

# It Takes a Village: The Economics of Parenting with Neighborhood and Peer Effects\*

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## Abstract

As children reach adolescence, peer interactions become increasingly central to their development, whereas the direct influence of parents wanes. Nevertheless, parents can continue to exert leverage by shaping their children's peer groups. We study interactions of parenting style and peer effects in a model where children's skill accumulation depends on both parental inputs and peers, and where parents can affect the peer group by restricting who their children can interact with. We estimate the model and show that it can capture empirical patterns regarding the interaction of peer characteristics, parental behavior, and skill accumulation among US high school students. We use the estimated model for policy simulations. We find that interventions that move children to a more favorable neighborhood have large effects but lose impact when they are scaled up because parents' equilibrium responses push against successful integration with the new peer group. We suggest complementary policies that can sustain the effect of scaled-up policies.

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## I. Introduction

The two most important influences on children’s development are their parents and their peers. The relative salience of these two factors changes as children grow up: once children pass into adolescence, parents’ ability to hold sway over them wanes, whereas the influence of peers looms larger. Yet, parents can try to influence how children select their peers. They can choose neighborhoods and schools, and coax their children into activities and hobbies that expose them to specific peer groups. Or, more directly, they can push their children to associate with or separate from specific peers.

In this paper, we examine the determinants and consequences of parental interference in their children’s peer formation. We build on evidence from the Add Health study, which follows a large group of children in the United States throughout the high school years. The data set includes information on children’s grades, test scores, and socio-economic characteristics of their families. Crucially for our purposes, it also provides rich information on parents’ behavior and on children’s friendship networks. We are specifically interested in how parents intervene in peer-group formation. The data set includes a question that addresses this issue directly: “Do your parents let you make your own decisions about the people you hang around with?” In our baseline classification, we label a parent whose child answers “No” as being authoritarian about friends—or more simply, as *authoritarian*. Conversely, a parent whose child answers “Yes” is associated with a nonauthoritarian parenting style.<sup>1</sup>

We interpret the choice to adopt an authoritarian parenting style through the lens of a theory where parents are concerned about their children’s present and future welfare and are responsive to the characteristics of both their children and the surrounding community. We begin by documenting correlations between the parenting style parents adopt and the peer environment their children face. We show that parents are more likely to meddle in their children’s peer choices when the average quality of the peer group (measured by school performance) is low and when its variance is high. Authoritarian parenting also appears to be effective: interfering with a child’s peer formation is associated with an improvement over time in the quality of friends.

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<sup>1</sup>We also construct an alternative measure of a latent parenting style based on children’s responses to multiple questions. The notion of an authoritarian parenting style (stretching back to [Baumrind 1967](#)) is usually more general and covers many aspects of behavior; we use the shorthand “authoritarian” because we are specifically interested in parents’ impact on peer selection. In the developmental psychology literature, authoritarian parenting often carries a negative connotation and is associated with unfavorable outcomes (see, e.g., [Brooks 2013](#)). In contrast, following [Doepke and Zilibotti \(2017\)](#), we do not attach a value judgement to the notion of authoritarian parenting, and simply use “authoritarian” to denote parents who restrict their children’s choices.

These correlations are consistent with the view that parents' actions are a purposeful response to the environment that their children face. To study the implications of this hypothesis, we develop a model that combines dynamic skill formation by children (Cunha and Heckman 2007) with endogenous friendship networks (Agostinelli 2018) and a rational-choice theory of parent-child interactions. In the model, building on Doepke, Sorrenti, and Zilibotti (2019), parents' concern for their children has a paternalistic component: parents are relatively more concerned about the children's skill accumulation than are the children themselves. This disagreement motivates parental interventions that can take two forms. First, parents can interfere with their child's selection of friends—namely, be authoritarian. Second, they can invest time to directly support their children's skill formation, such as helping them with homework or motivating them to work hard. We interpret such time investments as an element of an *authoritative* parenting style.<sup>2</sup> The two strategies are not exclusive: parents may decide to combine elements of authoritarian and authoritative parenting.

Children form friendships based on the mutual agreement of two potential friends, where the utility a child derives from a friendship depends on their own and the friend's characteristics as well as on match-specific shocks. Children subject to an authoritarian parenting style suffer a utility loss if they befriend low-performing children. Thus, an authoritarian parenting style improves the quality of a child's peer group. However, inspired by the findings of the child development literature, we allow authoritarian parenting to have some negative repercussions. For instance, meddling in the choice of friends may put a strain on the parent-child relationship and make the child less receptive to other parental interventions. Thus, parents face a tradeoff, the optimal resolution of which hinges on the peer environment a child is exposed to. Influencing the choice of friends is more urgent in riskier neighborhoods where certain social interactions could hamper children's educational success. In contrast, in affluent neighborhoods where most potential peers have a solid family background, parents can grant their children leeway and spare them the downsides of an authoritarian upbringing.

We estimate the model by indirect inference and find that it provides a good fit for the empirical relationships between child skills, peer skills, and parenting style observed in the Add Health study. The primary sources of identification in the estimation are the within-school/grade and within-child panel variation in the makeup of peer groups. While unobserved heterogeneity across families in their propensity to be authoritarian could explain part of the cross-sectional

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<sup>2</sup>Authoritative parenting is generally characterized by high parental engagement and by explaining the reasoning behind parents' views rather than just demanding obedience as in the authoritarian style. See Doepke and Zilibotti (2019) for a detailed discussion of parenting styles from an economic perspective.

correlation between parenting styles and peer quality, the panel regressions are informative about the parental responses to changes in peer environment, controlling for heterogeneous preferences for parenting across families. The model fits well the observed variation in parenting styles across schools from richer and poorer neighborhoods, which is not a targeted moment in the estimation.<sup>3</sup>

The estimated model implies a flexible interaction between different dimensions of parenting style. For nonauthoritarian parents, time investments in a child's skills are a substitute input for the quality of the child's peers (in line with [Agostinelli 2018](#)). As a result, parents increase their time investment when their children face a worse peer group. In contrast, the time investment of authoritarian parents does not respond to the quality of peers. These findings suggest that parents regard authoritative time investments and authoritarian restrictions on the choice of friends as alternative responses to a problematic peer environment.

Having confirmed that parenting choices can indeed be understood as a rational response to variation in the peer environment, we explore the implications of the model for the effects of policy interventions aimed at improving opportunities for disadvantaged children.

In this regard, we study a policy that moves children out of the disadvantaged neighborhoods where they reside. Our model implies that when children are moved to better neighborhoods they face two barriers to integration. The first is homophily bias, i.e., children's tendency to associate with peers who are similar to them, here in terms of school proficiency. The second is the endogenous response of parents in the host neighborhood. We find that the strength of both barriers hinges on the scale of the intervention. A small-scale policy that moves only a few children has large beneficial effects on the moved children and hardly any negative impact on the children at the receiving school. However, the effectiveness of the policy declines as it is scaled up to cover more children. First, homophily bias induces the moved children to stick together and mix less with others. And second, parents at the receiving school become prone to turn authoritarian and discourage their children from befriending less proficient peers, which pushes against successful integration. In an extension, we also study the possibility that some families in the host neighborhood decide to move away in response to the policy, which further lowers the benefits of the intervention. These findings underline the importance of taking parental responses into account when considering the effects of policies that are aimed at shaping peer effects.

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<sup>3</sup>Data limitations prevent us from estimating an endogenous residential choice prior to when children start high school. In the estimation we address concerns related to the selection of parents with unobserved heterogeneous preferences into different neighborhoods.

## Relationship to Literature

Our paper links three strands of the child development literature. The first is the literature on children’s skill formation, including James Heckman’s recent work with different coauthors (e.g., [Cunha and Heckman 2007](#); [Cunha, Heckman, and Schennach 2010](#)), which has led to new insights on how children’s skills and attitudes evolve as a function of endowments and parental and other inputs.<sup>4</sup> Our main innovation relative to this literature is that parents can choose alternative strategies through which to foster their children’s skill acquisition.

The second strand of literature studies the importance of neighborhood effects. This literature shows that children who grew up in distressed areas tend to reach lower outcomes and display less upward mobility than children from wealthier areas (e.g., [Cutler and Glaeser 1997](#); [Chetty et al. 2014](#)). The importance of childhood exposure to neighborhoods is also supported by recent papers studying the effect of moving to better areas (see, e.g., [Chetty, Hendren, and Katz 2016](#), [Chetty and Hendren 2018a](#), [2018b](#), and [Chyn 2018](#)).

Most empirical studies do not uncover the mechanism through which the benefits of being exposed to a better neighborhood accrue. In addressing this question, our study complements the theoretical literature on social interactions within neighborhoods (e.g., [Brock and Durlauf 2001a](#), [2001b](#), [2002](#), and [Durlauf and Ioannides 2010](#)) and the empirical literature on peer effects in education.<sup>5</sup> [Calvó-Armengol, Patacchini, and Zenou \(2009\)](#) estimate a friendship network model using, as we do, the Add Health data.<sup>6</sup> [List, Momeni, and Zenou \(2019\)](#) documents large spillovers of programs targeting disadvantaged children on the cognitive and noncognitive skills of other local children. In line with our modeling approach, the evidence suggests that these spillovers operate through children’s social networks. [Angrist and Lang \(2004\)](#) study the effect of a desegregation busing policy in the Boston area. They find that negative spillovers on the receiving community are small, although there are some negative effects on local black children who are more likely to interact with the moved children. These results

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<sup>4</sup>Other important studies in this literature include [Todd and Wolpin \(2003\)](#), [Heckman, Stixrud, and Urzua \(2006\)](#), [Cunha and Heckman \(2008\)](#), [Almlund et al. \(2011\)](#), [Dahl and Lochner \(2012\)](#), [Løken, Mogstad, and Wiswall \(2012\)](#), [Heckman, Pinto, and Savelyev \(2013\)](#), [Del Boca, Flinn, and Wiswall \(2014\)](#), [Agostinelli and Wiswall \(2016\)](#), [Agostinelli and Sorrenti \(2018\)](#), [Heckman, Humphries, and Veramendi \(2018\)](#), [Attanasio, Meghir, and Nix \(2019\)](#), and [Attanasio et al. \(2020\)](#). For a literature review, see [Heckman and Mosso \(2014\)](#).

<sup>5</sup>[Case and Katz \(1991\)](#) is an early contribution on the effect of neighborhood peers on the behavior of youths. Other studies of peer effects in education include [Altonji and Mansfield \(2018\)](#), [Hoxby \(2000\)](#), [Zimmerman \(2003\)](#), [Sacerdote \(2011\)](#), [Arcidiacono et al. \(2012\)](#), [Carrell, Sacerdote, and West \(2013\)](#), and [Feld and Zölitz \(2017\)](#). [Blume et al. \(2011, 2015\)](#) discuss identification problems in social interactions models.

<sup>6</sup>Other studies on peer effects using the Add Health data set include [Bifulco, Fletcher, and Ross \(2011\)](#), [Badev \(2016\)](#), [Mele \(2019\)](#), and [Olivetti, Patacchini, and Zenou \(2020\)](#).

are consistent with the findings of our counterfactual policy analysis. Two recent macroeconomic papers by [Eckert and Kleineberg \(2019\)](#) and [Fogli and Guerrieri \(2018\)](#) study the effect of neighborhoods on human capital and social mobility.

The third strand of related literature merges insights from child development psychology with the Beckerian tradition of family economics, as in our previous work in [Doepke and Zilibotti \(2017 and 2019\)](#), and [Doepke, Sorrenti, and Zilibotti \(2019\)](#). While the psychology literature views parenting styles as traits of parents, the economics literature regards them as the endogenous choice of rational parents seeking to influence their children’s behavior.<sup>7</sup> Strategic interaction between parents and children is also central to [Del Boca et al. \(2019\)](#), who focus on monetary incentives that parents provide for their children (related to [Weinberg 2001](#)) rather than on interference with friend selection. Relative to this literature, the key innovation of this paper is to consider how parenting choices interact with peer effects.<sup>8</sup>

Section II describes the data and provides descriptive evidence. Section III develops a structural model of parent-child interactions with peer effects. Section IV describes the estimation. Section V uses the model for policy analysis. Section VI concludes. The Appendix contains additional details.

## II. Parenting, Peers, and Skills in the Add Health Data

In this section, we describe the data and document empirical correlations that motivate our structural model.

### A. Data

The National Longitudinal Study of Adolescent to Adult Health (Add Health) is a nationally representative longitudinal survey of adolescents in the United States. The original data set includes about 90,000 students in grades 7–12 from 132 schools in the school year 1994–95. Our analysis focuses on the baseline survey (Wave I) and the 1996 follow up (Wave II).

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<sup>7</sup>Earlier work on the economics of parenting includes [Akabayashi \(2006\)](#) and [Lizzeri and Siniscalchi \(2008\)](#), who emphasize informational frictions and learning. More recent studies include [Patacchini and Zenou \(2011\)](#), [Zumbuehl, Dohmen, and Pfann \(2018\)](#), [Brenøe and Epper \(2019\)](#), [Cobb-Clark, Salamanca, and Zhu \(2019\)](#), [Kim \(2019\)](#), and [Boucher et al. \(2023\)](#).

<sup>8</sup>The link between parenting and peer effects has been stressed previously in the developmental psychology literature. For instance, [Brooks \(2013\)](#) describes parenting as a “process of action and interaction between parent and child . . . . Society is a third dynamic force in the process. . . . The child, the parent, and society all influence the process of parenting, and, in turn, are changed by it” (pp. 6–7). The impact of parents through shaping their children’s peer environment is acknowledged even by authors who are skeptical of the influence of parents on adolescent children, such as [Harris \(1998\)](#).

A subsample of students is selected for a home interview that includes questionnaires for both the students and their parents. The data set includes detailed information on family background, grades, and test scores. The survey asks questions that can be used for measuring parenting styles. Importantly for our research, the survey also asks detailed questions on students' peers. Students are asked to nominate their best five male and best five female friends. Since students are observed repeatedly, we have information on how peer groups evolve over time. In addition, we can study how students' characteristics (including grades and tests scores) affect peer group formation.

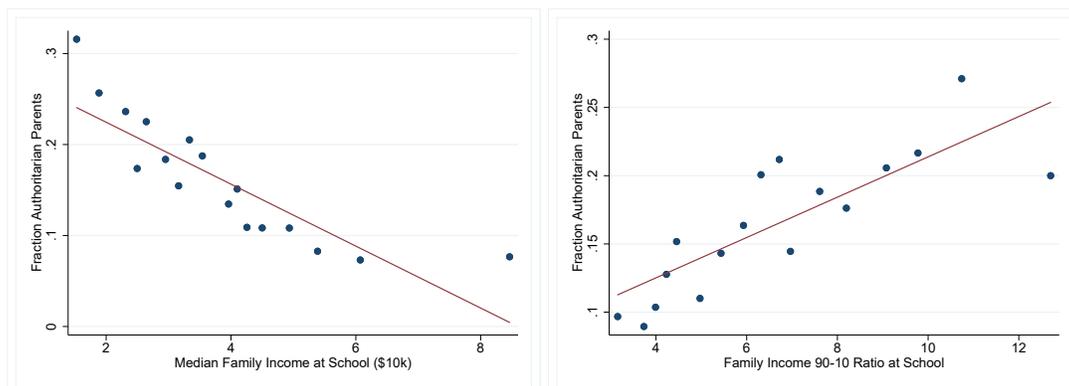
We are particularly interested in children's answers to the question: "Do your parents let you make your own decisions about the people you hang around with?" We classify a parent whose child answers "No" ("Yes") as behaving in an authoritarian (nonauthoritarian) fashion. In our sample, 14 percent of parents are authoritarian according to this definition. To address concerns about measurement error, we also construct alternative measures that rely on a larger set of questions in Add Health—see Subsection D. Appendix Table A-1 provides descriptive statistics for the main variables used in our analysis.

## **B. Authoritarian Parenting Across Schools**

In this section, we provide correlational evidence on how parenting styles vary with the peer environment that children are exposed to. Our main hypothesis is that, driven by a concern about their children's educational success, parents are more likely to adopt an authoritarian parenting style when their children interact with low-performing students.

Figure 1 shows by way of binned scatter plots how authoritarian parenting varies across schools with different characteristics. The proportion of parents adopting an authoritarian parenting style is decreasing with the median income at the school level (left panel) and increasing with income inequality (right panel). Since income is correlated with school performance, this evidence suggests that parents are more likely to meddle in the choice of friends in poorer and more unequal environments. The differences are quantitatively large. Moving from a neighborhood (school) with a median income of \$20,000 to one with a median income of \$60,000 or more decreases the percentage of parents behaving in an authoritarian fashion from 26 percent to eight percent. Likewise, moving from the three most equal to the three most unequal bins is associated with more than doubling the share of authoritarian parents. Appendix Table A-2 shows that the same pattern emerges in multiple regressions where we simultaneously include median income and income inequality and control for parental and child characteristics.

Figure 1: Authoritarian Parenting and Neighborhood Characteristics



The figure shows how the incidence of the authoritarian parenting style varies with within-school median family income (left panel) and inequality (right panel). Inequality is measured by the 90th–10th percentile ratio of within-school family income.

### C. Authoritarian Parenting Within Schools and Families

Part of the correlations displayed in Figure 1 could be driven by omitted variables at the school level, such as variation in parental characteristics other than family income. To address this concern, we exploit within-school variation in the peer environment across grades and within-child changes in the average characteristics of friends.

First, in the spirit of Hoxby (2000), we exploit sampling variation in the realization of grade composition within the same school. We measure peer quality by the mean grade point average (GPA). Table 1 shows the results of regressing a dummy for our baseline measure of authoritarian parenting style on the mean and standard deviation of the GPA among the children in a given school cohort. Parents are significantly more inclined to be authoritarian when their children are exposed to peers with low and unequal skills. The result is robust to the inclusion of family characteristics.<sup>9</sup> The correlation of parenting style with inequality in GPA is stronger and more robust than that of parenting style with the mean GPA. Our results suggest that a one-standard-deviation increase ( $\sigma=0.08$ ) in the inequality of GPA leads to an increase in the incidence of the authoritarian parenting style between two (column 6) and three (column

<sup>9</sup>Among the family characteristics, we control for the mother’s education. We focus on mothers because mothers are, in most cases, the main respondent of the survey. The information about the partner’s education is missing for approximately 35 percent of the families, and whether this information is missing cannot be assumed to be random. Moreover, when the information on the partner’s education is available, this information concerns the current spouse/partner rather than the biological parent. Regarding the inequality measure, Appendix Table A-3 shows that the results are robust to using the Gini coefficient instead of the standard deviation of GPA. Also, as shown in Appendix Table A-4, we did not detect significant gender-specific heterogeneity in these results.

**Table 1: Authoritarian Parenting and Peer Environment within Schools**

	(1)	(2)	(3)	(4)	(5)	(6)
	Authoritarian					
Mean GPA within Grade	-0.135*** (0.039)		-0.070* (0.039)	-0.086** (0.039)		-0.049 (0.038)
SD GPA within Grade		0.389*** (0.078)	0.311*** (0.081)		0.291*** (0.090)	0.249*** (0.089)
Mean Dependent Var.	0.138	0.138	0.138	0.138	0.138	0.138
Observations	13327	13327	13327	13327	13327	13327
Clusters	73	73	73	73	73	73
Controls	No	No	No	Yes	Yes	Yes
School F.E.	Yes	Yes	Yes	Yes	Yes	Yes

The table shows the effect of school-grade mean and standard deviation of the GPA on authoritarian parenting. The dependent variable is an indicator variable for authoritarian parenting at the individual level. The SD GPA is the standard deviation in GPA across pupils within school and grade. All regressions include school fixed effects. The set of controls are mother's education, family income, and child's race, age, and gender. Standard errors are clustered at the school level. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

2) percentage points. This is a sizable difference, given that about 14 percent of parents are authoritarian in our sample.

While the regression results in Table 1 are interesting, the coefficients do not necessarily have a causal interpretation. For example, the share of parents adopting an authoritarian parenting style could affect the average quality of the peer environment, raising a reverse causality problem. For this reason, below we turn to a structural model that incorporates this and other feedback effects. Our estimation procedure ensures that the model can reproduce reduced-form relationships of the kind displayed in Table 1. The estimated model indeed suggests that both directions of causality are relevant but indicates nevertheless a sizeable causal impact of the local environment on parents' choices.

If the parenting style responds to the child's peer environment, we should expect changes in parenting style for a given child to track changes in the peer environment over time. To check whether the data support this hypothesis, we use the longitudinal dimension of the saturated

Table 2: Authoritarian Parenting and Friends' Quality within Children

	(1)	(2)	(3)	(4)	(5)	(6)
	Change in Authoritarian Style					
Change in Peer GPA	-0.029** (0.011)	-0.028** (0.011)	-0.027** (0.012)	-0.027** (0.010)	-0.026** (0.010)	-0.026** (0.011)
Change in Child GPA		-0.017 (0.014)	-0.055*** (0.015)		-0.016 (0.015)	-0.054** (0.017)
Child GPA ( $t-1$ ) $\times$ Change in Child GPA			0.012* (0.007)			0.012 (0.007)
Mean Dependent Variable	-0.036	-0.036	-0.036	-0.036	-0.036	-0.036
Observations	1489	1489	1489	1489	1489	1489
Clusters	10	10	10	10	10	10
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Classroom F.E.	No	No	No	Yes	Yes	Yes

The table shows the effect of changes in peer quality and a child's GPA on changes in authoritarian parenting. The dependent variable is the within-child longitudinal change in authoritarian parenting between the first and second wave of interviews. The Change in peer GPA and the change in the child's GPA represent the longitudinal change between the first and second wave of interviews of the average GPA of peers and a child's GPA, respectively. Finally, the child's GPA ( $t - 1$ ) represents the GPA of a child during the first wave of interviews. All regressions are estimated with the saturated sample of schools in Add Health, for which repeated information on peer networks and parenting style (based on the replies of children) is available. All regressions include school-grade fixed effects. The set of controls are mother's education, family income, and child's race, age, and gender. Standard errors are clustered at the school level. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

sample in Add Health, for which repeated information on peer networks and parenting style is available.<sup>10</sup> Focusing on changes over time for individual children has two advantages. First, it addresses concerns that variation in both the peer environment and parenting style could be driven by omitted family characteristics. Second, it addresses the possibility of child-specific unobserved heterogeneity, such as time-invariant reporting bias of individual children regarding parenting style.

Table 2 shows that, for a given child, parents are more likely to turn authoritarian when either the GPA of their own child or that of the child's friends slips from one year to the next. We also consider potential heterogeneity of these effects, and find that the parental response is stronger when their own child has low grades. In the structural estimation of our model below, we use both across-families and within-child regression coefficients as target moments.

<sup>10</sup>The saturated sample in the Add Health data is obtained by selecting a set of schools in Wave I where all students (rather than a subsample) are recruited for in-home interviews (Harris et al. 2013). Appendix Table A-1 provides the summary statistics for this sample. Note that, contrary to children, parents are interviewed only once, during the first wave of data collection.

Table 3: Authoritarian Parenting and Dynamics of Peer Quality

	(1)	(2)	(3)	(4)	(5)	(6)
	Next Period Peer GPA					
Authoritarian	0.023 (0.038)	0.033* (0.016)	0.041** (0.014)	0.034 (0.039)	0.039* (0.021)	0.045** (0.017)
Peer GPA		0.510*** (0.059)	0.419*** (0.045)		0.460*** (0.076)	0.387*** (0.059)
Child GPA			0.134*** (0.018)			0.120*** (0.023)
Mean Dependent Var.	2.711	2.711	2.711	2.711	2.711	2.711
Observations	1941	1941	1941	1941	1941	1941
Clusters	10	10	10	10	10	10
Controls	No	No	No	Yes	Yes	Yes
Classroom F.E.	Yes	Yes	Yes	Yes	Yes	Yes

The table shows the effect of being authoritarian, peers and a child's GPA on future peers' GPA. The dependent variable is the average GPA of peers in the second wave of interviews. The Peer GPA is the average GPA of peers in the first wave of interviews. The regressions are estimated with the sample of saturated schools in Add Health. All regressions include school-grade fixed effects. The set of controls are mother's education, family income, and child's race, age, and gender. Standard errors are clustered at the school level. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

Finally, we document that, within schools and grades, authoritarian parenting is correlated with children's peer formation. Table 3 shows that the raw correlation between authoritarian parenting and next-period peer GPA is positive but statistically insignificant. However, the correlation turns positive and significant if we control for own and peer GPA in the current period. These conditional correlations are consistent with the structural model we develop below. In that model, authoritarian parenting, own GPA, and current peer GPA all have positive causal effects on future peer GPA. In addition, parents are more likely to adopt an authoritarian style if the own child's and the current peers' grades are low.

#### D. Alternative Measures of Parenting Style and Parental Investments

Relying on children's answers to a single question in Add Health raises concerns about measurement error, which we address in a variety of ways. We start by constructing an index of authoritarian parenting style based on multiple questions in the Add Health data. In addition to the question about parents' interference with the choice of people to hang around

with, the index uses the answers to the following three questions: (1) Do your parents let you make your own decisions about the time you must be home on weekend nights? (2) Do your parents let you make your own decisions about what you wear? (3) Do your parents let you make your own decisions about what time you go to bed? While not directly addressing friendships, these questions are closely related to peer selection; for instance, the curfew time imposes restrictions on the possibility of hanging around with certain types of peers. Following [Driscoll, Russell, and Crockett \(2008\)](#) and [Shakya, Christakis, and Fowler \(2012\)](#), we construct a composite index (Bartlett score) to measure a latent parenting style. This measure is highly correlated (in part, by construction) with our baseline measure. The results of the motivating regressions presented in this section are robust to using the index measure of parenting style—see Appendix Tables [A-5](#) and [A-6](#).

We use the index measure to correct for measurement error bias in the estimated regression coefficients that we use as target moments in the structural estimation. A disadvantage of the index is that it does not provide information about the share of authoritarian parents among all families. For this reason, when using the index measure, we anchor the model to the fraction of authoritarian parents in different neighborhoods and in the aggregate by our baseline measure.

Another concern is that the children’s answers could reflect subjective, and possibly biased, perceptions of their parents’ behavior. Unfortunately, Add Health does not ask parents questions about their interference with their children’s choice of friends. We address this concern using two strategies. First, we already exploit the longitudinal dimension of the saturated sample of Add Health to run regressions in differences (see [Table 2](#) above). These regressions absorb time-invariant individual heterogeneity capturing (among other things) child-specific reporting biases.

Second, we check the correlation between the child’s answer to whether parents let them choose the people they hang around with and a question asked to their parents that reveals a generic (i.e., not specific to friends) authoritarian attitude. In particular, parents are asked: “Of the following, which do you think is the most important thing for a boy/girl to learn?” We take the answer “be well-behaved” as indicative of an authoritarian parenting style.<sup>11</sup> [Appendix Figure A-1](#) shows that the two measures of authoritarian parenting style are highly positively

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<sup>11</sup>In our theory, parenting style is not a fixed characteristic of parents; rather, it reflects a rational response to features of the environment. Therefore, some parents who exhibit an authoritarian style with respect to friends may not be authoritarian in other respects (and vice versa). Nevertheless, we expect a positive correlation, partly because disadvantaged neighborhoods tend to be hazardous (and induce parents to adopt an authoritarian parenting style) in multiple dimensions.

correlated at the school level. The correlation is also highly significant at the individual level. Parents stating that being well-behaved is the most important thing for a child to learn are 54 percent more likely (17 percent versus 11 percent) not to let their children make their own decisions about the people they hang around according to what their children report.

We can also use the same set of questions to measure the other two basic parenting styles that are widely used in developmental psychology, namely authoritative and permissive parenting. We construct these parenting styles following the approach of [Doepke and Zilibotti \(2017\)](#).<sup>12</sup> Appendix Figure A-2 shows that parents tend to be more permissive in wealthier and more equal neighborhoods, while they tend to be more authoritative and authoritarian in poorer and more unequal neighborhoods. This is in line with our results in Figure 1 for our more specific baseline measure of authoritarian parenting and also consistent with the cross-country evidence documented by [Doepke and Zilibotti \(2017\)](#) and [Doepke, Sorrenti, and Zilibotti \(2019\)](#). Hence, while we focus on a specific aspect of parenting, our notion of being authoritarian about friends can be viewed as a facet of a broader authoritarian parenting style that contrasts with authoritative and permissive approaches.

In the model developed below, in addition to choosing a parenting style parents also decide how much effort to put into investing in their children’s skills. To discipline this aspect of the model, we construct a measure of parental investment based on activities parents do together with their children, such as working on a project for school, talking about a party the child attended, or talking about a personal problem. We restrict attention to activities done by the child with the mother to avoid selection problems, since the father is often not present. Parental investments of this kind can be considered as an element of an authoritative parenting style, in the sense that parents do not restrict their children’s choice set but motivate and support their children to achieve the objectives parents care for.

## **E. Taking Stock**

The reduced-form regressions in Tables 1, 2, and 3 suggest a rational motive for parents to interfere in the process of peer selection. To make progress beyond the correlational analysis, we move to a structural model. In the theory, consistent with the evidence in Tables 1 and

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<sup>12</sup>We use the answer parents give to the following question: “Of the following, which do you think is the most important thing for a boy/girl to learn? Be well-behaved, work hard, think for himself, help others, be popular.” As already mentioned, we classify parents as authoritarian when they choose “be well-behaved.” Parents are classified as authoritative when they choose “work hard” and as permissive when they choose “think for themselves.” In the analysis, we exclude parents who choose either “think for himself” or “be popular.” The result does not change significantly if we classify the excluded parents as permissive.

2, parents determine whether to interfere with their children’s choice of friends based on the children’s current school performance and that of their peers. Conversely, conditional on the peer environment, the choice of parenting style affects the child’s future selection of peers, consistent with the results in Table 3.

In the dynamic model, causality between the peer environment and parenting choices runs in both directions. Estimating the structural model allows us to quantify these bidirectional relationships in a way that is consistent with the conditional correlations in Tables 1–3. Our framework also allows to consider other forces behind the observed correlations. For instance, some of the correlation between parenting style and a child’s cognitive skills could reflect technological complementarities in the process of skill formation that are not directly identified from the data. Lastly, the model helps isolate how the effects of parenting choices vary across economic environments and allows us to perform counterfactual policy analysis.

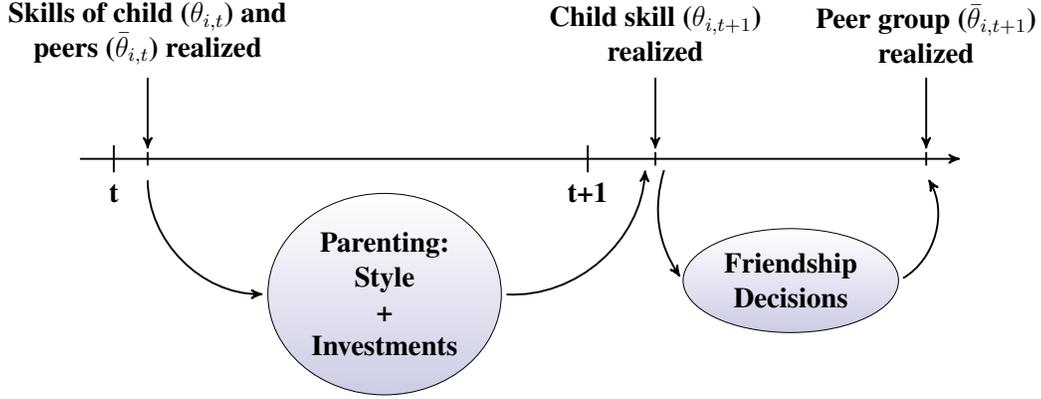
### III. A Model of Parents, Peers, and Skill Accumulation

The model economy comprises a set of neighborhoods indexed by  $n$ , each populated by families composed of a child and a parent. The focal point of the theory is the accumulation of children’s skills  $\theta_{i,t}$ , where  $i$  is the index of a child and  $t$  denotes time. We model the interaction of parent and child from  $t = 1$  to  $t = T$ . In the empirical application, this interval corresponds to the four years of high school (grades 9 to 12), and thus  $T = 4$ .

Each neighborhood  $n$  is characterized by a set  $\mathcal{X}^n$  of children living in the neighborhood and by the initial ( $t = 1$ ) skill distribution of these children. All children living in a given neighborhood attend the same school. Figure 2 outlines the timing of events within each period. At the beginning of the period, the child’s current skill level  $\theta_{i,t}$  is realized. Next, the child forms friendships with some of the other children of the same age in the same school. The characteristics of these friends (which affect skill formation) are summarized by the variable  $\bar{\theta}_{i,t}$ .

The parent can affect the evolution of the child’s skills and peers through two channels. First, she can undertake (authoritative) parenting investments  $I_{i,t}$  that affect the child’s skill formation. Second, she chooses her parenting style,  $P_{i,t} \in \{0, 1\}$ , where  $P_{i,t} = 1$  means that the parent behaves in an authoritarian fashion by interfering in the child’s next round of friendship decisions. This interference reflects a disagreement between the parent and the child about the tradeoff between the enjoyment of the present (namely, interacting with fun friends) and the benefits of favorable peer effects for skill formation. A child may prefer to hang out with

Figure 2: Model Timing



The figure shows the timeline of the model. The child’s skills at  $t = 0$  are drawn from the initial distribution. The peers’ skills at  $t = 0$  are determined by the peer environment (the distribution of children’s skills at the school and grade level) and by the random utility preferences without parental interventions. From period  $t = 1$  onward,  $\theta_t$  and  $\bar{\theta}_t$  are endogenous state variables.

“cool” kids who do not necessarily do well in school rather than associating with “nerdy” peers with a high GPA who can improve their school proficiency.

At the beginning of the next period, the child’s updated skill  $\theta_{i,t+1}$  is realized and a new group of friends with the average skill  $\bar{\theta}_{i,t+1}$  is formed. This sequence of events repeats itself until the final year of high school, when the child enters adult life with skills  $\theta_{i,T}$ .

### A. The Technology of Skill Formation

The distribution of children’s skills in the first period is drawn from the distribution  $F^n(\theta_{i,1})$  that we treat as an exogenous initial condition. By allowing this distribution to depend on the neighborhood  $n$ , we take into account that the assignment of families to neighborhoods may not be random, resulting in correlation between initial conditions and the parents’ propensity to adopt different parenting styles.

Subsequently, skills evolve as a function of family inputs and peer influences. For each child  $i$ , skill  $\theta_{i,t+1}$  in the next period depends on the current stock of skills  $\theta_{i,t}$ , a summary statistic of the quality of peers  $\bar{\theta}_{i,t}$  (specifically, the average of peer skills), parental investments  $I_{i,t}$ , and the parent’s choice of whether to interfere in the child’s choice of peers  $P_{i,t} \in \{0, 1\}$ . We

formalize the technology of skill formation as:

$$\theta_{i,t+1} = s(\theta_{i,t}, \bar{\theta}_{i,t}, I_{i,t}, P_{i,t}). \quad (1)$$

The direct effect of parenting style  $P_{i,t}$  in Equation (1) captures the impact of the quality of the parent-child relationship on skill accumulation. While we do not impose a restriction in the estimation, we conjecture, and empirically confirm, that authoritarian parenting has a negative effect on skill accumulation. This could arise either from discord between parent and child or from time use: the time some parents spend telling off their kids for keeping certain peers is not available for more productive interactions. Still, from the parent’s point of view, the authoritarian parenting style may still be optimal because it affects the composition of the peer group, hence limiting the disruptive effects of less proficient kids on average peer quality.

## B. The Parent’s Decision Problem

To keep the model parsimonious, we limit attention to the choices and state variables that are part of our empirical analysis and omit other factors such as goods consumption. The individual state variables for a family are the child’s skills  $\theta_{i,t}$  and the characteristics of the child’s peers  $\bar{\theta}_{i,t}$ . The aggregate state variable  $\Theta_t^n$  for a family in neighborhood  $n$  is the distribution of these individual states across families in the neighborhood:

$$\Theta_t^n = \{\theta_{j,t}, \bar{\theta}_{j,t}\}_{j \in \mathcal{X}^n}.$$

Families care about the aggregate state because the distribution of family characteristics in the neighborhood drives the evolution of the peer environment.

The parent decides on parenting style  $P_{i,t}$  and parenting investments  $I_{i,t}$ , and the child chooses peers, i.e., who to be friends with. The structure of preferences builds on [Doepke and Zilibotti \(2017\)](#) and [Doepke, Sorrenti, and Zilibotti \(2019\)](#). In particular, the utility of the parent combines elements of altruism and paternalism. Altruism means that the child’s utility enters the parent’s utility so that the parent wants the child to be “happy.” In contrast, paternalism implies that the parent evaluates the child’s choices and educational outcomes from the standpoint of her own preferences. Specifically, the parent’s paternalistic self attaches a higher weight to the child’s skill accumulation than does the child herself. The conflicting motives of altruism and paternalism imply that the parent’s behavior responds to the environment in a way that can be fitted to data. The paternalistic motive explains why the parent may want to interfere in the child’s friendship decisions (against the child’s wishes), and the altruistic motive explains

why the parent will interfere only when the benefits of doing so are high relative to the child's loss of utility.

We represent the parent's preferences with a value function that summarizes utility in a period after the child's current skills and peer group have already been realized. In period  $t$ , this value function is given by:

$$V_t^n(\theta_{i,t}, \bar{\theta}_{i,t}, \Theta_t^n) = \max_{\{I_{i,t}(\xi_{i,t}), P_{i,t}(\xi_{i,t})\}} \left\{ \mathbb{E}_t [U^n(I_{i,t}, P_{i,t}, \xi_{i,t}) + Z [\lambda \tilde{u}(\theta_{i,t}, P_{i,t}) + (1 - \lambda)u(f_{i,t+1})] + BV_{t+1}^n(\theta_{i,t+1}, \bar{\theta}_{i,t+1}, \Theta_{t+1}^n)] \right\}. \quad (2)$$

Here  $U^n(\cdot)$  denotes the parent's period utility. Given that we abstract from other choices such as consumption, the period utility solely captures the cost of exerting parenting effort through the choice of  $P_{i,t}$  and  $I_{i,t}$ . We allow the utility function to vary across neighborhoods, which can capture unobserved residential sorting based on preferences for parenting. Parents optimally choose  $P_{i,t}$  and  $I_{i,t}$  conditional on the realization of a vector of i.i.d. taste shocks  $\xi_{i,t}$  that represent the parent's idiosyncratic preference over different parenting styles. The shocks ensure a smooth mapping from state variables into decision rules. We denote the vector of taste shocks across parents in neighborhood  $n$  at time  $t$  by  $\Xi_t^n$ , and there is also a vector of taste shocks  $\Phi_t^n$  for the children in the neighborhood which we will discuss in the following section. The expectation  $\mathbb{E}_t$  in (2) is with regards to the realization of both shocks  $\Xi_t^n$  and  $\Phi_t^n$ , which are the only source of uncertainty in the model. The parent's utility is affected by the preference shocks of other families in the neighborhood (in addition to her own taste shocks  $\xi_{i,t}$ ) because these matter for the realization of the child's future friendship utility  $f_{i,t+1}$  and peer characteristics  $\bar{\theta}_{i,t+1}$  (as detailed below).

The parent also cares about the child, where  $Z$  is the overall weight attached to the child's welfare. The altruistic component, which has a weight  $1 - \lambda$ , consists of the child's actual period utility  $u(f_{i,t+1})$ , which is derived from interactions with the set of friends that the child makes during the year and that consequently make up the peer group that the child takes into period  $t + 1$ . The paternalistic component in the parent's preferences, which has a weight  $\lambda$ , is the parent's own evaluation of child's outcomes. The paternalistic utility  $\tilde{u}(\theta_{i,t}, P_{i,t})$  is focused on the child's accumulation of skills  $\theta_{i,t}$ , where we allow for the parent's evaluation of the child's skill to interact with parenting style  $P_{i,t}$ . The parent's concern for their child's educational accomplishments reflects the desire to see the child succeed in their future life as an adult. At the same time, parents also care about a positive parent-child relationship that in

turn depend on the choice of parenting style.

The optimization in (2) is subject to the skill acquisition technology (1) and to the law of motion of the aggregate state vector, which describes the evolution of the aggregate state vector as a function of the current state and the vector of preference shocks:

$$\Theta_{t+1}^n = \Gamma(\Theta_t^n, \Xi_t^n, \Phi_t^n).$$

The aggregate law of motion arises from the interactions between the parents and children in a neighborhood. The parent takes the aggregate law of motion as given, i.e., parents behave atomistically.<sup>13</sup> The optimization is also subject to the determination of the child's friendship utility and future peer group, which depends on both the parent's and the child's choices.

The parent's continuation utility at the end of high school depends solely on the child's final skills  $\theta_T$  (where  $T = 4$ , corresponding to grade 12, the final year of high school):

$$V_T^n(\theta_{i,T}, \bar{\theta}_{i,T}, \Theta_T^n) = V_T(\theta_{i,T}). \quad (3)$$

Here the function  $V_T(\theta_T)$  is taken as given and assumed to be identical across neighborhoods. As in [Del Boca, Flinn, and Wiswall \(2014\)](#), this continuation utility captures the value of entering a new stage in the child's life, which depends on the skill endowment at the beginning of that stage. This continuation utility, which creates dynastic link between parents and children, can be thought as the discounted present value of lifetime earnings as well as non-monetary benefits of having more skills. The parental decision problem in the preceding period  $T = 3$  is modified because the final continuation utility does not depend on the quality of peers. Thus, parents no longer attempt to shape the peer group.

### C. The Child's Decision Problem and the Equilibrium Peer Network

The only decision taken by the child concerns the formation of the peer network, i.e., the child decides who to be friends with. A new round of friendship formation takes place at the end of each period, when the children's updated skills  $\theta_{i,t+1}$  have already been realized according to the skill acquisition technology (1). When making new friendships, children take as given this distribution of skills in the neighborhood as well as their parent's decision  $P_{i,t}$  on parenting style.

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<sup>13</sup>In principle, because there is a finite number of families in each neighborhood, peer interactions imply that there is a feedback from a family's decisions to the aggregate state. In practice, given the size of neighborhoods in the estimated model, this feedback effect is small, so we assume that parents do not internalize this feedback.

Friendships are formed as the outcome of a set of bilateral decisions, where two children become friends if there is mutual consent. There are no matching frictions, that is, all children meet and can potentially form a friendship with all children living in the same neighborhood. The potential utility  $f_{i,j,t+1}$  child  $i$  would derive from forming a new friendship with  $j$  in the same neighborhood,  $i, j \in \mathcal{X}^n$ , is given by:

$$f_{i,j,t+1} = g(\theta_{i,t+1}, \theta_{j,t+1}, P_{i,t}, \phi_{i,j,t}). \quad (4)$$

The utility from a friendship link depends on both the own skill of child  $i$  and the skill of the potential friend  $j$ . This specification allows for homophily bias in terms of skills, a feature that will play a central role in the analysis.<sup>14</sup> The potential utility of forming a particular friendship does not depend on the number and characteristics of other friendships.

The utility from a friendship also depends on the parenting style  $P_{i,t}$ . As parents seek to encourage skill formation, our parameterization below implies that an authoritarian parenting style ( $P_{i,t} = 1$ ) lowers the utility of befriending a low-skill peer relative to a high-skill one. For instance, the parent can reward the child for making “desirable” friends or mete out punishments for befriending less desirable peers.

Finally, the utility depends on an i.i.d. taste shock  $\phi_{i,j,t}$ , which guarantees that the probability that a friendship is established is a smooth function of fundamentals as in the canonical random utility model. Note that the realization of the taste shock is not assumed to be symmetric, namely, generically,  $\phi_{i,j,t} \neq \phi_{j,i,t}$ . Intuitively, it is possible that child  $i$  is attracted to child  $j$  without that feeling being reciprocated.

Given the potential friendship utilities, the problem of child  $i$  is to choose a set of friends  $\mathcal{F}_{i,t+1} \subseteq \mathcal{X}^n$  so as to maximize the total utility derived from friendships. Formally, the optimization problem for the child is:

$$\max_{\mathcal{F}_{i,t+1} \subseteq \mathcal{X}^n} \left\{ \sum_{j \in \mathcal{F}_{i,t+1}} f_{i,j,t+1} \right\}, \quad (5)$$

where child  $i$  would like to befriend child  $j$  if she benefits from that friendship:

$$f_{j,i,t+1} \geq 0 \quad \forall j \in \mathcal{X}^n.$$

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<sup>14</sup>Homophily bias is the common tendency of people in social networks to be drawn toward others who are similar to them in some dimension (see e.g., [McPherson, Smith-Lovin, and Cook 2001](#); [Currarini, Jackson, and Pin 2009](#); [Jackson 2010](#), and, in a context similar to ours, [Agostinelli 2018](#)).

Here we normalize the value of the outside option to zero. Clearly, the child will want to engage in all friendships that yield positive utility, but the friendship is formed ( $j \in \mathcal{F}_{i,t+1}$ ) only if the desire is mutual. More formally, a friendship between child  $i$  and child  $j$  is formed if and only if:

$$f_{i,j,t+1} \geq 0 \ \& \ f_{j,i,t+1} \geq 0. \quad (6)$$

The total friendship utility child  $i$  earns is the sum of the utilities derived from the formed friendships:

$$f_{i,t+1} = \sum_{j \in \mathcal{F}_{i,t+1}} f_{i,j,t+1}. \quad (7)$$

The child's period utility  $u(f_{i,t+1})$ —that also enters in the altruistic component of the parent's value function (2)—is given by an increasing weakly concave function  $u(\cdot)$  of total friendship utility  $f_{i,t+1}$ .

From the perspective of the parent who makes her decisions on  $I_{i,t}$  and  $P_{i,t}$  before friendship formation takes place, the child's utility and friendship network are random variables that depend on the realization of the vector of taste shocks in the neighborhood  $\Phi_t^n = \{\phi_{i,j,t}\}_{i,j \in \mathcal{X}^n}$ . The parent can influence the distribution of these variables through her choices of  $I_{i,t}$  and  $P_{i,t}$ , both of which enter in the determination of friendship utility (4) (in the case of  $I_{i,t}$ , by shaping the child's skills  $\theta_{i,t+1}$  through the skill acquisition technology (1)).

Note that our formulation of the child's problem assumes that the child takes the parent's decisions as given and chooses her optimal portfolio of friends accordingly. In other words, we impose a non-cooperative outcome in which the parent serves as the Stackelberg leader and the child as the follower. This rules out that parent and child can commit to a potentially Pareto-improving outcome, such as the parent committing not to be authoritarian (which, recall, comes at a cost for parent and child) and the child promising to form friendships so as to maximize joint surplus for parent and child, rather than just maximizing her own utility (5). The non-cooperative outcome is a natural focus given the myopic preferences of the child; there is no future utility to reward or enforce cooperation.<sup>15</sup> More generally, we believe that some degree of non-cooperative decision-making is a desirable feature in an analysis of potential conflict between parents and teenagers.

Given that friendships are formed by mutual consent, the process of friendship formation

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<sup>15</sup>While myopic preferences simplify the analysis, they are not an essential component. It would be possible to endow the child with a discounted continuation utility and a preference for skill acquisition. What is essential is that child and parent disagree on the relative importance of enjoyment of friendships and skill acquisition.

entails externalities across families. When a parent meddles in the process of friendship formation, this intervention affects not only her child, but also other children. Given that parents do not care about other children, their decisions generally fail to be socially optimal across families.

Once new friendships are formed, this also pins down the evolution of the peer effects that matter for skill acquisition. Specifically, given the new set of friends  $\mathcal{F}_{i,t+1}$  we have:

$$\bar{\theta}_{i,t+1} = \frac{\sum_{j \in \mathcal{F}_{i,t+1}} \theta_{j,t+1}}{|\mathcal{F}_{i,t+1}|}, \quad (8)$$

i.e., the new peer effect is given by the average skill of the new friends. These new peer effects together with the children's own skills  $\theta_{i,t+1}$  form the state variables for the parental decision problem in the following period  $t + 1$ .

In the aggregate, we can write the full peer network  $\mathcal{F}_{t+1}^n = \{\mathcal{F}_{i,t+1}\}_{i \in \mathcal{X}^n}$  as a function of the skill distribution, parenting style decisions, and the vector of preference shocks:

$$\mathcal{F}_{t+1}^n = F(\{\theta_{i,t+1}, P_{i,t}\}_{i \in \mathcal{X}^n}, \Phi_t^n), \quad (9)$$

where each friendship link exists if and only if (6) is satisfied, with friendship utilities  $f_{i,j,t+1}$  generated by (4). Likewise, given (8), the full set of peer effects can be written as a function of the skill distribution and the realized friendship network:

$$\{\bar{\theta}_{i,t+1}\}_{i \in \mathcal{X}^n} = G(\{\theta_{i,t+1}\}_{i \in \mathcal{X}^n}, \mathcal{F}_{t+1}^n). \quad (10)$$

In setting up the decision problem of the parent, we also need to specify the initial ( $t = 1$ , corresponding to ninth grade) distribution of peer quality  $\bar{\theta}_{i,1}$ . Rather than taking this state variable as parametric, we assume that only the initial distribution of skills is given and that friendships are formed through the same process as in later periods. This approach allows us to run policy analyses where we counterfactually vary the initial skill distribution and adjust the network of friends accordingly. A limitation is that we do not observe parenting style in the preceding period. For this reason, we assume that parents cannot affect the initial choice of friends.<sup>16</sup> Since this happens in the period when children enter high school and are exposed to new peers, this entails only a limited loss of generality.

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<sup>16</sup>Formally, we set  $P_{i,t-1} = 0$  when evaluating Equation (4) and Equation (6) at time  $t = 1$ .

An equilibrium in a given neighborhood requires that both parents and children make optimal choices on parenting and friendships, respectively, and these choices jointly determine the laws of motion of individual skills and peer effects. We provide a formal definition of equilibrium in Appendix C.

#### D. Functional Forms for Estimation

To estimate the model, we impose functional forms and restrictions that allow us to summarize the model by a list of parameters.

**Initial Conditions.** The initial distribution of children’s skills within each neighborhood  $n$  is drawn from a log-normal distribution. This specification captures the initial (and to us unobserved) sorting of families into different neighborhoods. We define the initial condition for each neighborhood  $n$  as:

$$\ln \theta_{i,1} \sim N(\mu^n, (\sigma^n)^2), \quad (11)$$

where  $\mu^n$  and  $\sigma^n$  represent the neighborhood-specific mean and standard deviation of log skills.

Once the initial heterogeneity of children’s skills within the neighborhood is realized, children select their initial peer group according to their friendship choice problem (5).<sup>17</sup> At this stage, the initial vector of state variables  $\{\theta_{i,1}, \bar{\theta}_{i,1}\}$  is determined, and the dynamic parent-child interaction starts according to the model described above.<sup>18</sup>

**Technology of Skill Formation.** We parameterize the technology of skill formation with the following nested CES production function:

$$s(\theta_{i,t}, \bar{\theta}_{i,t}, I_{i,t}, P_{i,t} \equiv p) = A_p(t) \cdot H_p(\theta_{i,t}, \bar{\theta}_{i,t}, I_{i,t}), \quad (12)$$

where  $p \in \{0, 1\}$ ,  $A_p(t) = \exp(\psi_0 + \psi_1 \cdot t + \psi_2 \cdot p)$ , and

$$H_p(\theta_{i,t}, \bar{\theta}_{i,t}, I_{i,t}) = \left[ \alpha_{1,p} \theta_{i,t}^{\alpha_{4,p}} + (1 - \alpha_{1,p}) \left[ \alpha_{2,p} \bar{\theta}_{i,t}^{\alpha_{3,p}} + (1 - \alpha_{2,p}) I_{i,t}^{\alpha_{3,p}} \right]^{\frac{\alpha_{4,p}}{\alpha_{3,p}}} \right]^{\frac{\alpha_{5,p}}{\alpha_{4,p}}}.$$

<sup>17</sup>We do not have information about parenting style leading up to this round of friendship formation (at time  $t = 0$ ), and hence we set  $P = 0$  for all children in this initial round. Note that children start high school at time  $t = 1$ , which is generally a new environment where they meet new potential friends. For this reason, we find it plausible to assume that parents have a limited impact on peer selection in the first period.

<sup>18</sup>An alternative specification for the initial conditions would be to specify an exogenous bi-variate joint distribution of children’s skills and peer quality. However, in this case the initial peer quality would be exogenously determined and hence policy-invariant. Our model specification allows for immediate endogenous peer selection, which is important when evaluating policies that change the initial neighborhood composition, as we do below.

Note that all parameters of the skill formation technology depend on  $P_{i,t} \in \{0, 1\}$ , namely, whether the parent chooses an authoritarian parenting style. First, this affects the total factor productivity  $A_p(t)$ , capturing the potential disruptive effect of authoritarian parenting on the parent-child relationship documented by the developmental psychology literature. Our estimation below indeed finds that  $\psi_2 < 0$ , i.e., an authoritarian parenting style depresses skill accumulation. Second, parenting style affects the parameters  $\alpha_{1,p}$  and  $\alpha_{2,p}$ , capturing the weights of the different inputs. Our estimation finds that the authoritarian style attenuates the influence of peers. Third, an authoritarian parenting style also affects the elasticity-of-substitution parameters  $\alpha_{3,p}$  and  $\alpha_{4,p}$  and the returns-to-scale parameter ( $\alpha_{5,p}$ ). Here, the data suggests that whether peer effects are substitutes or complements to other inputs in the production of skills hinges on the parenting style  $P_{i,t}$ .

**Parent's Preferences.** We specify the parent's period utility in (2) as follows:

$$U^n(I_{i,t}, P_{i,t}, \xi_{i,t}) = \delta_1 \ln(1 - I_{i,t}) + \delta_2^n P_{i,t} + \xi_{i,t}(P_{i,t}), \quad (13)$$

where  $\delta_1$  defines the disutility of authoritative investment, while  $\xi_{i,t}(P_{i,t})$  is a taste shock that is conditional on the parenting style. We assume that this shock follows a type-I extreme value distribution. We allow the disutility of engaging in an authoritarian parenting style to be neighborhood-specific to account for possible selection into locations based on preferences for parenting ( $\delta_2^n$ ). We make this parameter a function of the neighborhood (average) family income ( $\bar{Y}^n$ ):

$$\delta_2^n \equiv \delta_{2,0} + \delta_{2,1} \cdot (\bar{Y}^n - \bar{Y}^4).$$

Hence,  $\delta_{2,0}$  represents the disutility of being authoritarian for the highest-income neighborhood ( $n=4$ ), while  $\delta_{2,1}$  represents the income gradient that applies to the lower-income neighborhoods.

The paternalistic utility of the parent takes the following form:

$$\tilde{u}(\theta_{i,t}, I_{i,t}, P_{i,t}) = \delta_3 \ln(\theta_{i,t}) \cdot (1 + \delta_4 P_{i,t}), \quad (14)$$

where  $\delta_3$  captures the level of the parent's paternalistic enjoyment of the child's skills, which may depend on the parenting style through parameter  $\delta_4$ . The utility derived from the child's adult skills  $\theta_{i,T+1}$  takes the same form as the period-by-period paternalistic utility from skills:

$$V_{T+1}^n = \delta_3 \ln(\theta_{i,T+1}).$$

We set both the discount rate and the altruism factor to one,  $Z = B = 1$ . This is without loss of generality, as an increase in either  $B$  or  $Z$  is observationally equivalent to a proportional decrease in cost parameters  $\delta_1$  and  $\delta_2$ . Changing  $B$  and/or  $Z$  would affect the numerical estimates of those parameters without altering the model fit or the counterfactual experiments.

**Child's Preferences.** Recall that the formation of a friendship requires mutual consent and that the value of no friendship between two children is normalized to zero. The function  $f_{i,j,t+1} = g(\theta_{i,t+1}, \theta_{j,t+1}, P_{i,t}, \phi_{i,j,t})$  that specifies the utility child  $i$  earns from being friends with child  $j$  is:

$$g(\theta_{i,t+1}, \theta_{j,t+1}, P_{i,t}, \phi_{i,j,t+1}) = \gamma_0 + \gamma_1 \ln \theta_{i,t+1} + \gamma_2 \ln \theta_{j,t+1} + \gamma_3 (\ln \theta_{i,t+1} - \ln \theta_{j,t+1})^2 + \gamma_4 \mathbb{1}(\theta_{j,t+1} < \theta_{i,t+1}) (\ln \theta_{i,t+1} - \ln \theta_{j,t+1})^2 P_{i,t} + \phi_{i,j,t+1}, \quad (15)$$

where  $\phi_{i,j,t+1}$  is a random taste shock, which we assume to be i.i.d. standard logistic distributed. The first and second terms capture, respectively, the effect of child  $i$ 's and child  $j$ 's skills on the utility child  $i$  earns from being friends with child  $j$ . The quadratic term  $(\ln \theta_{i,t+1} - \ln \theta_{j,t+1})^2$  captures a potential homophily bias. If  $\gamma_3 < 0$ , the larger the skill difference between the two children, the lower the utility for child  $i$  to be friends with child  $j$ .

The last term captures the effect of an authoritarian parenting style. If  $\gamma_4 < 0$ , authoritarian parents impose a penalty on the child's utility whenever the child is friends with a lower-skill peer. The penalty increases with the skill gap between the two children. The goal of the parental intervention (through, e.g., moral suasion, threat of punishment, or incentives) is to improve the quality of the child's peer selection.

Given the assumption that friendships require mutual consent, the conditional probability that a friendship link between child  $i$  and child  $j$  is formed is:<sup>19</sup>

$$Pr(j \in \mathcal{X}_{i,t+1} | \theta_{i,t+1}, P_{i,t}, \theta_{j,t+1}, P_{j,t}) = \frac{\exp(\Gamma_{i,j})}{1 + \exp(\Gamma_{i,j})} \frac{\exp(\Gamma_{j,i})}{1 + \exp(\Gamma_{j,i})}, \quad (16)$$

where:

$$\Gamma_{i,j} = \gamma_0 + \gamma_1 \ln \theta_{i,t+1} + \gamma_2 \ln \theta_{j,t+1} + \gamma_3 (\ln \theta_{i,t+1} - \ln \theta_{j,t+1})^2$$

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<sup>19</sup>The conditional probability in Equation (16) might suggest a potential strategic interaction between parents when deciding about their own parenting style. However, under our assumptions, only the parent of the higher-skill child can actively affect the probability in Equation (16), so there is in fact no strategic interaction among parents. Note that in our model parents have an additional motive to invest in their children's skills, namely, to give them more opportunities to condition their children's choice of peers in the future.

$$+ \gamma_4 \mathbb{1}(\theta_{j,t+1} < \theta_{i,t+1}) (\ln \theta_{i,t+1} - \ln \theta_{j,t+1})^2 P_{i,t},$$

$$\begin{aligned} \Gamma_{j,i} = & \gamma_0 + \gamma_1 \ln \theta_{j,t+1} + \gamma_2 \ln \theta_{i,t+1} + \gamma_3 (\ln \theta_{i,t+1} - \ln \theta_{j,t+1})^2 \\ & + \gamma_4 \mathbb{1}(\theta_{i,t+1} < \theta_{j,t+1}) (\ln \theta_{i,t+1} - \ln \theta_{j,t+1})^2 P_{j,t}. \end{aligned}$$

To summarize, authoritarian parenting has a direct effect on the technology of skill formation given the current child’s skill and peers. In addition, it affects the process of peer selection by discouraging the child from choosing low-skill friends. Our estimates below imply that, *ceteris paribus*, an authoritarian parenting style causes a productivity loss in the skill formation technology. Yet, some parents still choose to be authoritarian because this improves the future peer effects. Thus, in homogeneously wealthy neighborhoods where the risk that a child connects to low-skill peers is low, an authoritarian parenting style yields few benefits. It is in disadvantaged neighborhoods where children are exposed to many low-skill peers that parents are likely to resolve to be authoritarian.

## IV. Model Estimation

We estimate the model using the Simulated Method of Moments (SMM) by matching a set of moments generated from the Add Health data. More specifically, we follow an indirect inference approach where some of the target moments are estimated coefficients of regression models, including both school-grade fixed effects models as well as child-level panel data regression models.

### A. Identification

Our model envisions the choice of parenting style as a rational response to the peer environment. We exploit multiple sources of identifying variation, namely within-school/grade and within-child longitudinal variation in peer quality, parenting and children’s outcomes. An important assumption is that, conditional on the residential choice, the initial distribution of individual skill endowments within neighborhoods is exogenous. That is, conditional on the neighborhood, the initial conditions are independent of unobserved factors that can also affect parenting choices. This type of conditional independence assumption is common in the child development literature when modeling the initial heterogeneity in skill endowments (Cunha,

Heckman, and Schennach 2010; Agostinelli and Wiswall 2016).<sup>20</sup> For example, Cunha, Heckman, and Schennach (2010) use a similar exclusion restriction between the initial skills and unobserved heterogeneity in parental investments in the initial period to identify the parental investment response function, although the authors allow for a rich time-varying unobserved heterogeneity in their dynamic model of skill formation.<sup>21</sup> The limited longitudinal structure of our data (we have only two consecutive waves) limits our ability to model time-varying unobserved heterogeneity in parenting choices or outcomes. As a partial remedy, we show that our results are robust to an extension where both the skill formation technology and preferences over parenting styles vary with the mother's education. Since the proportion of college-educated mothers varies across neighborhoods, this extension introduces correlation between preferences, the productivity of parental inputs in the skill formation technology, and initial neighborhood characteristics.

A general concern is that some of the variation that we document could be driven by additional sources of heterogeneity both at the neighborhood and at the individual level. For example, residential choice can lead to ex-ante sorting of families with different characteristics, which could be reflected both in parenting choices and the peer environment. Such sorting could imply that parents who reside in poor neighborhoods with problematic peer environments have on average a higher individual propensity to adopt an authoritarian parenting style. We deal with such concerns in a variety of ways.

First, to address potential variation of families' characteristics across neighborhoods, we do not use the variation across schools in the regressions we target. Instead, conditioning on the neighborhood/school choice, we use the within school-grade variation in peer group realizations and parental choices to identify the correlation between peer skills and parenting choices. Here the identifying assumption is that given the neighborhood and initial skills, the remaining variation is driven by conditionally independent shocks to peer formation.

Second, we recognize the possibility that there may be additional time-invariant heterogeneity in preferences for parenting style even among families in the same neighborhood. Such preference heterogeneity could explain part of the within-school correlation between parenting style and realized peers, and would not be informative of behavioral parental responses to peer quality. To guard against this possibility, We include in our estimation as targeted moments the

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<sup>20</sup>Heckman, Humphries, and Veramendi (2016) develop a framework, which can be applied in dynamic models of skill formation, for estimating dynamic treatment effects through instrumental variables (when available) and conditional independence assumptions.

<sup>21</sup>Cunha, Heckman, and Schennach (2010) also analyze a longer period of child development starting from the early-childhood period.

estimated coefficients from panel data regression models with child fixed effects. In particular, we use the panel structure of the Add Health data to generate two-period child-level panel data with repeated information about parenting and peers. The additional target moments are estimated coefficients of panel data regression models of longitudinal changes in parenting style and peers groups between consecutive school years, which filter out child-level time-invariant heterogeneity that could affect both parents' and children's shocks. More generally, we use as target moments both cross-sectional and panel regressions, and show that the estimated model accurately matches both set of regression coefficients.

Third, we address the concern that the assignment of families to neighborhoods is not random and reflects a residential choice that parents make before their children enter high school by allowing unobservable heterogeneity in preferences to be correlated with the initial conditions at the neighborhood level. This is especially important for the counterfactuals. If family characteristics (beyond the skills and peer environments that we observe) vary across neighborhoods, this matters for the counterfactual analysis where we move some children from poorer to richer neighborhoods and study the endogenous response of parents. In this case, it is important to take into account that, conditional on the child's own skill and on the peer environment, the parents of the moved children behave differently from the parents in the receiving neighborhood. To deal with this issue, we recognize that the choice of parenting style may be partly driven by preference shocks whose distribution can be correlated with neighborhood characteristics. Hence, our model allows for a neighborhood-specific period utility  $U^n$  for parents. Modeling this heterogeneity allows us to account for residential sorting based on unobserved characteristics that are correlated with preferences over parenting styles.

## **B. Target Moments**

The initial skill distribution are estimated outside the model. We follow [Heckman, Pinto, and Savelyev \(2013\)](#), and measure latent skills via the Bartlett factor score, which creates a composite unbiased predictor of skills by aggregating multiple "error-contaminated" measures. This method allows us to infer the initial parametric distribution of latent skill outside the model.<sup>22</sup> We use the same method to construct unbiased measures of parenting style and parental investments from multiple measures in Add Health. Appendix Table [A-1](#) provides the summary statistics of our measures for skills, parenting style, and parental investments. Appendix [B](#) provides additional information on how we measure skills and parental investments.

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<sup>22</sup>Consistent with the model, we measure a child's initial skill endowment with skill measurements during the 9th grade.

We target the following 36 moments:

1. Aggregate and neighborhood-specific shares of authoritarian parents, as well as school-grade fixed effects regressions of parenting style on current period own child's and peers' skills (seven moments, see Table D-1)
2. Child's skill dynamics: Average by school grades, as well as school-grade fixed effects regressions of a child's next-period skills on previous-period own skills, peers' skills, and authoritarian parenting style (eleven moments, see Table D-2).
3. Peers' skill dynamics: Number of friends and school-grade fixed effects regressions of next-period peers' skills on previous period own skills, peers' skills, and authoritarian parenting style (eight moments, see Table D-3).
4. Parental investment: Mean and regressions of parental investments on current period own skills, peers' skills, by authoritarian parenting style (six moments, see Table D-4).
5. Within-child longitudinal changes in parenting style: Panel data regressions (at child level) of parenting style on longitudinal changes in peers' skills and own child's skills; longitudinal changes in parental investments by previous ( $t-1$ ) adopted parenting style (four moments, see Table D-5).

To estimate the model, we need to define the neighborhoods in which children form friendships and solve for a local equilibrium in each neighborhood. Ideally, we should have as many environments as there are schools in our sample. However, when implementing a simulation-based estimator, this approach becomes computationally infeasible. To overcome this issue, we pursue a parsimonious approach where each neighborhood is characterized by the mean and standard deviation of a log-normal distribution of initial skills. We carry out the estimation using synthetic neighborhoods based on the variation across schools observed in the Add Health sample. Specifically, we sort schools by average child skills and then form four synthetic neighborhoods from the quartiles of this distribution.

Table 4 summarizes the characteristics of these neighborhoods (from the lowest to the highest quartile). Using the data, we map the quartiles of the skill distribution to quartiles of the income distribution. As expected, average grades are higher in high-income neighborhoods. The median real family income in 2016 US dollars for the four synthetic neighborhoods are approximately \$48,500 (Neighborhood 1), \$53,000 (Neighborhood 2), \$68,000 (Neighborhood 3), and \$83,000 (Neighborhood 4).

Table 4: Characteristics of Synthetic Neighborhoods

	Mean ( $\mu_e$ )	Standard Deviation ( $\sigma_e$ )	Population
Neighborhood 1	-0.56 (0.061)	0.92 (0.047)	229
Neighborhood 2	-0.15 (0.047)	0.98 (0.035)	273
Neighborhood 3	0.13 (0.042)	0.91 (0.040)	340
Neighborhood 4	0.47 (0.058)	0.85 (0.040)	189

The table shows the mean and standard deviation of skills (from log-normal distributions) in four synthetic neighborhoods. The associated distributions are the initial conditions in the structural estimation of the dynamic model of skill formation. The standard errors reported in parentheses are calculated via 100 school-clustered non-parametric bootstrap repetitions.

### C. Parameter Estimates

**Skill Formation Technology.** Table 5 shows the estimates of the parameters of the skill formation technology in Equation (12). Recall that the parameters are different for parents adopting an authoritarian ( $P = 1$ ) and a nonauthoritarian ( $P = 0$ ) parenting style. For our baseline parameterization for authoritarian parents ( $P = 1$ ), we use a parsimonious specification in which we impose a Cobb-Douglas production function. This decision is motivated by the evidence of a small (statistically insignificant) behavioral response of parental investments for authoritarian parents in Appendix Table D-4, which is consistent in a unit elasticity of substitution and hence a Cobb-Douglas specification. In the appendix, we provide a robustness exercise where we calibrate a general CES technology for authoritarian parents, and show that our main results are robust to this alternative methodology (see footnote 25 below). Our Cobb-Douglas production function looks as follows:

$$H(\theta_{i,t}, \bar{\theta}_{i,t}, I_{i,t}, 1) = \theta_{i,t}^{\bar{\alpha}_{1,1}} \bar{\theta}_{i,t}^{\bar{\alpha}_{2,1}} I_{i,t}^{\bar{\alpha}_{3,1}}, \quad (17)$$

where  $\bar{\alpha}_{1,1} = \alpha_{1,1}\alpha_{5,1}$ ,  $\bar{\alpha}_{2,1} = (1 - \alpha_{1,1})\alpha_{2,1}\alpha_{5,1}$ , and  $\bar{\alpha}_{3,1} = (1 - \alpha_{1,1})(1 - \alpha_{2,1})\alpha_{5,1}$ .

In contrast, the estimated substitution elasticities are significantly different from unity for nonauthoritarian parents. Specifically, when  $P = 0$ , we estimate  $\alpha_{3,0} > 0$ , which implies that parental investment and peer quality are substitutes, as in Agostinelli (2018). This elasticity is primarily identified by the covariation between inputs in the technology of skill formation.

Table 5: Estimated Parameters of the Skill Formation Technology

	Cobb-Douglas (Authoritarian = 1)
Child Skills ( $\alpha_{1,1}$ )	0.517 (0.0481)
Peer Skills ( $\alpha_{2,1}$ )	0.144 (0.0226)
Investments ( $\alpha_{3,1}$ )	0.055 (0.0520)
	CES (Authoritarian = 0)
Complementarity Parents vs. Peer ( $\alpha_{3,0}$ )	0.791 (0.0507)
Share Self-Production ( $\alpha_{1,0}$ )	0.566 (0.0173)
Share Peer Skills ( $\alpha_{2,0}$ )	0.384 (0.0349)
Complementarity Self-Production vs. Parents-Peer ( $\alpha_{4,0}$ )	-1.734 (0.2150)
CES Return to Scale ( $\alpha_{5,0}$ )	1.128 (0.0619)
	Total Factor Productivity
TFP Constant ( $\psi_0$ )	0.399 (0.0328)
TFP Age Trend ( $\psi_1$ )	0.019 (0.0032)
TFP Parenting Style ( $\psi_2$ )	-0.300 (0.0428)

The table shows the estimated parameters of the skill formation technology. See Equation (12) for  $P = 0$  and Equation (17) for  $P = 1$ . The standard errors in parentheses are calculated via 100 school-clustered non-parametric bootstrap repetitions.

For authoritarian parents, parental investment barely responds to the skills of the child and the peers, consistent with a unit elasticity. In contrast, nonauthoritarian parents spend more time with their children when the peer group is weak, suggesting that parental investment and peer quality are substitutes.

The estimates of the other technology parameters reveal additional interesting patterns. An authoritarian parenting style reduces both total factor productivity and the relative importance of peer effects. Both results are intuitive and in line with the findings of the child development literature. For nonauthoritarian parents, we find a strong complementarity between the child's skills and the composite input of peer effects and parental investments ( $\alpha_{4,0} < 0$ ). As a result,

Table 6: Estimated Parent’s Preference Parameters

	1 (Normalized)
Disutility of Investment ( $\delta_1$ )	(-)
Disutility of Authoritarian: Intercept ( $\delta_{2,0}$ )	-2.503 (0.1931)
Disutility of Authoritarian: Heterogeneity by Neighborhood Income ( $\delta_{2,1}$ )	-0.080 (0.0098)
Child Skills ( $\delta_3$ )	2.086 (0.3918)
Authoritarian $\times$ Child Skills ( $\delta_4$ )	-0.196 (0.0222)

The table shows the estimated parents’ preference parameters, see Equations (13) and (14). The standard errors in parentheses are calculated via 100 school-clustered non-parametric bootstrap repetitions. The value of  $\delta_{2,1} = -0.080$  implies that a neighborhood with average family income of \$50,000 displays approximately a 20% lower cost of being authoritarian than a neighborhood with \$100,000 average family income.

nonauthoritarian parents invest more time when the child has high skill. This complementarity has an important implication: a combination of nonauthoritarian parenting and authoritative investments is highly productive for gifted children. Therefore, high-skill children are less likely to be subject to an authoritarian parenting style and more likely to attract other types of time-intensive (authoritative) parental investments. This insight casts a new light on the conventional wisdom in the child development literature that an authoritarian parenting style leads to poor child outcomes. This wisdom is rooted in the positive correlation found in observational data. Our structural theory implies that children with low cognitive or noncognitive abilities are more likely to attract an authoritarian parenting style. Thus, part of the correlation observed in the data might reflect (and according to our estimates, indeed does reflect) a reverse causation.

**Preferences.** Table 6 displays the estimates of parents’ preferences. In the estimation, we exogenously set  $\lambda = 0.95$ , i.e., we assume parents are highly paternalistic. It is difficult to find sources of variation in the data to credibly identify this parameter. The results show little sensitivity to changes in  $\lambda$ , as long as we stay in a high range. For lower values of  $\lambda$ , the model cannot match the observed share of authoritarian parents.<sup>23</sup> According to our estimates,

<sup>23</sup>The results are very similar for any  $\lambda \geq 0.9$ . One could construct an alternative model where  $\lambda$  varies across parents and only some of them choose an authoritarian parenting style. This model would yield similar results.

**Table 7:** Estimated Child’s Preference Parameters

Child $i$ Skills ( $\gamma_1$ )	-0.189 (0.0270)
Child $j$ Skills ( $\gamma_2$ )	-0.202 (0.0400)
Homophily ( $\gamma_3$ )	-0.261 (0.0352)
Authoritarian ( $\gamma_4$ )	-0.538 (0.1301)
Constant ( $\gamma_0$ )	-1.431 (0.0368)

The table shows the estimated child’s preference parameters, see Equation (15). The standard errors in parentheses are calculated via 100 school-clustered non-parametric bootstrap repetitions.

parents dislike being authoritarian ( $\delta_{2,0} < 0$ ), and more so when they live in a higher-income neighborhood ( $\delta_{2,1} < 0$ ) or when they have high-skill children ( $\delta_4 < 0$ ).

Table 7 shows the estimates for the child’s preferences in the random utility model. The coefficients of own and peer skills are both negative, indicating that high-skill children are both less keen on forming friendship ties and less popular with other children. Intuitively, from a child’s perspective, low school performers are more attractive friends than “nerdy” achievers. The estimate of the homophily parameter has a negative sign. As this parameter multiplies the squared difference between own and peer skills, the negative point estimate implies a positive homophily bias, i.e., the larger the difference in skills between the two children, the less valuable the friendship. The parameter  $\gamma_4$  captures the penalty from socializing with low-skill peers when parents are authoritarian. This penalty is quantitatively large: the estimate is almost twice the size of the homophily coefficient  $\gamma_3$ . Thus, an authoritarian parenting style has a strong causal effect on the child’s future peer selection.

These estimation results paint a clear picture of the tradeoff involved in the choice of parenting style. On the one hand, authoritarian parenting style entails a productivity loss in the skill formation technology. On the other hand, it improves peer selection over time. Being authoritarian is therefore more attractive in poor and unequal neighborhoods, where the ben-

enefit of improving the selection of friends is large. Also, all else being equal, it is the parents of children with many low-grade friends who have the strongest incentive to behave in an authoritarian fashion because their children’s skill formation benefits little from their current peers. Finally, the (authoritative) time investment responds more to the quality of peers if the parent is nonauthoritarian. Specifically, parents who give children leeway spend more time with them when the quality of the peer environment is low. For all these reasons, parents are less prone to be authoritarian in wealthier neighborhoods.

#### **D. Sample Fit**

Appendix Tables [D-1](#)–[D-5](#) report information about the sample fit of the model. The model is estimated via indirect inference, i.e., the SMM estimation targets auxiliary regression coefficients from the data. All regressions, both in the data and in the model, include school-grade fixed effects (and, in some cases, individual fixed effects that are differenced out.) The tables show how successful the simulated model is in matching the targeted moments.

Table [D-1](#) focuses on the results of linear probability models where  $P = 1$  (i.e., being authoritarian) is regressed on the child’s and the peers’ skills. For the reasons discussed above, parents are less likely to interfere with peer formation when their own children are proficient and when the peer group is of high quality. The model accurately predicts both the sign and magnitude of the coefficients, as well as both the aggregate and neighborhoods’ fraction of authoritarian parents.

Table [D-2](#) displays results for the skill dynamics. In the upper panel, the child’s next-period skills are regressed on her own current skills, the average skills in her peer group, and the parenting style to which she is exposed. Both in the model and in the data, the coefficient of the child’s skills is the largest; the coefficient of the peers’ skills is smaller but still sizeable. Both in the model and in the data, the reduced-form effect of parenting style on next-period skills is not too large. While the model replicates this reduced-form effect, our structural estimate implies a large causal effect of an authoritarian parenting style. The lower panel shows the evolution of mean skills throughout the high school years in the model and in the data. Again, the fit is very good.

Table [D-3](#) compares the regression coefficients for the evolution of peer skills in the model and in the data. Both data and model display a seemingly modest correlation between authoritarian parenting with the quality of peers in the next period. However, the model implies a large positive causal effect of authoritarian parenting on the selection of peers discussed above.

Table D-4 displays results for authoritative parental investments broken down by (authoritarian versus nonauthoritarian) parenting style. For authoritarian parents, time investments are unresponsive to both the child’s and the peers’ skills. The model accounts for this finding by estimating a unit elasticity (Cobb Douglas) in the skill formation technology.<sup>24</sup> In contrast, when  $P = 0$  parental investments are positively associated with the child’s skills and negatively associated with the peers’ skills. The model accounts for this pattern by estimating a higher elasticity of substitution in the CES technology, as discussed above. Note that the average level of investment also strongly depends on the parenting style, with a good fit between the model and data.

Table D-5 shows the sample fit for the child-level panel data regression coefficients. Even after accounting for time-invariant determinants of parental choices, the model replicates the longitudinal correlation between parenting style and both the child’s and the peers’ skills (top panel). Moreover, the model also replicates the longitudinal substitution in parenting choices of parents between authoritarian and authoritative investments (bottom panel).

### E. Heterogeneous Parental Inputs and Parenting Style

In our model, conditional on a child’s and peer skills, there is no heterogeneity in the return to or quality of parental inputs. In reality, these factors could vary across parents, and moreover could be correlated with the parents’ propensity to adopt different parenting styles. If, for instance, low-skill parents provided inputs of lower quality and were also more prone to be authoritarian, ignoring these correlations could lead to overestimating the productivity losses associated with an authoritarian parenting style.

To assess this dimension of heterogeneity, in this section we allow both the productivity parameter  $A_p$  in Equation (12) and the disutility parameter of being authoritarian  $\delta_2^n$  in Equation (13) to depend on the mothers’ education (college graduates vs. non-college graduates). The structure of the data (a short panel where we only have two observations per child while at school) does not allow us to control more general forms of unobserved heterogeneity in the skill production. The estimated heterogeneity is shown in Appendix Table D-6. Less educated mothers have a higher propensity to be authoritarian. However, the estimated productivity is essentially the same for the two education categories. All the main results are very similar to the baseline model.

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<sup>24</sup>The point estimates of the regression coefficients are small and are not statistically different from zero. In footnote 25 above we discuss a robustness exercise after calibrating a general CES technology for authoritarian parents (see Appendix Figure E-1).

## F. Comparative Statics

In this section, we discuss the comparative statics of the estimated model to illustrate the role of parental decisions and some of the key parameters.

Appendix Figure D-1 shows how the probability that two children  $i$  and  $j$  form a friendship varies as function of each child's skill and the parenting style each child is subject to. We plot child  $i$ 's skill percentile on the horizontal axis. The red and blue lines represent the probability that child  $i$  makes friends with child  $j$  if  $j$  is in the 10th and 90th percentile of the skill distribution, respectively. Each panel represents a different configuration of the parenting style the two children are subject to. In all panels, the red curve (child  $j$  is in the 10th percentile) is negatively sloped, indicating that the probability for child  $i$  to make friends with a low-performing child decreases with child  $i$ 's skills. Conversely, the blue curve (child  $j$  is in the 90th percentile) is positively sloped as the opposite pattern arises when child  $j$  is a strong performer. These relationships reflect the strong homophily bias in the estimated peer formation model. Moving on to the effects of parenting style, the second panel shows that when subject to authoritarian parenting, child  $i$  is substantially less likely to befriend a low performing child—unless child  $i$  herself is a weak student. Similarly, the third panel shows that if child  $j$  is a strong performer, if  $j$ 's parent is authoritarian there is a much higher probability that  $j$  declines making friends with a low-skill child  $i$ . When both children are subject to an authoritarian parenting style (fourth panel), the overall matching become even more positively assortative. Thus, the authoritarian parenting style magnifies the homophily bias, resulting in friendships that are highly assortative by skills.

Appendix Figure D-2 shows the effect of perturbing key parameters around their estimated value on a variety of empirical moments that are important for their identification. The scale in the horizontal axis is normalized so that the estimated value of each parameter is set to unity. Each dot represents a particular simulated moment from the computed new equilibrium of the model for each new parameterization.

The upper panels illustrate the quantitative effect of changing the parameters of the process of friendship formation. Both the homophily bias and an authoritarian parenting style increase the correlation of child  $i$ 's current skills with the average skill of her future peers. The three lower panels illustrate the effects of the parameters in the technology of skill formation. Increasing the elasticity of substitution between peer effects and parental investment increases the effect of the peer environment on parental authoritative time investments (panel c). Increasing the elasticity  $\alpha_{4,0}$  implies that highly performing children receive more attention than

low performing ones relative to the baseline (panel d). Finally, panel e shows that increasing the productivity parameter  $\psi_2$  reduces the fraction of authoritarian parents (by increasing the opportunity cost of the authoritarian style). All correlations are sensitive to parameter changes indicating that the parameters are well identified.

## V. Parents, Peers, and Policy Interventions

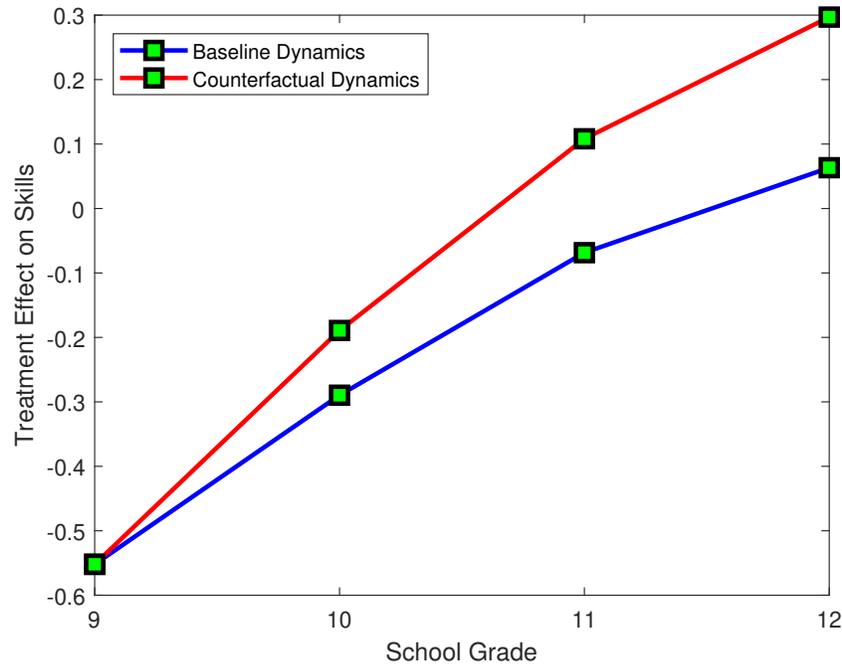
In this section, we run counterfactual policy experiments based on the estimated structural model. We study how parenting styles and friend networks respond to policy interventions that change the peer environment and how this affects human capital accumulation and inequality. We consider two sets of experiments. The first is a “moving-to-opportunity policy” that relocates some children from a disadvantaged to a wealthy neighborhood. The second is a change in the initial conditions, which we interpret as resulting from interventions affecting children’s skills before they start high school.

### A. Moving to Opportunity

Consider a policy experiment that moves children from the synthetic neighborhood with the lowest income (henceforth, N1), whose median family income is \$48,500, to the highest-income neighborhood (henceforth, N4), where median family income is \$83,000. In 2016, the year in which income is measured, the national median family income was \$58,000. The initial difference in children’s mean skills between these two neighborhoods is approximately one standard deviation. We are interested in learning about the individual treatment effect of moving to a better neighborhood, the mechanisms behind the treatment effect, and how the treatment effect changes as the policy is scaled up to include more students.

**Individual Treatment Effects.** Figure 3 shows the dynamic treatment effect for a child moving from N1 to N4 when entering 9th grade. The blue line displays the average evolution of skills for a typical child staying in N1 throughout the high school years. The red line shows the counterfactual evolution of skills if the same child is moved to N4. The treatment effect starts showing up in 10th grade because skills are predetermined at the beginning of 9th grade. Subsequently, a growing gap opens up between the benchmark and counterfactual skills. The treatment effect increases over time because of the dynamic complementarity between skill accumulation and friendship formation. In other words, the gain in skills accruing to the moved child in 10th grade has a positive effect on skill accumulation in the following periods and also improves the peer group the child is exposed to owing to the homophily bias in preferences.

Figure 3: Treatment Effects of Moving to a Better Neighborhood



The figure shows the treatment effect of moving a child in 9th grade from N1 to N4. The blue line displays the baseline skills dynamics for the median child in the skills distribution in N1. The red line shows the counterfactual skills dynamics if the child moves to N4 at the beginning of her 9th grade. The skill dynamics are calculated by averaging among 200 model simulations.

To gauge the quantitative impact of the policy, we compare our treatment effect with the quasi-experimental evidence of Chyn (2018). Chyn studies the effect of an exogenous shock, namely, public housing demolition, that forced many families to leave poor neighborhoods in Chicago. Three years after the demolition, the typical displaced family lived in a less poor and less crime-ridden neighborhood than a similar family that did not have to move. The displaced children earned on average \$602 more per year during their first adult years than those who stayed—a 16 percent increase. In addition, displaced children had 14 percent fewer arrests for violent crimes and a significantly lower probability of dropping out of high school.

To compare our findings to Chyn’s results, we perform a back-of-the-envelope calculation. First, we convert differences in children’s school performance into earning differences by regressing adult earnings in the Add Health data on our measure of skills during adolescence. Second, we note that, according to our estimates, a child moving from N1 to N4 experiences a skill increase equal to about 0.2 standard deviations. These two pieces of information jointly

imply that moving one child from N1 to N4 increases its future annual earnings by about \$900 to \$1,000 (in 2012 dollars).

Our back-of-the-envelope calculation yields an effect that is 50 percent larger than the causal effect estimated by Chyn (2018). Note that our moving-to-opportunity policy relocates children from a moderately poor neighborhood to a wealthy neighborhood, rather than a slightly-less-poor one. This is a more intense treatment than that experienced by the typical displaced child exposed to public housing demolition of Chicago. In addition, our monetization of the skill differences in Add Health is based on an empirical correlation of test scores and earnings that likely overestimates the causal effect of test scores. We conclude that, with some caveats, the quantitative policy effects predicted by our model are in the ballpark of recent estimates in the literature.

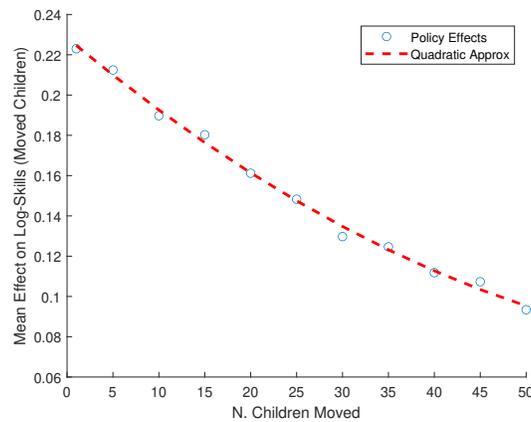
**Scaling Effects.** Figure 3 refers to moving just one child from N1 to N4. If many children are moved together, the treatment effect changes, because a scaled-up policy has an increasing impact on the peer environment in N4. Figure 4 shows how the effect of the moving-to-opportunity policy changes with the scale of the policy. The upper panel shows effects for the relocated children and the lower panels displays effects on children in the receiving community. A small-scale policy yields large gains for the moved children and negligible losses for the receiving children. As the number of relocated children increases, the positive effects for the moved children decline, while the negative effects on the receiving ones increase. The impact of the scale of the policy is quantitatively large. When 50 children move simultaneously, the positive treatment effect on the moved children is cut in half compared with the case of only one child moving. Moreover, the children in the wealthy neighborhood experience average skill losses that are as large as the gains of the arriving children. Because there are more receiving children than new arrivals, the average effect on the skill accumulation of all children involved (both moved and receiving children) turns negative as the policy is scaled up.<sup>25</sup>

Multiple factors combine to attenuate the beneficial effects of the policy as it is scaled up. First, there is a mechanical dilution effect: as more children are relocated, the peer environment of the receiving neighborhood worsens. Second, there are two endogenous mechanisms. The first is peer formation. In our model, low school performers are attractive as friends. This

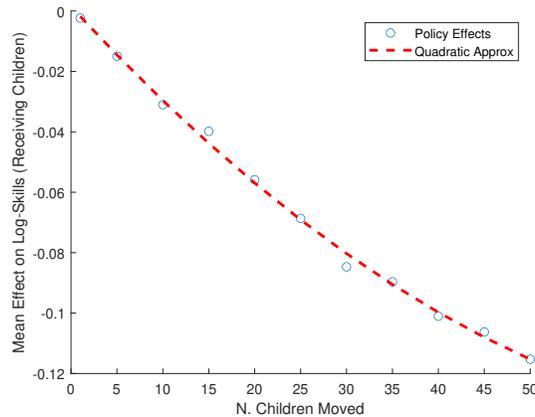
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<sup>25</sup>In our main exercise, we assume that the skill formation technology is parameterized by a Cobb-Douglas function for the authoritarian parents. As a robustness exercise, we repeat the counterfactual exercise after calibrating a general CES technology for authoritarian parents, instead of using a Cobb Douglas. Appendix Figure E-1 shows that the results of Figure 4 are robust to this alternative specification.

Figure 4: Scaling of Treatment Effects on Skills



(a) Moved Children



(b) Receiving Children

The figure shows the equilibrium policy effect on skills in 12th grade of moving children from N1 to N4 as a function of the number of relocated children. Panel (a) illustrates the average effect for moved children. Panel (b) illustrates the average effect for receiving children. Policy effects represent the average impact on skills for either moved children (Panel a) or receiving children (Panel b) for a given number of moved children. The policy effects are calculated by averaging among 200 different model simulations.

implies that as more children from a disadvantaged background arrive, peer groups become disproportionately tilted toward them. In addition, because of the homophily bias, a large share of the moved children form ties with each other, thereby reducing the benefits from liaising with high-performing students in the receiving community.

The second mechanism stems from the behavioral response of parents. Panels (a) and (b) of Figure 5 show how the parents of the relocated children adjust their behavior as the scale

of the program increases. When just one child moves from N1 to N4, the probability for its parent to adopt an authoritarian parenting style falls; this is a rational response to the more favorable peer group in N4. On its own, this shift in parenting style promotes skill accumulation. However, if the parent was nonauthoritarian in the first place, her authoritative time investment declines in response to the improved peer environment. Both effects fade away as more children are relocated to N4.

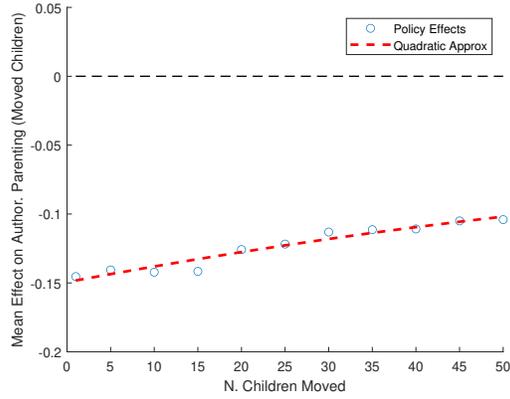
Panels (c) and (d) of Figure 5 show the response of parents in the host community. The share of authoritarian parents increases with the scale of the policy. Intuitively, as more low-skill children arrive, parents in N4 start to worry about their own children befriending them, and more of the parents turn authoritarian. Some parents, especially those of the most proficient children, do not turn authoritarian but rather increase their time investments to compensate for the weaker peer environment. The intensity of both parental responses increase with the scale of the policy.

Both the homophily in peer-group formation and the endogenous pushback of parents in the host community lead to more assortative friendship networks as the policy is scaled up. In other words, as more children are moved, there is less mixing between the locals and the newcomers.

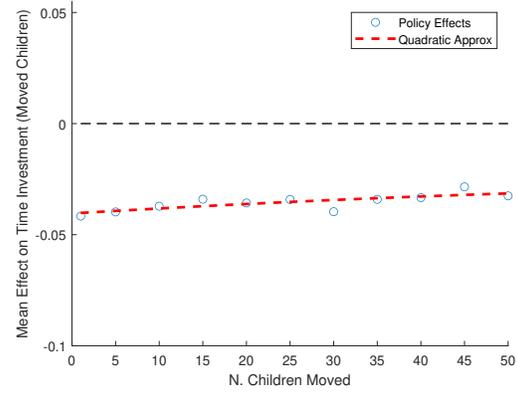
**The Importance of Endogenous Parenting Behavior.** How important is the endogenous response of parents? To answer this question, we run alternative policy counterfactuals in which we hold parenting choices fixed at the baseline level while allowing other channels (i.e., the dilution of the peer group and endogenous peer formation) to operate. The results are shown in Figure 6. The upper panel highlights the role of endogenous parental responses for the skill accumulation of the moved children. The blue dots represent the effect of the moving-to-opportunity policy as a function of the number of moved children, and the red dots represent the counterfactual effects after muting the endogenous parental response. The gains for the treated children would be substantially larger if parents in both communities did not change their behavior. The quantitative effect of the parental response is large: the policy effect under fixed parenting behavior when 50 children are moved is similar to the policy effect with an endogenous parental response when only 25 children are moved.

The lower panel of Figure 6 shows the quantitative effect of the endogenous response of parents in N4 on the skills of their own children. When 50 children are moved from N1 to N4, the defensive response of these parents reduces the negative effect on their children's skill accumulation by about 30 percent.

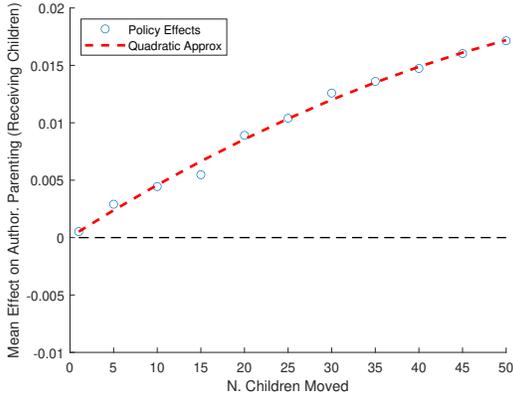
Figure 5: Scaling of Treatment Effects on Parental Behavior



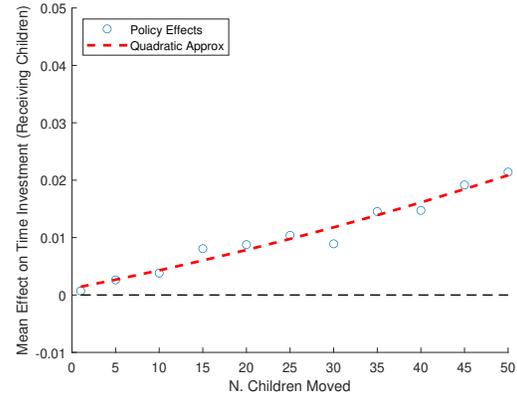
(a) Authoritarian (Moved)



(b) Time Investment (Moved)



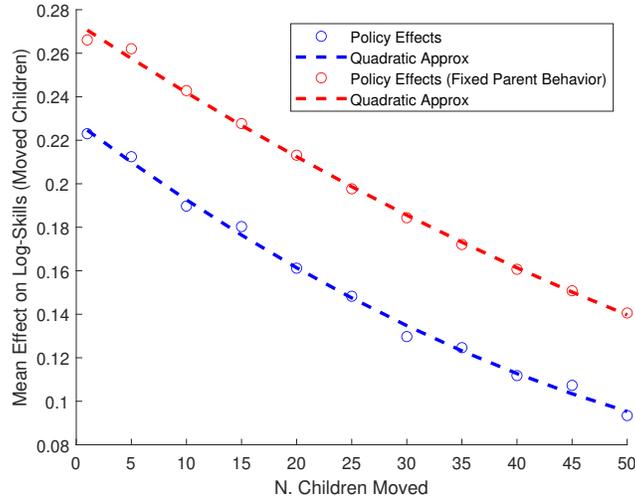
(c) Authoritarian (Receiving)



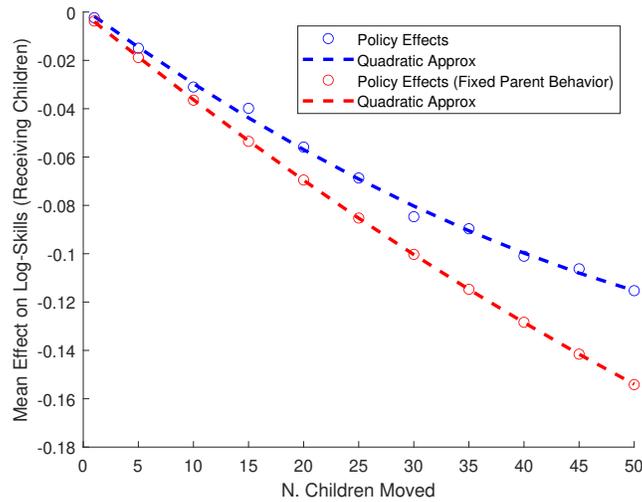
(d) Time Investment (Receiving)

The figure shows the equilibrium policy effect on the probability of being authoritarian (Panels (a) and (c)) and on parental time investment (Panels (b) and (d)) of moving children from N1 to N4 as a function of the number of moved children. Panels (a) and (b) illustrate the policy effect on parental behavior for moved children. Panels (c) and (d) illustrate the policy effect on parental behavior for receiving children. The policy effects represent the average impact on parenting style or parental investments for either moved children (Panels (a) and (b)) or receiving children (Panels (c) and (d)) for a given number of moved children. The policy effects are calculated by averaging among 200 different model simulations.

**Figure 6:** Endogenous Parental Behavior and Policy Effects



(a) Moved Children



(b) Receiving Children

The figure shows the quantitative importance of the endogenous parental response for the counterfactual policy effects. The outcome is skills in 12th grade. The blue lines represent the equilibrium policy effects on skills in 12th grade of moving children from  $N_1$  to  $N_4$  as a function of the number of moved children (as in Figure 4). The red lines show the effect of the policy when parental behavior is held fixed. Panel (a) illustrates the effect for moved children. Panel (b) illustrates the effect for receiving children. Policy effects represent the average impact on skills for a given number of moved children. The policy effects are calculated by averaging among 200 different model simulations.

**Homophily and Skill Formation Technology.** The homophily in friendship networks attenuates the effect of the moving-to-opportunity policy. Appendix Figure E-2 shows how the effects of moving 50 children in Panels a and b of Figure 4 changes as a function of the homophily parameter  $\gamma_3$ . Decreasing  $\gamma_3$  by 50% relative to its estimated value increases the policy effect on the log-skills of the moved children by about a third. This finding suggests that campaigns directed to facilitate the integration of the moved children could enhance the effectiveness of the policy. Still, reducing the homophily bias by 50 percent has smaller effects than muting the parents' response (cf. panel a of Figure 6).

The extent of parental responses varies with the elasticity of substitution between parental investments and peers in the production of a child's skills. Appendix Figure E-3 shows the effect of changing the technological parameter  $\alpha_{3,0}$  for a policy that moves 50 children. As the inputs become closer substitutes, nonauthoritarian parents of moved children reduce their investments to a greater extent. Conversely, the nonauthoritarian parents in the host community increase their investments more strongly in response to the policy. Therefore, a higher elasticity of substitution reduces both the benefits of the policy on the treated children and the harm on the receiving children.

**Endogenous Residential Responses.** Some families living in the affluent neighborhood might decide to leave in response to the influx of disadvantaged children, which would bring about additional changes to peer effects. To study this channel, we predict how many families would leave in response to the policy based on the estimate of [Agostinelli, Lufade, and Martellini \(2022\)](#) of the elasticity of neighborhood choice with respect to peer school quality (see Appendix Figure E-4).<sup>26</sup> We allow families to make an irreversible relocation decision in the first period ( $t = 1$ ) in response to the change in the peer environment induced by the policy. Then, we solve for the counterfactual equilibrium in the receiving neighborhood comprising the moved children and the children of the families that decide to stay. Appendix Figure E-5 shows that residential mobility increases the challenge of scaling up the moving-to-opportunity policy. In particular, the policy effect fades faster as more children are moved. An important factor behind this amplification is that, empirically, the families of the most proficient children exhibit a higher propensity to leave. Our calibration takes this selection into account. The selective outmigration has an independent negative effect on the skill formation of the children in N4, as it impoverishes the local peer environment.

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<sup>26</sup>[Agostinelli, Lufade, and Martellini \(2022\)](#) study the universe of children enrolled in elementary schools of Wake County, North Carolina. Our exercise is subject to the caveat that [Agostinelli, Lufade, and Martellini \(2022\)](#) considers a different context, as well as different period of a child's life.

Table 8: Counterfactual Policy Experiments: Changing Initial Conditions (e.g., Early Childhood Interventions)

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Aggregate						
	Mean	90–10 Ratio	10th Percentile	Gini	Author. Parenting	Time Inv.
No Inequality	10.18%	-42.68%	53.75%	-0.12	-0.04	0.06
No Between-Neighb. Inequality	-2.15%	-9.10%	3.65%	-0.02	-0.00	0.00
No Within-Neighb. Inequality	10.98%	-18.18%	30.58%	-0.05	-0.03	0.05
Truncate Local Distrib. at 10th percent	9.75%	-13.16%	21.23%	-0.03	-0.03	0.01
Halving Cost of Parental Investments	29.38%	11.27%	19.86%	0.02	-0.03	0.17
Panel B: Low-Income Neighborhood						
	Mean	90–10 Ratio	10th Percentile	Gini	Author. Parenting	Time Inv.
No Inequality	37.90%	-41.43%	88.80%	-0.11	-0.10	0.05
No Between-Neighb. Inequality	22.76%	-8.82%	29.69%	-0.02	-0.05	-0.00
No Within-Neighb. Inequality	8.08%	-41.27%	50.42%	-0.11	-0.06	0.05
Truncate Local Distrib. at 10th percent	8.98%	-16.40%	23.05%	-0.04	-0.04	0.02
Halving Cost of Parental Investments	25.88%	12.12%	16.71%	0.02	-0.04	0.16
Panel C: High-Income Neighborhood						
	Mean	90–10 Ratio	10th Percentile	Gini	Author. Parenting	Time Inv.
No Inequality	-10.30%	-23.07%	3.10%	-0.06	0.01	0.07
No Between-Neighb. Inequality	-21.76%	24.51%	-32.74%	0.04	0.03	0.02
No Within-Neighb. Inequality	11.96%	-25.22%	31.58%	-0.06	-0.01	0.04
Truncate Local Distrib. at 10th percent	9.53%	-11.96%	18.52%	-0.03	-0.01	-0.01
Halving Cost of Parental Investments	31.35%	5.60%	26.30%	0.01	-0.02	0.18

The table shows the results for a set of different counterfactuals (each row represents a different counterfactual). All the results are compared to the baseline economy. Each result is calculated by averaging among 200 different model simulations. Columns (1) to (3) are percentage changes relative to the baseline model, and columns (4) to (6) are absolute changes compared to the baseline.

## B. Changing Initial Conditions

In this section, we study counterfactual changes in the initial distribution of skills, emphasizing different forms of reductions in inequality. We interpret these experiments as interventions occurring before children reach high school, including early childhood education policies, interventions in middle school, and policies targeting residential sorting. Altering the initial distribution of skills affects both the process of friendship formation and the endogenous parental responses. We evaluate the effect of these policies by comparing moments of the skill distribution in 12th grade.

The first column of Table 8 describes how we change initial conditions. The other columns report the effects of each counterfactual relative to the baseline on the mean skill accumulation, on three measures of inequality (where the 10th percentile is reported to zoom in on poor families), and on parenting decisions. The table also shows the aggregate effect across all neighborhoods and a breakdown into below- and above-median neighborhoods.

**No Inequality.** The first experiment equalizes the initial human capital of all students while keeping the national mean at the baseline level. Although there is no inequality in the first year, some differences arise over time because random utility shocks lead to the formation of different peer networks. However, final inequality is much lower compared to the baseline, which is hardly surprising. More interestingly, equalizing opportunities increases average skill accumulation—the gain in poor neighborhoods exceeds the loss in rich ones. This results stems, in part, from a decline in the popularity of the authoritarian parenting style in poor neighborhoods: the share of authoritarian parents drops from 18 to 8 percent. In contrast, authoritative parental investments increase across the board. In poor neighborhoods, investments increase because parents fewer parents are authoritarian. In previously rich neighborhoods, parents compensate for the worse peer environment by increasing their own time investment.

**No Inequality Between Neighborhoods.** The second experiment equalizes initial conditions across neighborhoods, setting inequality in each location equal to nationwide inequality in the baseline economy. In other words, overall inequality (measured by the variance of the log-normal distribution of skills) is unchanged, but all inequality is within neighborhoods. The policy can be interpreted as a drastic reduction of residential segregation. Like in the first experiment, the policy increases skill accumulation in low-income neighborhoods and decreases it in high-income neighborhoods. However, the aggregate effect in terms of average skill accumulation is now negative. Although inequality declines, the gain for the families in the bottom decile is small. This might be surprising at first glance, given that disadvantaged children now live in more diverse neighborhoods where they can interact with strong peers. However, eliminating residential segregation does not guarantee that those children will form many friendship ties with high-skill peers. Both the homophily bias and the increasing number of authoritarian parents raise new barriers to the social integration of children of different initial skills.

**No Inequality Within Neighborhoods.** In the third experiment, we remove all within-neighborhood inequality while leaving intact the original inequality between neighborhoods.<sup>27</sup> While the reduction in overall inequality is similar to the previous case, this experiment boosts the average skill accumulation more strongly. The gains are especially large for families in the bottom decile, who enjoy a 30 percent gain relative to the baseline. Both the demise of the authoritarian parenting style and an increase in authoritative investments explain these results.

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<sup>27</sup>In this experiment, total inequality declines because we do not compensate the reduction in within-neighborhood inequality by an increase between neighborhoods. If we do the compensation so as to hold total inequality at the same level as in the baseline, the average effect is still positive but highly asymmetric across rich and poor neighborhoods, which is largely driven by the artificial increase in between-neighborhood inequality.

**No Lower Tail Inequality.** The fourth experiment consists of truncating the initial skill distribution at the 10th percentile within each neighborhood and redistributing the lower tail in proportion to the original distribution at each other percentile. This can be interpreted as a form of early childhood intervention that targets the most-disadvantaged groups in each neighborhood’s population. This policy generates larger average gains than those associated with shutting down inequality altogether. Although part of this gain accrues mechanically, the endogenous dynamics of skills and peers ensure that the gains are persistent and are even amplified over time. The policy triggers a significant decrease in the incidence of the authoritarian parenting style by about one quarter relative to the baseline. This counterfactual highlights an additional benefit of early childhood interventions that has not been captured by past research: by reducing the share of low-skill peers in the population, the policy makes parents more relaxed about their children’s peer groups, which reduces the barriers faced by the more disadvantaged children and improves skill formation.

**Subsidy to Time-Intensive Parental Investments.** Finally, we consider a policy that reduces the cost of authoritative investments. The size of the policy is such that the investment cost halves, resulting in an increase of investment by 17 percentage points (a 50 percent increase relative to the average baseline investments in the baseline). The effects of the policy are beneficial across the board. While a large part of the gains stem from higher parental investments, there is also a shift in parenting styles, with a reduction in the share of authoritarian parents by 3–4 percentage points.

Across all the policies considered, we find that endogenous parental responses play an important role in shaping the effects of the intervention. There is a particularly high upside to interventions that reduce local inequality. Such policies improve the peer environment and thereby reduce the share of parents that adopt an authoritarian style. This shift in parenting has a direct positive impact on skill accumulation (through productivity) and additional benefits for inequality because it promotes interactions between peers from different backgrounds.

## **VI. Conclusions**

In this paper, we study the effects of parents and peers on the skill formation of children during the high school years through the lens of a dynamic rational choice model. In the model, children choose who to be friends with. Parents can actively discourage friendships with low-skill peers, which we interpret as adopting an authoritarian parenting style. An authoritarian parenting style improves the quality of the (future) child’s peer group, but reduces

the productivity of the technology of skill formation.

The model is estimated using an indirect inference approach that exploits variation in skills and peers within schools and grades and over time. We use the estimated model to evaluate the impact of a counterfactual moving-to-opportunity policy whereby children from a low-income neighborhood are moved to a school in an affluent area. Our model is well-suited to study how the benefits of the policy change as it is scaled up, i.e., many disadvantaged children are moved to a better school at the same time. We find that scaling up substantially lowers the treatment effect. A significant part of the attenuation stems from endogenous parental responses.

Our study raises broader questions about the interpretation of reduced-form estimates of neighborhood effects (e.g., [Chetty, Hendren, and Katz 2016](#)). When a single family moves to a better neighborhood, the children may indeed enjoy large gains, in part because of better peer effects. However, larger-scale policies such as building social housing in affluent areas can trigger reactions that limit their effectiveness. Our analysis highlights complementary policy interventions—both before and after children reach high school—that can sustain the effectiveness of moving-to-opportunity policies when such policies are scaled up.

Our results are subject to some limitations. First, we have no information on residential choice before children start high school. Second, the short panel dimension reduces the possibility to filter out individual heterogeneity in the quality of parental inputs. Third, Add Health dates back to the 1990s. New technologies may affect the structure of social interaction across children as well as the effect of parents' interference with the process of skill formation. In spite of these and other limitations, our paper provides a first theory- and data-driven exploration of the dynamic interaction between parenting, children's decisions, and society in the process of skill formation of teenagers whose insights we hope can contribute to the success of future policy interventions.

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# APPENDIX

## A Additional Figures and Tables

Table A-1: Summary Statistics

	Wave I: In-School Interview					
	Full Sample			Saturated Sample		
	Mean	SD	Obs	Mean	SD	Obs
English Grade	2.80	0.98	58,766	2.75	0.99	3,679
Math Grade	2.68	1.03	56,502	2.48	1.04	3,490
History Grade	2.84	1.00	52,182	2.79	1.02	3,350
Science Grade	2.77	1.01	52,914	2.58	1.02	3,278
Child GPA	2.76	0.79	61,113	2.64	0.78	3,730
Peer GPA	2.79	0.53	56,845	2.73	0.52	3,429
Number of Schools		75			12	
	Wave I: In-Home Interview					
	Full Sample			Saturated Sample		
	Mean	SD	Obs	Mean	SD	Obs
PPVT Score	65.67	11.05	13,018	64.46	10.53	2,965
Talked with your mom about a party you attended	0.52	0.50	12,770	0.50	0.50	2,910
Talked with your mom about a personal problem	0.41	0.49	12,770	0.40	0.49	2,910
Worked with your mom on a project for school	0.11	0.31	12,770	0.10	0.30	2,910
Do your parents let you choose your own friends?	0.14	0.34	13,327	0.15	0.36	3,065
Do your parents let you choose the time you must be home on weekend nights?	0.60	0.49	13,322	0.59	0.49	3,062
Do your parents let you choose what you wear?	0.09	0.28	13,332	0.12	0.32	3,067
Do your parents let you choose what time you go to bed on week nights?	0.26	0.44	13,334	0.28	0.45	3,066
	Wave II: In-Home Interview					
	Full Sample			Saturated Sample		
	Mean	SD	Obs	Mean	SD	Obs
English Grade	2.82	0.94	7,670	2.79	0.95	1,891
Math Grade	2.64	1.02	6,697	2.62	1.00	1,554
History Grade	2.89	0.97	6,576	2.79	1.00	1,567
Science Grade	2.80	0.98	6,127	2.63	1.00	1,451
Child GPA	2.77	0.74	7,861	2.70	0.76	1,926
Peer GPA	2.80	0.70	6,930	2.71	0.62	2,362
Talked with your mom about a party you attended	0.55	0.50	8,296	0.53	0.50	2,001
Talked with your mom about a personal problem	0.46	0.50	8,296	0.43	0.49	2,001
Worked with your mom on a project for school	0.11	0.31	8,296	0.09	0.29	2,001
Do your parents let you choose your own friends?	0.11	0.32	8,634	0.12	0.33	2,100
Do your parents let you choose the time you must be home on weekend nights?	0.52	0.50	8,630	0.52	0.50	2,099
Do your parents let you choose what you wear?	0.07	0.25	8,638	0.08	0.27	2,100
Do your parents let you choose what time you go to bed on week nights?	0.20	0.40	8,635	0.22	0.41	2,100

The table shows summary statistics for the variables in the sample of schools used in our estimations (Full Sample). Note that we restrict the original sample in Add Health to high schools with at least 200 children. The table also shows summary statistics for the variables in the sample of saturated schools used in our estimation (Saturated Sample). The saturated sample is used to estimate the regression models in Tables 2-3, and to construct the targeted moments about the within-child dynamics of both peer quality and parenting behavior in Tables D-3 and D-5.

Table A-2: Authoritarian Parenting and Peer Environment Across Schools

	(1)	(2)
	Authoritarian	
Median Family Income at School	-0.031*** (0.005)	-0.021*** (0.004)
90-10 Family Income at School	0.006* (0.003)	0.005* (0.003)
Mean Dependent Var.	0.162	0.162
Observations	20033	20033
Clusters	144	144
Controls	No	Yes

The table shows the effect of within-school median family income and inequality on authoritarian parenting. The dependent variable is an indicator variable for authoritarian parenting at the individual level. The regressions are estimated with the entire In-Home sample in Add Health. The set of controls are mother's education, family income, and child's race, age, and gender. Standard errors are clustered at the school level. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

Table A-3: Authoritarian Parenting and Neighborhood Quality

	(1)	(2)	(3)	(4)	(5)	(6)
	Authoritarian					
Mean GPA within Grade	-0.135*** (0.039)		0.005 (0.052)	-0.086** (0.039)		0.006 (0.049)
Gini GPA within Grade		0.035*** (0.007)	0.036*** (0.009)		0.026*** (0.008)	0.027** (0.010)
Mean Dependent Var.	0.138	0.138	0.138	0.138	0.138	0.138
Observations	13327	13327	13327	13327	13327	13327
Clusters	73	73	73	73	73	73
Controls	No	No	No	Yes	Yes	Yes
School F.E.	Yes	Yes	Yes	Yes	Yes	Yes

The table shows the effect of school-grade mean of GPA and Gini coefficient for GPA on authoritarian parenting. The dependent variable is an indicator variable for authoritarian parenting at the individual level. The Gini GPA within grade is calculated as the Gini coefficient for GPA at the school-grade level. All regressions include school fixed effects. The set of controls are mother's education, family income, and child's race, age, and gender. Standard errors are clustered at the school level. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

Table A-4: Authoritarian Parenting and Peer Environment within Schools (by Gender)

	(1)	(2)	(3)	(4)	(5)	(6)
	Authoritarian					
Male × Mean GPA within Grade	-0.135*** (0.038)		-0.065* (0.039)	-0.087** (0.040)		-0.052 (0.037)
Female × Mean GPA within Grade	-0.135*** (0.039)		-0.075* (0.040)	-0.085** (0.041)		-0.044 (0.042)
Male × SD GPA within Grade		0.389*** (0.078)	0.295*** (0.083)		0.255*** (0.094)	0.211** (0.089)
Female × SD GPA within Grade		0.389*** (0.078)	0.328*** (0.084)		0.328*** (0.096)	0.290*** (0.099)
Mean Dependent Var. (Male)	0.138	0.138	0.138	0.138	0.138	0.138
Mean Dependent Var. (Female)	0.137	0.137	0.137	0.137	0.137	0.137
Observations	13327	13327	13327	13327	13327	13327
Clusters	73	73	73	73	73	73
Controls	No	No	No	Yes	Yes	Yes
School F.E.	Yes	Yes	Yes	Yes	Yes	Yes

The table shows the effect of school-grade mean and standard deviation of the GPA by gender on authoritarian parenting. The dependent variable is an indicator variable for authoritarian parenting at the individual level. The SD GPA is the standard deviation in GPA across pupils within school and grade. Both Mean GPA and SD GPA are interacted with a child's gender. All regressions include school fixed effects. The set of controls are mother's education, family income, and child's race, age, and gender. Standard errors are clustered at the school level. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

Table A-5: Authoritarian Parenting (Index) and Peer Environment within Schools

	(1)	(2)	(3)	(4)	(5)	(6)
	Authoritarian (Index)					
Mean GPA within Grade	-1.005*** (0.172)		-0.579*** (0.145)	-0.449*** (0.131)		-0.291*** (0.105)
SD GPA within Grade		2.680*** (0.343)	2.038*** (0.331)		1.302*** (0.333)	1.053*** (0.305)
Mean Dependent Var.	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000
Observations	13307	13307	13307	13307	13307	13307
Clusters	73	73	73	73	73	73
Controls	No	No	No	Yes	Yes	Yes
School F.E.	Yes	Yes	Yes	Yes	Yes	Yes

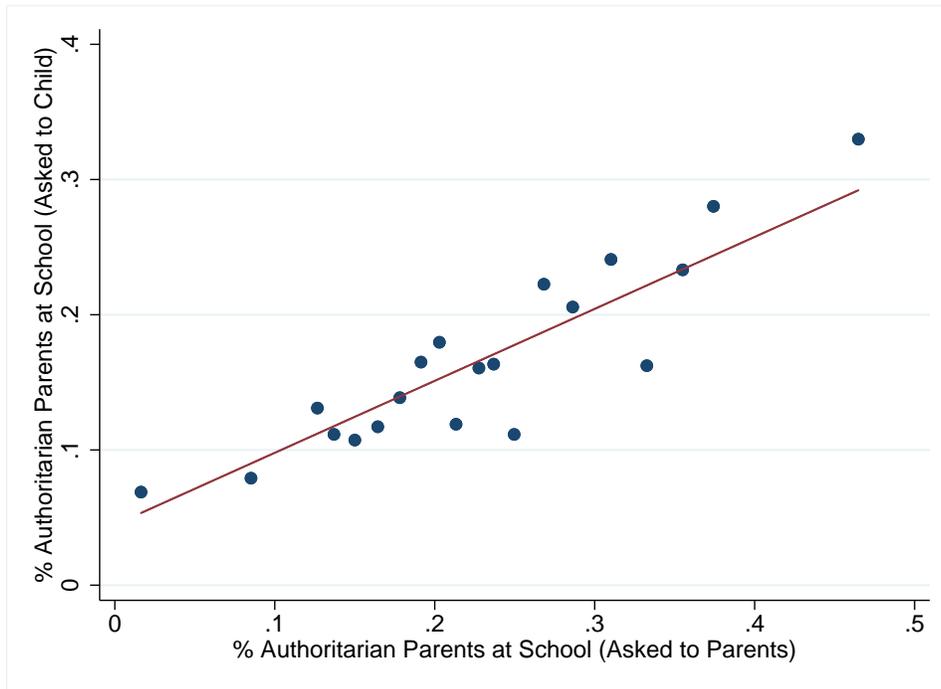
The table shows the effect of school-grade mean and standard deviation of the GPA on an index for authoritarian parenting. The dependent variable is an index (Bartlett score) for authoritarian parenting at the individual level. The SD GPA is the standard deviation in GPA across pupils within school and grade. All regressions include school fixed effects. The set of controls are mother's education, family income, and child's race, age, and gender. Standard errors are clustered at the school level. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

**Table A-6: Authoritarian Parenting and Dynamics of Peer Quality  
(Index Measure)**

	(1)	(2)	(3)	(4)	(5)	(6)
	Change in Authoritarian Style (Index)					
Change in Peer GPA	-0.117*** (0.029)	-0.111*** (0.030)	-0.110*** (0.029)	-0.122*** (0.033)	-0.118*** (0.033)	-0.116*** (0.032)
Change in Child GPA		-0.057** (0.018)	-0.224** (0.081)		-0.058** (0.019)	-0.234** (0.079)
Child GPA (t-1) × Change in Child GPA			0.070 (0.040)			0.073 (0.041)
Mean Dependent Variable	-0.062	-0.062	-0.062	-0.062	-0.062	-0.062
Observations	1484	1484	1484	1484	1484	1484
Clusters	10	10	10	10	10	10
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Classroom F.E.	No	No	No	Yes	Yes	Yes

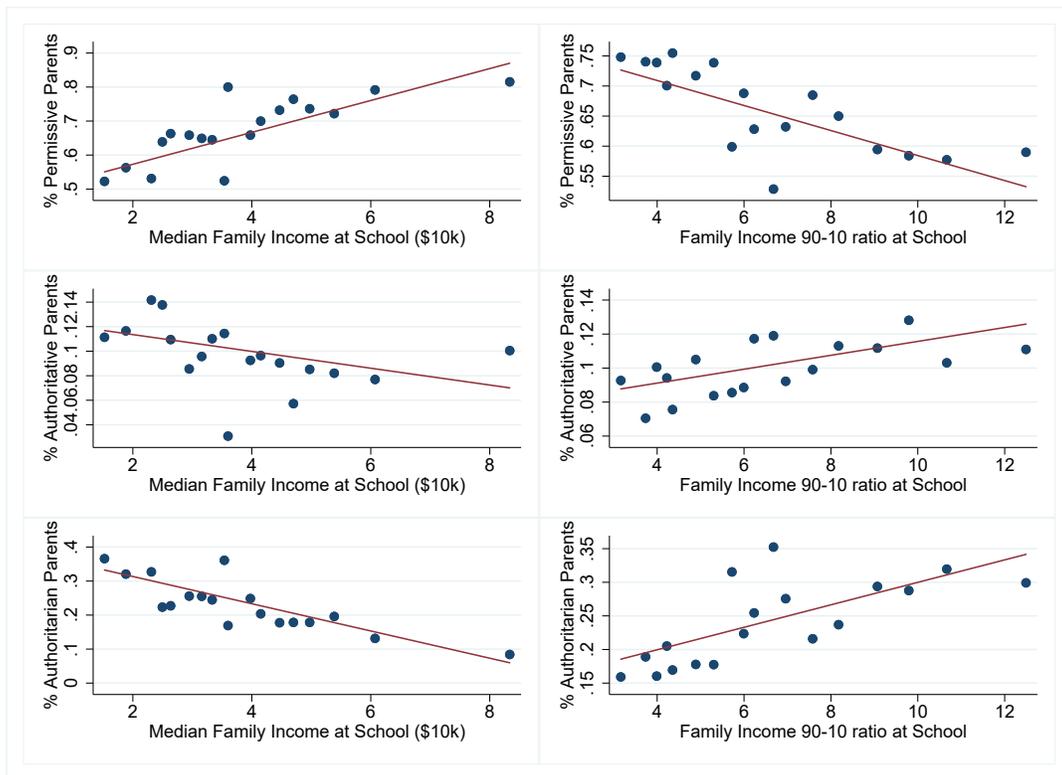
The table shows the effect of changes in peers and a child's GPA on changes in an index for authoritarian parenting. The dependent variable is the within-child longitudinal change in authoritarian parenting between the first and second wave of interviews. The Change in Peer GPA and the Change in Child's GPA represent the longitudinal change between the first and second wave of interviews of the average GPA of peers and a child's GPA, respectively. Finally, the Child's GPA ( $t - 1$ ) represents the GPA of a child during the first wave of interviews. The regressions are estimated with the sample of saturated schools in Add Health. All regressions include school-grade fixed effects. The set of controls are mother's education, family income, and child's race, age, and gender. Standard errors are clustered at the school level. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

Figure A-1: Correlation between Parent and Child Reported Measure of Authoritarian Parenting



The figure shows the correlation between the shares of authoritarian parents at school constructed with the child questionnaire (y-axis), versus the parent questionnaire (x-axis). Each dot represents the share of authoritarian parents at school.

Figure A-2: Parenting Style and Neighborhood Quality



The figure shows how the incidence of the three parenting styles (permissive, authoritative, and authoritarian) varies with within-school median family income (left panel) and inequality (right panel). The measure of parenting style follows [Doepke and Zilibotti \(2017\)](#) and is discussed in the text. Inequality is measured by the 90th–10th percentile ratio of within-school family income. The top, central, and bottom panel show the incidence of permissive, authoritative, and authoritarian parenting style, respectively.

## B Supplementary Material to Section II.

### Measuring Skills and Parental Investments in Add Health

In this section we provide additional details on how we measure children’s skills and parental investment in Add Health.

*Parenting Style.* We measure parenting style using the following yes-no questions asked to children during the in-home survey (both Wave I and Wave II): (1) “Do your parents let you make your own decisions about the people you hang around with?” 2) “Do your parents let you make your own decisions about the time you must be home on weekend nights?” (3) “Do your parents let you make your own decisions about what you wear?” (4) “Do your parents let you make your own decisions about what time you go to bed?” Our baseline measure of parenting style is (1), which is used to anchor the model to the right fraction of authoritarian parents among different neighborhoods and in the aggregate. We classify a parent whose child answers “No” as adopting an authoritarian parenting style. Following [Driscoll, Russell, and Crockett \(2008\)](#) and [Shakya, Christakis, and Fowler \(2012\)](#), we also construct a composite index (Bartlett score), which we use to correct for measurement error that could bias the estimated regression coefficients, including the ones we use as target moments in the structural estimation. For the structural estimation, we follow [Driscoll, Russell, and Crockett \(2008\)](#) and map the Bartlett score index into the binary parenting style (authoritarian versus nonauthoritarian) based on the median value of the score.

*Other Parental Investments (Time).* We measure parental investments using the following yes-no questions asked to children during the in-home survey about certain activities they engaged in with their mothers: “Talked with your mom about a party you attended”; “Talked with your mom about a personal problem”; “Worked with your mom on a project for school.” We aggregate the three measures using the Bartlett factor score.

*Children’s Skills:* We measure children’s skills using both grades at school (English, Math, History and Science) and a standardized test of receptive vocabulary (Peabody Picture Vocabulary Test, PPVT).<sup>28</sup> Similar to [Cunha and Heckman \(2007\)](#), [Cunha, Heckman, and Schennach \(2010\)](#), [Agostinelli and Wiswall \(2016\)](#), [Attanasio, Meghir, and Nix \(2019\)](#), and [Attanasio et al. \(2020\)](#), we use a linear measurement system to have a comparable scaling between different measures. The measurement model maps each of the five observed measures above ( $M_{i,t}^m$ ) into children’s skills ( $\theta_{i,t}$ ) as follows:

$$M_{i,t}^m = \nu_{0,m} + \nu_{1,m} \ln \theta_{i,t} + \phi_{i,t}^m. \quad (\text{B-1})$$

where the measurement error is assumed to be mean independent to the latent skills  $E[\phi_{i,t}^m | \ln \theta_{i,t}] = E[\phi_{i,t}^m] = 0$ . This model allows us to have a linear transformation for each measure  $m$  that measures the children’s skills:  $\widetilde{M}_{i,t}^m \equiv \frac{M_{i,t}^m - \nu_{0,m}}{\nu_{1,m}} = \ln \theta_{i,t} + \widetilde{\phi}_{i,t}^m$ .<sup>29</sup> The identification and estimation of the measurement parameters is based on the normalization of the mean (zero) and variance (unitary) for skills at  $t = 1$  (see [Agostinelli and Wiswall \(2016\)](#)). Once we have the set of re-scaled measures  $\left\{ \widetilde{M}_{i,t}^m \right\}_{m=1}^5$ , they can be used to identify the dynamics of (average) skills over a child’s age  $E[\widetilde{M}_{i,t}^m] = E[\ln \theta_{i,t}]$ , while we aggregate them in a composite unbiased index using Bartlett factor scores to deal

<sup>28</sup>Add Health includes the PPVT scores only for Wave I.

<sup>29</sup>The re-scaled measurement error is  $\widetilde{\phi}_{i,t}^m = \frac{\phi_{i,t}^m}{\nu_{1,m}}$ .

with the measurement error in our regressions (see [Heckman, Pinto, and Savelyev 2013](#)). The estimates of the measurement parameters in Equation (B-1) are shown below.

**Table B-1:** Estimates for the Measurement Model in (B-1)

	$\nu_0$	$\nu_1$
English Grade	2.71	0.73
Math Grade	2.71	0.63
Science Grade	2.78	0.82
History Grade	2.72	0.78
PPVT	64.07	3.24

The table shows the estimates for the measurement model, see Equation (B-1). The parameters are estimated under a zero mean and unitary variance normalization of the log-skills in 9th grade (see [Cunha and Heckman \(2007\)](#), [Cunha, Heckman, and Schennach \(2010\)](#), and [Agostinelli and Wiswall \(2016\)](#) for further details).

## C Supplementary Material to Section III.

### Equilibrium Definition

We now define an equilibrium for a given initial state vector in period  $t = 1$ . As described above, in the computational model this initial state is drawn from an initial distribution of skills together with an initial round of friendship formation, but the equilibrium definition is applicable more generally for an arbitrary initial state. An equilibrium requires that both parents and children make optimal choices on parenting and friendships, respectively, and these choices jointly determine the laws of motion of individual skills and peer effects.

**Definition 1** (Neighborhood Equilibrium). *Given a set of children  $\mathcal{X}^n$  and an initial state vector  $\Theta_0^n = \{\theta_{j,0}, \bar{\theta}_{j,0}\}_{j \in \mathcal{X}^n}$ , an equilibrium for neighborhood  $n$  consists of:*

- Parental value functions  $V_t^n(\theta_{i,t}, \bar{\theta}_{i,t}, \Theta_t^n)$ ,
- optimal policy functions  $I_t(\xi_{i,t})(\theta_{i,t}, \bar{\theta}_{i,t}, \Theta_t^n)$  and  $P_t(\xi_{i,t})(\theta_{i,t}, \bar{\theta}_{i,t}, \Theta_t^n)$ ,
- a friendship formation function  $\mathcal{F}_{t+1}^n = F(\{\theta_{i,t+1}, P_{i,t}\}_{i \in \mathcal{X}^n}, \Phi_t^n)$ ,
- and an aggregate law of motion  $\Gamma(\Theta_t^n, \Xi_t^n, \Phi_t^n)$

such that:

1. The value functions  $V_t^n(\theta_{i,t}, \bar{\theta}_{i,t}, \Theta_t^n)$  satisfy the parents' dynamic programming problem (2),
2. the optimal policy functions  $I_t(\xi_{i,t})(\theta_{i,t}, \bar{\theta}_{i,t}, \Theta_t^n)$  and  $P_t(\xi_{i,t})(\theta_{i,t}, \bar{\theta}_{i,t}, \Theta_t^n)$  solve the maximization problem in (2),
3. The aggregate law of motion  $\Theta_{t+1}^n = \Gamma(\Theta_t^n, \Xi_t^n, \Phi_t^n)$  is such that each child's skill evolves according to (1) given the optimal policy functions and realized parental preference shocks  $\Xi_t^n$ , i.e., for all  $i \in \mathcal{X}^n$ :

$$\theta_{i,t+1} = s(\theta_{i,t}, \bar{\theta}_{i,t}, I_t(\xi_{i,t})(\theta_{i,t}, \bar{\theta}_{i,t}, \Theta_t^n), P_t(\xi_{i,t})(\theta_{i,t}, \bar{\theta}_{i,t}, \Theta_t^n)). \quad (\text{C-1})$$

4. Friendships in period  $t$  are formed such that children solve their maximization problem (5), i.e., we have:

$$\mathcal{F}_{t+1}^n = F(\{\theta_{i,t+1}, P_t(\xi_{i,t})(\theta_{i,t}, \bar{\theta}_{i,t}, \Theta_t^n)\}_{i \in \mathcal{X}^n}, \Phi_t^n), \quad (\text{C-2})$$

with the evolution of individual skills given by (C-1) and  $F(\cdot)$  being such that where each friendship link exists if and only if (6) is satisfied, with friendship utilities  $f_{i,j,t+1}$  generated by (4).

5. The aggregate law of motion  $\Theta_{t+1}^n = \Gamma(\Theta_t^n, \Xi_t^n, \Phi_t^n)$  is such that peer effects evolve according to (10), i.e.,

$$\{\bar{\theta}_{i,t+1}\}_{i \in \mathcal{X}^n} = G(\{\theta_{i,t+1}\}_{i \in \mathcal{X}^n}, \mathcal{F}_{t+1}^n),$$

with the evolution of individual skills given by (C-1) and the friendship network given by (C-2).

## D Supplementary Material to Section IV.

### Sample Fit

Tables D-1–D-5 show the sample fit of the model. Table D-1 reports the sample fit for the estimates of a linear probability model of authoritarian parenting style on a child’s and peers’ skills. Table D-2 focuses on the linear regression model of a child’s next-period skills on current skills, peers’ skills, and authoritarian parenting style. Table D-3 shows the estimates for the regression of the next-period average peers’ skills on the child’s current period skills, peers’ skills, and authoritarian parenting style. Finally, Table D-4 reports the estimates for regressions of authoritative parental investments on the child’s current period skills and peers’ skills, with a breakdown between authoritarian and nonauthoritarian parents. The first panel of Table D-5 shows the sample fit of the child-level panel regression models of longitudinal changes in parenting style on the longitudinal changes in both a child’s skills and peer skills. The second panel of Table D-5 shows the longitudinal change in parental investments by previous parenting style.

Table D-1: Sample Fit of the Model: Parenting Style

	Authoritarian	
	(1)	(2)
	Model	Data
Child Skills	-0.022	-0.014
Peer Skills	-0.039	-0.016
Fraction Authoritarian Parents	0.133	0.147
Fraction Authoritarian Parents (by Neighborhood):		
Neighborhood 1	0.182	0.206
Neighborhood 2	0.138	0.153
Neighborhood 3	0.101	0.119
Neighborhood 4	0.068	0.099

The table shows the sample fit for the estimates of a linear probability model of authoritarian parenting style on a child’s skills and on the peers’ skills. Column (1) displays the estimates generated from the simulated model. Column (2) shows the estimates from the data. We calculate the model’s predicted coefficients by averaging among 50 different model simulations.

**Table D-2: Sample Fit of the Model: Skill Accumulation**

	Next-Period Skills					
	Pooled Sample		Authoritarian = 0		Authoritarian = 1	
	(1) Model	(2) Data	(3) Model	(4) Data	(5) Model	(6) Data
Child Skills	0.818	0.813	0.831	0.818	0.764	0.782
Peer Skills	0.232	0.132	0.247	0.091	0.127	0.183
Authoritarian	-0.056	-0.029				
Mean Child Skills (Grade 9)	-0.036	-0.019				
Mean Child Skills (Grade 10)	0.020	0.027				
Mean Child Skills (Grade 11)	0.136	0.112				
Mean Child Skills (Grade 12)	0.218	0.272				

The table shows the estimates for a linear regression model of the next-period child's skills on the current period child's skills, peers' skills, and parenting style. Odd columns display the estimates generated from the simulated model. Even columns show the estimates from the data. We calculate the model's predicted coefficients by averaging among 50 different model simulations.

**Table D-3: Sample Fit of the Model: Peer Skills**

	Next Period Peer Skills					
	Pooled Sample		Authoritarian = 0		Authoritarian = 1	
	(1)	(2)	(3)	(4)	(5)	(6)
	Model	Data	Model	Data	Model	Data
Child Skills	0.165	0.180	0.149	0.173	0.265	0.178
Peer Skills	0.476	0.307	0.485	0.327	0.420	0.292
Authoritarian	0.069	0.033				
Mean Number of Friends	7.621	7.643				

The table shows the estimates for a linear regression model of next-period average skill of peers on current period child's skills, peers' skills, and parenting style. Odd columns display the estimates generated from the simulated model. Even columns show the estimates from the data. We calculate the model's predicted coefficients by averaging among 50 different model simulations.

**Table D-4:** Sample Fit of the Model: Parental Investments

	Parental Investments			
	Authoritarian = 0		Authoritarian = 1	
	(1)	(2)	(3)	(4)
	Model	Data	Model	Data
Child Skills	0.120	0.162	0.004	0.065
Peer Skills	-0.089	-0.110	-0.003	-0.056
Mean Dependent Var.	0.034	0.037	-0.218	-0.210

The table shows the estimates for a linear regression model of authoritative parental investments on current period child's skills and peers' skills with breakdown by (authoritarian) parenting style. Odd columns display the estimates generated from the simulated model. Even columns show the estimates from the data. We calculate the model's predicted coefficients by averaging among 50 different model simulations.

**Table D-5: Sample Fit: Longitudinal Analysis of Parenting**

	Change in Authoritarian Style	
	(1)	(2)
	Model	Data
Change in Peer Skills	-0.051	-0.060
Change in Child Skills	0.006	0.014
	Change in Parental Investments	
Authoritarian (t-1)	0.222	0.177
Intercept	-0.055	0.036

The table shows the estimates for a first-difference regression models of both authoritarian parenting style and authoritative parental investments. In the first part of the table, we show the estimated regression coefficients for the model of (within-child) longitudinal changes in parenting style on changes in a child's stock of skills and peers' skills. In the second part of the table we show the regression coefficients for the model of (within-child) longitudinal changes in parental investments on the lagged parenting style. Odd columns display the estimates generated from the simulated model. Even columns show the estimates from the data. We calculate the model's predicted coefficients by averaging among 50 different model simulations.

## Heterogeneous Parental Inputs and Parenting Style

**Table D-6:** Estimates of Heterogeneous Productivity and Preferences by Education

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Technology:	
TFP Constant ( $\psi_0$ )	0.394
Additional TFP (highly educated parents $\psi_{0,2}$ )	-0.012
Preferences:	
Disutility of Authoritarian ( $\delta_{2,0}$ )	-2.365
Additional Disutility of Authoritarian (highly educated parents $\delta_{2,2}$ )	-0.512

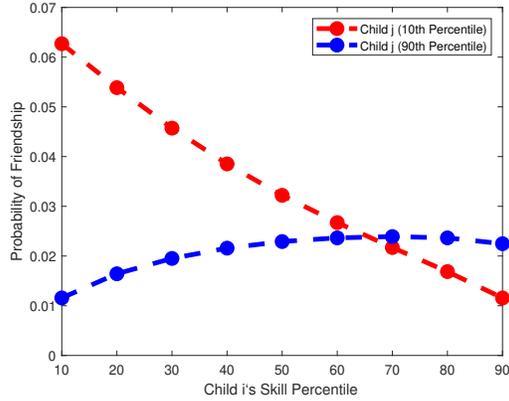
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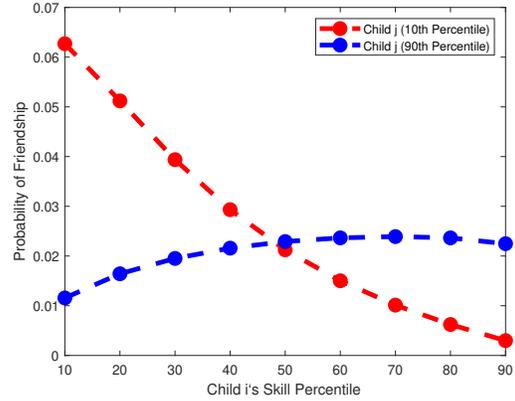
The table shows the estimated heterogeneity in the productivity parameter  $\psi_0$  of the skill formation technology and in the preference parameter  $\delta_2^n$  for a model in which parents have heterogeneous education (college graduates versus non-college graduates). Parameter  $\psi_{0,2}$  captures the additional productivity in skill accumulation if the mother is college educated, and  $\delta_{2,0}$ , and similarly  $\delta_{2,2}$  is the additional disutility of authoritarian parenting for college-educated compared to less-educated mothers. The remaining parameters are assumed to be homogeneous by education. The detailed results are available upon request.

## Comparative Statics

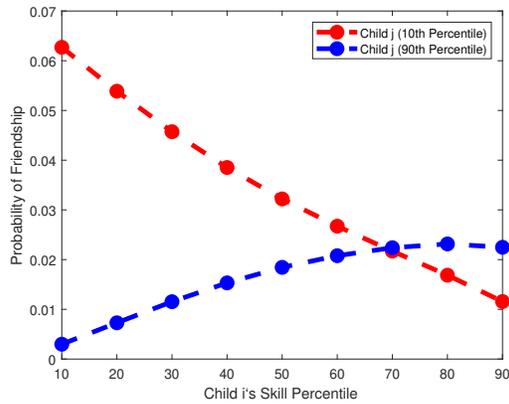
Figure D-1: Comparative Statics of Friendship Formation



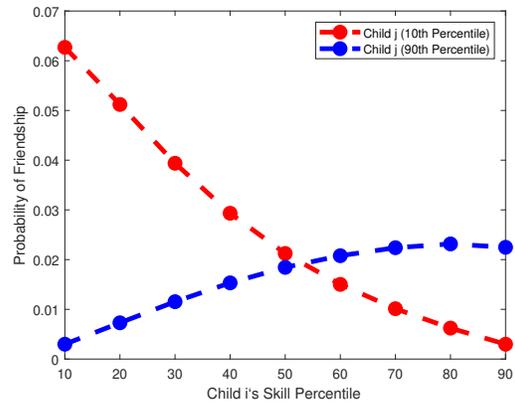
(a)  $P_i=0, P_j=0$



(b)  $P_i=1, P_j=0$



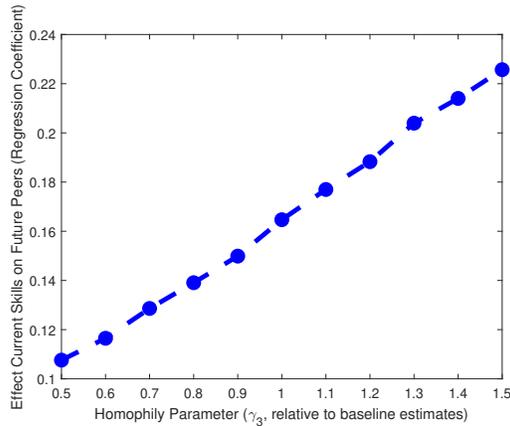
(c)  $P_i=0, P_j=1$



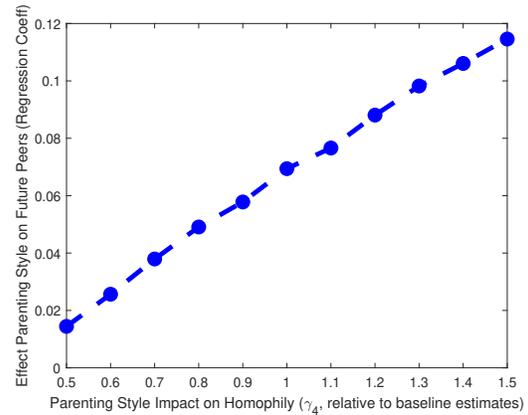
(d)  $P_i=1, P_j=1$

The figure shows the comparative statics of the probability of a friendship between two children with different skills, for different parenting style. In each panel, the x-axis shows the skill percentile for a child  $i$ , while the y-axis shows the probability of a friendship between child  $i$  and child  $j$ . The red and blue lines represent the probability of friendship with child  $j$  if she was in the 10th or 90th percentile of the skill distribution, respectively. Each panel represents a different scenario in terms of the adopted parenting style of the parents of the two children. For example, Panel A and D show how the probability of a friendship varies between children with different skills when either no parent is authoritarian or when both parents are. Instead, Panel B and C consider the case when either only parent of child  $i$  or parent of child  $j$  is authoritarian, respectively. The figure is computed using the estimated child's preference parameters in Table 7.

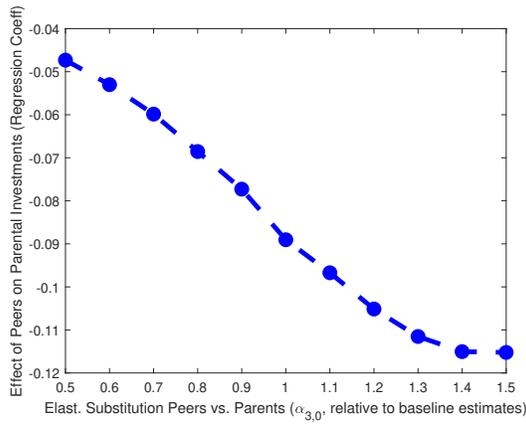
Figure D-2: Perturbation of Model's Parameters and Equilibrium Moments



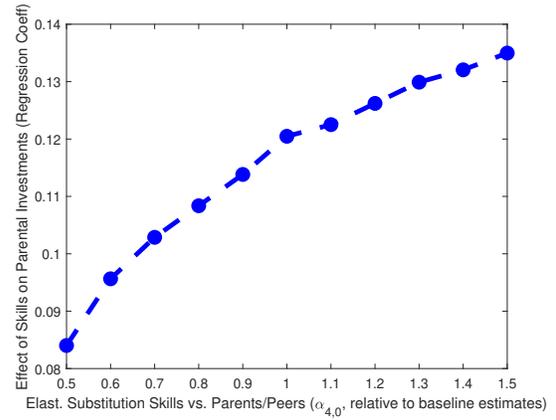
(a) Homophily ( $\gamma_3$ )



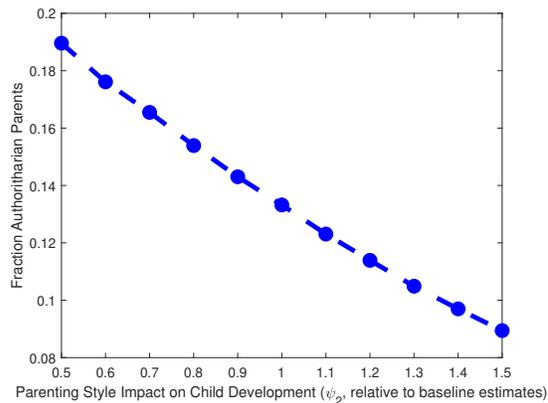
(b) Parenting Style on Homophily ( $\gamma_4$ )



(c) Complementarity Parents vs. Peers ( $\alpha_{3,0}$ )



(d) Complementarity vs. Self-Production vs. Parents-Peers ( $\alpha_{4,0}$ )

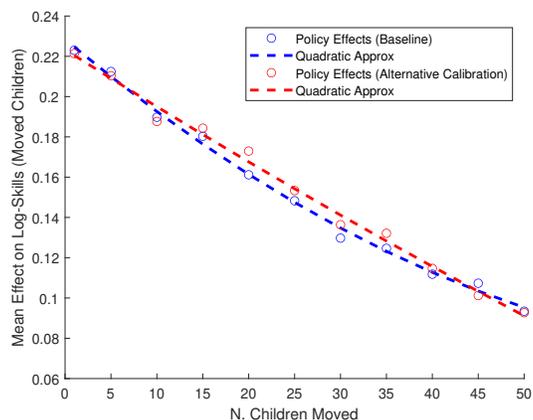


(e) Productivity Skill Accumulation ( $\psi_2$ )

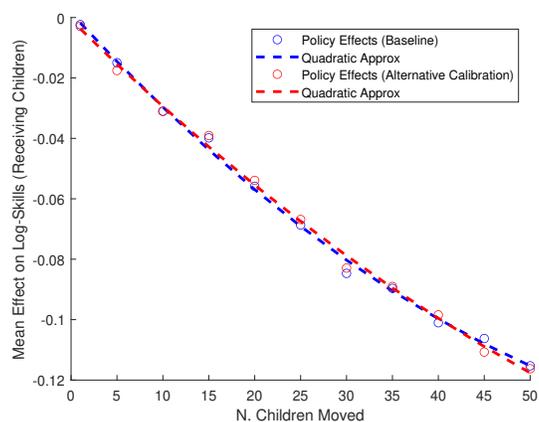
The figure shows the comparative statics of the equilibrium moments used for the estimation of the model. Each dot represents a particular simulated moment from the computed new equilibrium of the model for each new parameterization. In each panel, the x-axis represent the level of perturbation of a parameter (in %) relative to its estimated value in Table 5-7 (1 represents the estimated baseline level). The y-axis represents the values of the particular simulated moment.

## E Supplementary Material to Section V.

Figure E-1: Policy and Scaling Effects on Skills (Alternative Calibration)



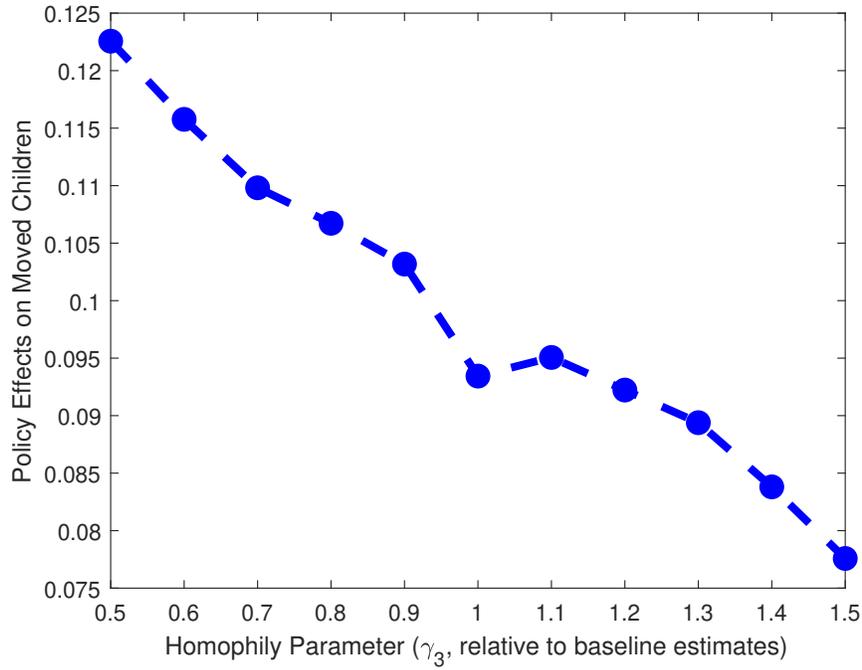
(a) Moved Children



(b) Receiving Children

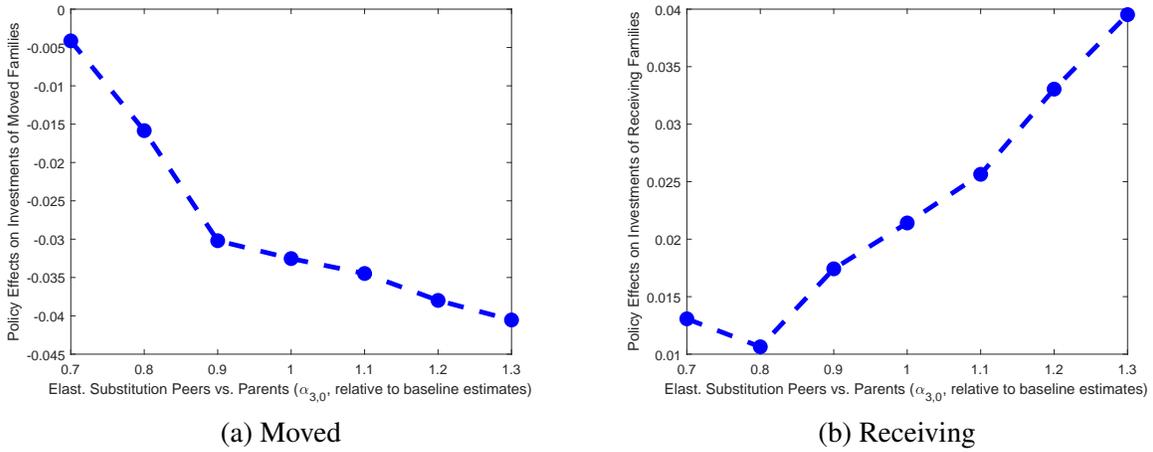
The figure shows the equilibrium policy effect on skills in 12th grade of moving children from N1 to N4 as in Figure 4. In this exercise, we provide a robustness exercise of our counterfactual results to alternative calibrations of the skill production function for authoritarian parents ( $P = 1$ ) in equation (17). In particular, we generalize the current Cobb-Douglas specification for authoritarian parents ( $P = 1$ ) with a calibrated CES technology with the following parameterization (see equation (12) for the general CES specification):  $\alpha_{1,1}=0.7221$ ,  $\alpha_{2,1}=0.6734$ ,  $\alpha_{3,1}=0.30$ ,  $\alpha_{4,1}=-0.40$ ,  $\alpha_{5,1}=0.7160$ . All the rest of other model's parameters are kept at the estimated values. Panel (a) illustrates the average effect for moved children. Panel (b) illustrates the average effect for receiving children. Each panel shows both results from the baseline estimates (blue dots) and the alternative calibration (red dots). Policy effects represent the average impact on skills for either moved children (Panel a) or receiving children (Panel b) for a given number of moved children. The policy effects are calculated by averaging among 200 different model simulations

Figure E-2: The Impact of Homophily on the Policy Scale Up



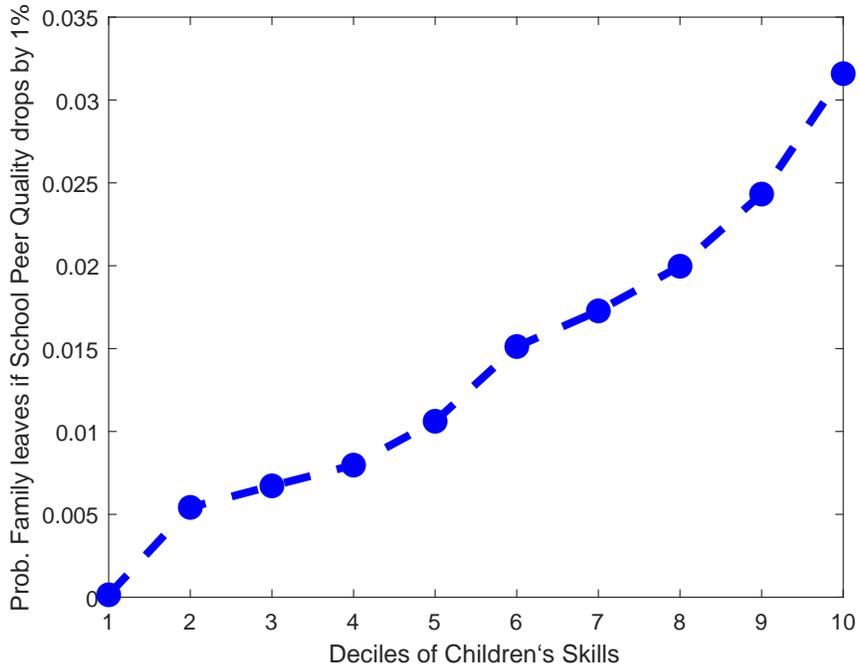
The figure shows how the equilibrium policy effects computed in Panel A of Figure 4 (for the case of 50 children moved) change with respect to the homophily parameter ( $\gamma_3$ ) of the model. The x-axis represent the level of perturbation of a parameter (in %) relative to its estimated value in Table 7 (1 represents the estimated baseline level). The y-axis shows the computed policy effects for moved children. Each dot represents a particular equilibrium policy effect, which is calculated by computing the new equilibrium in both the baseline and the counterfactual economy, for each new parameterization.

Figure E-3: Parental Responses and the Elasticity of Substitution Peers vs. Parents



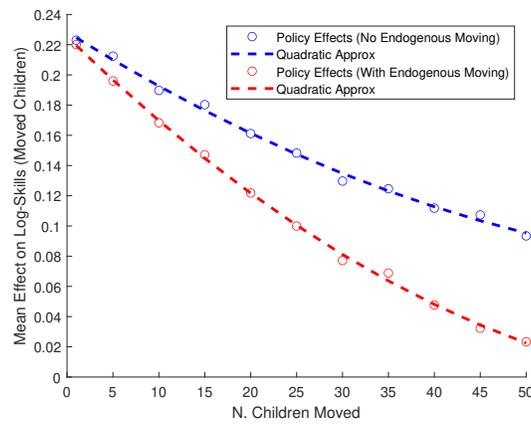
The figure shows how the equilibrium policy effects on parental investments computed in Panel B and D of Figure 5 (for the case of 50 children moved) change with respect to the elasticity of substitution parameter between parents and peers in the production of skills ( $\alpha_{3,0}$ ). In each panel, the x-axis represent the level of perturbation of a parameter (in %) relative to its estimated value in Table 5 (1 represents the estimated baseline level). The y-axis shows the computed policy effects on parental investments for moved families (Panel A) and for receiving families (Panel B). Each dot represents a particular equilibrium policy effect, which is calculated by computing the new equilibrium in both the baseline and the counterfactual economy, for each new parameterization. In Panel A, we show how the equilibrium policy affects moved families, while in Panel B we show how it affects receiving families.

Figure E-4: Residential Elasticities w.r.t. School Peer Quality

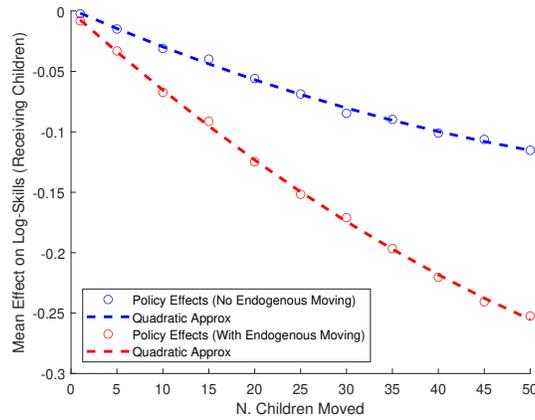


The figure shows the probability of a family leaving the receiving high-income neighborhood by their children's skill deciles. These behavioral estimates are from [Agostinelli, Luflade, and Martellini \(2022\)](#). A 0.01 probability means that a family has 1% probability of leaving the neighborhood if the (ex-ante) peer school quality in 9th grade drops by 1% because of the policy.

Figure E-5: Policy and Scaling Effects on Skills (with Endogenous Mobility)



(a) Moved Children



(b) Receiving Children

The figure shows the equilibrium policy effect on skills in 12th grade of moving children from N1 to N4 as a function of the number of moved children (red lines). In this exercise, compared to the results in Figure 4 (blue lines), we allow receiving families living in N4 to endogenously choose to leave the neighborhood as a response to the policy. The elasticities of residential responses are taken from estimates in Agostinelli, Luflade, and Martellini (2022) (see Figure E-4 for the values of the elasticities). Panel (a) illustrates the average effect for moved children. Panel (b) illustrates the average effect for receiving children. Policy effects represent the average impact on skills for either moved children (Panel a) or receiving children (Panel b) for a given number of moved children. The policy effects are calculated by averaging among 200 different model simulations.