Summary of the Model, Data, and Estimation Results for "It Takes a Village: The Economics of Parenting with Neighborhood and Peer Effects," NBER WORKING PAPER 27050, DOI 10.3386/w27050

Francesco Agostinelli, Matthias Doepke,
Giuseppe Sorrenti, and Fabrizio Zilibotti

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This document summarizes the model, estimation, and data in the paper "It Takes a Village: The Economics of Parenting with Neighborhood and Peer Effects." The estimated model is the base of the companion paper "When the Great Equalizer Shuts Down: Schools, Peers, and Parents in Pandemic Times."[10]

A The Baseline Model

We consider an economy where children live in neighborhood n and attend school s. A school s is characterized by a set $\mathcal{X}^s$ of attending children and their initial ($t = 1$) skill distribution.

At the beginning of each 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 then can undertake parenting investments $I_{i,t}$ and the parenting style $P_{i,t} \in \{0, 1\}$. At the beginning of the next period, the child's updated skill $\theta_{i,t+1}$ is realized and the new group of friends with the average skill $\bar{\theta}_{i,t+1}$ is formed. These events are repeated until the final year of high school. Then, the child enters adult life with skills $\theta_{i,T+1}$.

[10] This document contains no independent original contribution relative to the original article to which the interested reader is referred to for the details of the analysis. It should not be cited as an independent contribution.

A.1 Decision Problem of Parent and Child

The value function for child i in neighborhood n and school s in period t is given by:

$$v_t^{n,s}(\theta_{i,t}, \bar{\theta}_{i,t}) = \max \left\{ \mathrm{E}\left[u(\mathcal{F}_{i,t+1}) | \theta_{i,t}, \bar{\theta}_{i,t} \right] \right\}. \tag{S-1}$$

Here $u(\mathcal{F}_{i,t+1})$ captures the utility derived from peer interactions with the set of friends $\mathcal{F}_{i,t+1}$ chosen in period t, where $\mathcal{F}_{i,t+1} \subseteq \mathcal{X}^{n,s}$. The friend set $\mathcal{F}_{i,t+1}$ determines the next period's peer quality $\bar{\theta}_{i,t+1}$.

We model the formation of friendships as a random utility model. Every period, each child meets all potential peers $\mathcal{X}^{n,s}$ in the school and can try to be friends with some of them. The potential utility $f_{i,j,t+1}$ that child i would derive from forming a new friendship with $j \in \mathcal{X}^{n,s}$ is given by:

$$f_{i,j,t+1} = g(\theta_{i,t+1}, \theta_{j,t+1}, P_{i,t}, \eta_{i,j,t+1}). \tag{S-2}$$

Here $\eta_{i,j,t+1}$ is an i.i.d. taste shock. The utility from forming a friendship depends on both the own skill of child i and the skill of the potential friend j. The specification allows for homophily bias in terms of skills.[11] The parenting style $P_{i,t}$ affects how much utility accrues to the child when it forms friendships with children of different skill levels. Since parents want to encourage skill formation, we assume that an authoritarian parenting style ($P_{i,t} = 1$) lowers the utility of befriending a low-skill peer relative to a high-skill one. This could be done by rewarding the child in some way for making "desirable" friends or by meting out punishments for befriending less desirable ones. Friendships are subject to mutual agreement: a friendship between child i and child j is formed if and only if

$$f_{i,j,t+1} > 0 \;\; \& \;\; f_{j,i,t+1} > 0, \tag{S-3}$$

where we normalize the value of not forming a friendship to zero. The friendship utility $u(\mathcal{F}_{i,t+1})$ that determines the child's utility (S-1) is then:

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

The parent's total utility in period t is given by the value function:

$$\begin{aligned} V_t^{n,s}(\theta_{i,t}, \bar{\theta}_{i,t}) = \max \Big\{ \mathrm{E}\big[& U(I_{i,t}, P_{i,t}, \epsilon_{i,t}) + \\ & Z\left[\lambda \tilde{u}(\theta_{i,t}, P_{i,t}) + (1-\lambda) u(\mathcal{F}_{i,t+1}) \right] + B V_{t+1}^{n,s}(\theta_{i,t+1}, \bar{\theta}_{i,t+1}) | \theta_{i,t}, \bar{\theta}_{i,t} \big] \Big\}. \end{aligned} \tag{S-4}$$

[11] The homophily bias is a common tendency of people in social networks to be drawn toward others who are similar to them in some significant 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 $U(I_{i,t}, P_{i,t}, \epsilon_{i,t})$ is the parent's period utility, which depends on parenting style ($P_{i,t}$ and $I_{i,t}$), chosen optimally by the parent. Utility also depends on taste shocks $\epsilon_{i,t}$, which ensure a smooth mapping from state variables into decisions. The parent also cares about the child, where Z is the overall weight attached to the child's welfare. Parental concern about children has an altruistic and a paternalistic component. The altruistic component with weight $1 - \lambda$ consists of the child's actual period utility $u(\mathcal{F}_{i,t+1})$. The paternalistic component with weight λ is the parent's own evaluation of the current actions and outcomes of the child. The paternalistic concern is focused on the child's accumulation of skills $\theta_{i,t}$, where we allow for the possibility that the parent's evaluation of the child's skill interacts with parenting style $P_{i,t}$. Hence, paternalistic utility enters as $\tilde{u}(\theta_{i,t}, P_{i,t})$. The parent takes the quality of the child's current peers $\bar{\theta}_{i,t}$ as given, but the parent can influence future peer formation (and hence future peer quality $\bar{\theta}_{i,t+1}$) through the choice of parenting style $P_{i,t}$.

The continuation utility at the end of high school is identical to the child's continuation utility, and thus depends on θ_{T+1}:

$$V_{T+1}^{n,s} = v_{T+1}^{n,s}(\theta_{i,T+1}),$$

where the function $v_{T+1}^{n,s}(\theta_{T+1})$ (corresponding to the child's utility as an adult) is taken as given and assumed to be identical across schools.

B 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 school s is drawn from a log-normal distribution. This specification captures the initial (and to us unobserved) sorting of families into different schools characterized by different initial distributions of children's skills. We define the initial conditions for each school s as follows:

$$\ln \theta_{i,1} \sim N(\mu^s, (\sigma^s)^2), \tag{S-5}$$

where μ^s and σ^s represent the school-specific mean and the standard deviation of the log-skills.

Similarly, initial conditions at the neighborhood level (which are relevant during the pandemic are given by:

$$\ln \theta_{i,1} \sim N(\mu^n, (\sigma^n)^2), \tag{S-6}$$

Once the initial heterogeneity of children's skills within the school is realized, children select their initial peer group according to their preferences for friends (Equation (S-2)). 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.

Parent's Preferences. The paternalistic utility of the parent takes the following form:

$$\tilde{u}(\theta_{i,t}, P_{i,t}) = \delta_3 \ln(\theta_{i,t}) \cdot (1 + \delta_4 P_{i,t}), \tag{S-7}$$

where δ_3 captures the level of the parent's paternalistic enjoyment of the child's skills, which may depend on the parenting style through parameter δ_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:

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

In the empirical model, we set $Z = B = 1$. This is without loss of generality. An increase in either B or Z is equivalent to a proportional decrease in cost parameters δ_1 and δ_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. The utility child i earns from being friends with child j relative to not being friends with j is:

$$\begin{aligned} f_{i,j,t+1} = \gamma_0 + \gamma_1 \ln\theta_{i,t+1} + \gamma_2 \ln\theta_{j,t+1} + \gamma_3 (\ln\theta_{i,t+1} - \ln\theta_{j,t+1})^2 \\ + \gamma_4 \mathbb{1}(\theta_{j,t+1} < \theta_{i,t+1}) (\ln\theta_{i,t+1} - \ln\theta_{j,t+1})^2 P_{i,t} + \eta_{i,j,t+1}. \end{aligned} \tag{S-8}$$

Here, $\eta_{i,j,t+1}$ is a random taste shock for being friends with child j, which is i.i.d. standard logistic distributed. The terms $\gamma_1 \ln\theta_{i,t+1}$ and $\gamma_2 \ln\theta_{j,t+1}$ 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, where γ_1 and γ_2 are parameters that will be estimated. The quadratic term $(\ln\theta_{i,t+1} - \ln\theta_{j,t+1})^2$ captures potential homophily bias in the formation of friends. A negative coefficient $\gamma_3 < 0$ would imply that the higher the difference in skills between the two children, the lower the utility for child i to be friends with child j. The coefficient γ_4 captures the effect of an authoritarian parenting style on the preferences for child j's skills.

C Estimated Parameters

Baseline Parameters. Table S-1 reproduces the estimates in Table 5 of ADSZ20.

Table S-1: Estimated Parameters of the Skill Formation Technology

$\alpha_{1,1}$	0.412
$\alpha_{2,1}$	0.214
$\alpha_{3,1}$	0.073
$\alpha_{4,0}$	0.784
$\alpha_{1,0}$	0.564
$\alpha_{2,0}$	0.395
$\alpha_{3,0}$	-1.680
$\alpha_{5,0}$	1.087
ψ_0	0.418
ψ_1	0.025
ψ_2	-0.299
δ_1	1
δ_2	-2.208
δ_3	2.184
δ_4	-0.208
γ_1	-0.184
γ_2	-0.191
γ_3	-0.286
γ_4	-0.468
γ_0	-1.484

The table reproduces the relevant estimated parameters of ADSZ20.