(0.08)
Age=5	0.07	-0.08
	(0.07)	(0.08)
Age=6	0.08	-0.16*
	(0.07)	(0.09)
Female-Age=4	-0.12	-0.08
	(0.08)	(0.13)
Female-Age=5	-0.10	-0.05
	(0.08)	(0.12)
Female-Age=6	-0.13	-0.06
	(0.09)	(0.13)
Parents expect secondary ed.	0.21***	0.14***
	(0.04)	(0.04)
H. Head completed secondary ed.	0.29***	0.08
	(0.04)	(0.06)
Parental Investment IV	0.86***	-0.07
	(0.15)	(0.18)
Attendance IV	-0.06	0.94***
	(0.13)	(0.15)
Constant	-0.44	-0.32
	(0.28)	(0.31)
Observations	4,863	4,863
R-squared	0.17	0.14
Instruments F-Stat	33	41

Notes: This table reports average treatment effects on the perceived respect toward minority children as well as the perceived importance of preschool attendance. All variables are reported by the parents, thus, they reflect their perceptions. The variables are: categorical variables from 1 to 5 indicating how diverse is the school that children attend, if Roma children are respected by school staff, if Roma children are respected by teachers; and two binary variables, one indicating if parents consider preschool attendance important for primary education, and another one indicating if parents consider it important for secondary education. The treatment effects were calculated using the Double Machine Learning method with LASSO regression as the learner method. The experiment consisted of 7 treatment arms plus a control group. Panel A reports coefficients pooling all treatment interventions. Panel B reports the average effect across all individual treatment arms. All the reported standard errors and inference results are obtained using cluster robust procedures at the community level.

B Structural model identification

B.1 Setup

As discussed in section 5, our structural model is characterized by the equation that describes the production function and two equations that describe how socio-demographic characteristics and the intervention affect preschool attendance and parental investment.

Taking logarithm of the equation that describes production yields:

$$ln\ \ y^d_{igap} = \alpha^d_{ag} + \gamma^d X_{ip} + \frac{1}{\rho^d}\Big(\beta^d\big(I^d_{ip}\big)^\rho + (1-\beta^d)\big(S^d_{ip}\big)\Big) + \eta^d_{ip} \tag{12}$$

Where $d \in \{Numeracy, Literacy, Motor, Socioemotional\}$ denotes the developmental skill of interest. The outcome for child i whose gender is g, is a years old and has parents p is y_{igap}. The first term represents parental productivity which is determined by an age-gender fixed effect α_{ag}, parent and child observable characteristics (X_{ip}) such as the education and expectations of parents, baseline inputs, ethnicity and perceived discrimination, and an unobserved component η^d_{ip}.

Parental investment and preschool attendance choices are made before the IDELA test is administered. This means that parents and children choose inputs before y^d_{igap} is realized. Thus, we assume that η^d_{ip} is only partially observed by parents. Formally, we decompose η^d_{ip} as follows:

$$\eta^d_{ip} = \nu_i + \nu_p + \varepsilon^d_{ip} \tag{13}$$

Where ν_i and ν_p represent heterogeneity in children and parents' productivity that is common across developmental outcomes and observed by parents before the IDELA test is administered but not by the econometrician. ε_{ip} accounts for the remaining heterogeneity that is unobserved by both parents and researchers at the time that investment and attendance choices are made. We assume that inputs are independent from ε_{ip}, this is consistent with the assumption that parents cannot systematically predict productivity shocks that have not been realized at the time inputs are chosen.

Finally, the equations that describe how socio-demographic characteristics and the intervention affect preschool attendance and parental investment are as follows:

$$I_{ip} = \gamma^I_{ag} + \kappa^I X_{ip} + g^I\big(D_{ip}\big) + \phi^I \nu_i + \psi^I \nu_p + \xi^I_{ip} \tag{14}$$

$$S_{ip} = \gamma^S_{ag} + \kappa^S X_{ip} + g^S\big(D_{ip}\big) + \phi^S \nu_i + \psi^S \nu_p + \xi^S_{ip} \tag{15}$$

For $L = I, S$ the term γ^L_{ag} represents a gender-age fixed effect, we also include the remaining determinants of productivity from equation, namely X_{ip} which comprises observed determinants plus ν_i and ν_p which account for the unobserved determinants that parents observe. ξ^L_{ip} accounts for remaining unobserved preferences for inputs which we assume to be uncorrelated with age, gender, X_{ip}, ν_i and ν_p.

We replace $g^L(D_{ip})$ with the conditional expectation of I and S given age, gender and the treatment (which can be non-parametrically identified using saturated regression). Thus, equations 14 and 15 become:

$$I_{ip} = \gamma^I_{ag} + \kappa^I X_{ip} + \lambda^I \mu^I_{a,g,t} + \phi^I \nu_i + \psi^I \nu_p + \xi^I_{ip} \tag{16}$$

$$S_{ip} = \gamma^S_{ag} + \kappa^S X_{ip} + \lambda^S \mu^S_{a,g,t} + \phi^S \nu_i + \psi^S \nu_p + \xi^S_{ip} \tag{17}$$

B.2 Identification

We assume that ν_i, ν_p, ξ^I_{ip} and ξ^S_{ip} are independent from socio-demographic characteristics (the components of X_{ip} plus age and gender) and the intervention. This means that γ^L_{ag}, κ^L and λ^L from equations 16 and 17 can be identified using linear regression. From here, the terms $e^L_i \equiv \phi^L \nu_i + \psi^L \nu_p + \xi^L_{ip}$ are also identified for each child i and $L = I, S$.

Now consider a subpopulation of children such that $I_{ip} = I^*$ and $S_{ip} = S^*$ for some I^* and S^* in the support of I and S. Let a^* and g^* be the age and gender for the excluded category from the saturated regression used to identify equations 16 and 17. Now, note that:

$$\mathbb{E}[\Delta ln\ y^d_{igap} | I = I^*, S = S^*] \tag{18}$$

$$] := \mathbb{E}[ln\ y^d_{igap} | I = I^*, S = S^*] - \mathbb{E}[ln\ y^d_{igap} | I = I^*, S = S^*, a = a^*, g = g^*] \tag{19}$$

$$= \alpha^d_{ag} + \gamma^d \Big(\mathbb{E}[X_{ip} | I = I^*, S = S^*] - \mathbb{E}[X_{ip} | I = I^*, S = S^*, a = a^*, g = g^*] \Big) \tag{20}$$

$$+ \Big(\mathbb{E}[\nu_i + \nu_p | I = I^*, S = S^*] - \mathbb{E}[\nu_i + \nu_p | I = I^*, S = S^*, a = a^*, g = g^*] \Big) \tag{21}$$

$$+ \Big(\mathbb{E}[\varepsilon^d_{ip} | I = I^*, S = S^*] - \mathbb{E}[\varepsilon^d_{ip} | I = I^*, S = S^*, a = a^*, g = g^*] \Big) \tag{22}$$

Where the last term is equal to zero because ε^d_{ip} is assumed to be independent from age, gender and inputs.

Note that:

$$\mathbb{E}[\Delta(e^L_i)] := \mathbb{E}[e^L_i | I = I^*, S = S^*] - \mathbb{E}[e^L_i | I = I^*, S = S^*, a = a^*, g = g^*] \tag{23}$$

$$= \phi^L \Big(\mathbb{E}[\nu^L_i | I = I^*, S = S^*] - \mathbb{E}[\nu_i | I = I^*, S = S^*, a = a^*, g = g^*] \Big) \tag{24}$$

$$+ \psi^L \Big(\mathbb{E}[\nu^L_p | I = I^*, S = S^*] - \mathbb{E}[\nu_p | I = I^*, S = S^*, a = a^*, g = g^*] \Big) \tag{25}$$

Moreover, if ϕ and ψ are different from zero and from each other, a unique linear combination of e^I_i and e^S_i exists such that for $L = S$ and $L = I$:

$$k^I \mathbb{E}[\Delta(e^L_i)] + k^S \mathbb{E}[\Delta(e^L_i)] = \Big(\mathbb{E}[\nu_i + \nu_p | I = I^*, S = S^*] - \mathbb{E}[\nu_i + \nu_p | I = I^*, S = S^*, a = a^*, g = g^*] \Big) \tag{26}$$

This is true because it induces a linear system of two equations with two unknowns: k^I and k^S.

And therefore:

$$k^I \mathbb{E}[\Delta e^L_i] + k^S \mathbb{E}[\Delta e^L_i] = \mathbb{E}[\nu_i + \nu_p] \tag{27}$$

For $L = S, I$.

Furthermore, $\Delta(e^I_i)$ and $\Delta(e^S_i)$ are linearly independent from X and the age-gender indicators since they belong to the space generated by treatment assignment which is random and therefore we assume is linearly independent from any other observable characteristic.

Therefore, the conditional expectation from equation 19 is a unique linear combination of the age and gender indicators, the difference of expectations given by $\Big(\mathbb{E}[X_{ip} | I = I^*, S = S^*] - \mathbb{E}[X_{ip} | I = I^*, S = S^*, a = a^*, g = g^*] \Big)$, $\Delta(e^I_i)$ and $\Delta(e^S_i)$. This means that linear regression of $\Delta ln\ y^d_{igap} - \mathbb{E}[\Delta ln\ y^d_{igap} | I = I^*, S = S^*, a = a^*, g = g^*]$ on the age-gender indicators, X, $\Delta(e^I_i)$ and $\Delta(e^I_i)$ restricted to the subpopulation with $I = I*$ and $S = S^*$ identifies α^d_{ag}, γ^d, k^I and k^S. From here, $\mathbb{E}[\nu_i + \nu_p | X, a, g, I, S]$ is also identified.

Finally, taking expectation of equation 12 yields:

$$\mathbb{E}[ln\ \ y^d_{igap}|S,I] = \alpha^d_{ag} + \gamma^d \mathbb{E}[X_{ip}|S,I] + \Big[\frac{1}{\rho^d}\Big(\beta^d\big(I^d_{ip}\big)^\rho + (1-\beta^d)\big(S^d_{ip}\big)\Big) + \mathbb{E}[\nu_i + \nu_p|S,I] \quad (28)$$

Equation 28 is non-linear in ρ and β and we cannot prove that it is guaranteed to have a solution or that, when a solution exists, it is unique. However, during estimation, we tested several initial values of ρ in the interval [-100,1) and β in the interval (0,1) and found that in all cases our estimation procedure converged to the same solution. This suggests that in our sample and population equation 28 might have a unique solution and therefore is identified.