Supplementary Appendix
Treatment Effects with Heterogeneous Externalities

Appendix S1: Further Theoretical Results

Identification of Model (2)-(3) with Contextual Treatment Effects

Let $Y_c^E = \{y_{ic}\}_{i \in E}$, $Y_c^N = \{y_{ic}\}_{i \in N}$, $X_c^E = \{x_{-ic}\}_{i \in E}$, and $X_c^N = \{x_{ic}\}_{i \in N}$. Let $1_{a,b}$ be a matrix of ones of dimension $a \times b$. The adjacency group based matrices can be written as $\tilde{G}_c^E = \{g_{cij}^E\} = \frac{1}{e_c-1}(1_{e_c,e_c} - I_{e_c})$, $\tilde{G}_c^{EN} = \{g_{cij}^{EN}\} = \frac{1}{n_c} 1_{e_c,n_c}$, $\tilde{G}_c^N = \{g_{cij}^N\} = \frac{1}{n_c-1}(1_{n_c,n_c} - I_{n_c})$, $\tilde{G}_c^{NE} = \{g_{cij}^{NE}\} = \frac{1}{e_c} 1_{n_c,e_c}$. Let us define the share matrices as $S_c^E = \frac{e_c-1}{m_c-1} I_{e_c}$, $S_c^{EN} = \frac{n_c}{m_c-1} I_{n_c}$, $S_c^N = \frac{n_c-1}{m_c-1} I_{n_c}$, $S_c^{NE} = \frac{e_c}{m_c-1} I_{e_c}$.

The version of model (2)-(3) with contextual treatment effects can be written in matrix form as

$$Y_c^E = \phi^E G_c^E Y_c^E + \phi^{EN} G_c^{EN} Y_c^N + X_c^E \beta^E + \delta T_c + \lambda^E G_c^E T_c + G_c^E X_c^E \gamma^E + G_c^{EN} X_c^N \gamma^{EN} + \epsilon_c^E, \quad (S.1)$$

$$Y_c^N = \phi^N G_c^N Y_c^N + \phi^{NE} G_c^{NE} Y_c^E + X_c^N \beta^N + \lambda^N G_c^{NE} T_c + G_c^N X_c^N \gamma^N + G^{NE} X_c^E \gamma^{NE} + \epsilon_c^N, \quad (S.2)$$

where we set $G = \tilde{G}S$. Let us define the following vectors

$$A_c \theta^E = X_c^E \beta^E + G_c^E X_c^E \gamma^E + G_c^{EN} X_c^N \gamma^{EN} + \epsilon_c^E,$$

$$B_c \theta^N = +X_c^N \beta^N + G_c^N X_c^N \gamma^E + G_c^{NE} X_c^E \gamma^{NE} + \epsilon_c^N.$$

Let us suppress the c index to ease the notation. The reduced form of model (S.1)-(S.2) is thus

$$Y^E = M^{E(-1)}(\phi^{EN} G^{EN} J^N (\theta^N B + \lambda^N G^{NE} T) + \theta^E A + \delta T + \lambda^E G^E T), \quad (S.3)$$

$$Y^N = M^{N(-1)}(\phi^{NE} G^{NE} J^E (\theta^E A + \delta T + \lambda^E G^E T) + \theta^N B + \lambda^N G^{NE} T), \quad (S.4)$$

where $M^E = (I_E - \phi^E G^E - \phi^{EN}\phi^{NE} C^E)$, $C^E = G^{EN} J^N G^{NE}$, $J^N = (I_N - \phi^N G^N)^{-1}$, $M^N = (I_N - \phi^N G^N - \phi^{EN}\phi^{NE} C^N)$, $C^N = G^{NE} J^E G^{EN}$, $J^E = (I_E - \phi^E G^E)^{-1}$, I_E and I_N are identity matrices of dimensions e and n, respectively.

The following proposition establishes the conditions under which the parameters in model (S.1)-(S.2) are identified. Here, identification means that a consistent estimator of the parameters in equations (S.1) and (S.2) exists. Let us assume the model (S.1)-(S.2) represents a social equilibrium, so that the reduced form can be derived.

Proposition 2 *Under a partial population design, the parameters of model (S.1)-(S.2) are identified if and only if the share of eligible agents varies across groups.*

Proof of Proposition 2. From the reduced form of the model (S.3) and (S.4), we have

$$G^{NE}Y^E = G^{NE}(M^{E(-1)}(\phi^{EN}G^{EN}J^N(\theta^N B + \lambda^N G^{NE}T) + \theta^E A + \delta T + \lambda^E G^E T)),$$

$$G^N Y^N = G^N(M^{N(-1)}(\phi^{NE}G^{NE}J^E(\theta^E A + \delta T + \lambda^E G^E T) + \theta^N B + \lambda^N G^{NE}T)).$$

If we use a series expansion we can write

$$G^{NE}Y^E = G^{NE}\left(\sum_{j=0}^{\infty}(\phi^E G^E + \phi^{EN}\phi^{NE}C^E)^j(\phi^{EN}G^{EN}\sum_{j=0}^{\infty}(\phi^N G^N)^j(\theta^N B + \lambda^N G^{NE}T) + \theta^E A + \delta T + \lambda^E G^E T)\right), \tag{S.5}$$

$$G^N Y^N = G^N\left(\sum_{j=0}^{\infty}(\phi^N G^N + \phi^{NE}\phi^{EN}C^N)^j(\phi^{NE}G^{NE}\sum_{j=0}^{\infty}(\phi^E G^E)^j(\theta^E A + \delta T + \lambda^E G^E T) + \theta^N B + \lambda^N G^{NE}T)\right). \tag{S.6}$$

$E(G^{NE}Y^E|T)$ and $E(G^N Y^N|T)$ are valid instruments for $G^{NE}Y^E$ and $G^N Y^N$ since they are correlated with the endogenous terms but not with the error terms. Given (S.5)-(S.6), these two vectors can be represented as products of Gs and Ss times the treatment vector

$$E(G^N Y^N|T) = \tilde{R}_N^{\infty}T\tilde{\mu}^* = \sum_{r=1}^{\infty}\sum_{s=0}^{\infty}\sum_{q=0}^{\infty}\left\{(G^N)^r[G^{NE}(G^E)^q G^{EN}]^s G^{NE}(I_E + G_E)\tilde{\eta}_{rsq}\right\}T, \tag{S.7}$$

$$E(G^{NE}Y^E|T) = \tilde{R}_{NE}^{\infty}T\tilde{\iota}^* = \sum_{r=0}^{\infty}\sum_{s=0}^{\infty}\sum_{q=0}^{\infty}\left\{G^{NE}[(G^E)^q G^{EN}(G^N)^r G^{NE}]^s(I_E + G_E)\tilde{\iota}_{rsq}\right\}T, \tag{S.8}$$

where $\tilde{R}_N^{\infty}$ and $\tilde{R}_{NE}^{\infty}$ are two sets of matrices containing all of the combinations of products of powers of the adjacency matrices, and $\tilde{\mu}^*$ and $\tilde{\iota}^*$ are vectors containing the relative parameters,

$\tilde{\eta}_{rsq}$ and $\tilde{\iota}_{rsq}$, that in turn are products of δ, λ^E, λ^N and the endogenous effects (for each specific combination of r, s and q). Given that (S.7) and (S.8) are linear in T, $G^E T$, $G^{NE} G^E T$ and $G^{NE} T$, the approximations derived in the proof of Proposition 1, namely equations (10)-(11), are all included in (S.7) and (S.8) and can be used as instruments with the exception of the share of treated that is now included in the structural model.

One can derive the remaining terms of the approximation of the optimal instruments in a similar fashion of Proposition 1. It is straightforward to see that if e_c, n_c, and m_c vary across c (groups), $E(G^N Y^N|T)$, $E(G^{NE} Y^E)$, $E(G^E Y^E)$, and $E(G^{EN} Y^N)$ are linearly independent to T and thus $E(Z_E)$ and $E(Z_N)$, where $Z_E = [G^E Y^E, G^{EN} Y^N, A, T, G^E T]$ and $Z_N = [G^N Y^N, G^{NE} Y^E, B, G^{NE} T]$ have full column rank. ■

Identification of Model (2)-(3) with Homogenous Externalities

When externalities are constrained to be the same between and within groups model (2)-(3) is the model specification used by Lalive and Cattaneo (2009). While Lalive and Cattaneo (2009)'s identification strategy relies only on the fraction of eligible students as an instrument, our identification strategy exploits the full reduced form function of the endogenous variables. Let e_c and m_c be the number of eligibles and the number of individuals in group c, respectively. Let the outcome equation be

$$y_{ic} = \phi \bar{y}_{-ic} + t_{ic}\delta + x_{ic}\beta + \bar{x}_{-ic}\gamma + \epsilon_{ic}. \tag{S.9}$$

In matrix notation and sorting the units by the eligibility status, we have

$$Y_c = \phi G_c Y_c + T_c \delta + X_c \beta + G_c X_c \gamma + \epsilon_c, \tag{S.10}$$

where

$$G_c = \frac{1}{m_c - 1} J_c = \frac{1}{m_c - 1} \left(1_{m_c, m_c} - I_{m_c} \right) = \frac{1}{m_c - 1} \left(\begin{bmatrix} 1 & \cdots & 1 \\ \vdots & \ddots & \vdots \\ 1 & \cdots & 1 \end{bmatrix} - \begin{bmatrix} 1 & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & 1 \end{bmatrix} \right), \tag{S.11}$$

and $1_{m_c,m_c}$ is a $m_c \times m_c$ matrix of ones. The reduced form of (S.10) is

$$Y_c = M_c^{-1}(T_c\delta + X_c\beta + G_cX_c\gamma + \epsilon_c), \tag{S.12}$$

where $M_c = (I_c - \phi G_c)$. The following proposition establishes the conditions under which the parameters in model (S.10) are identified. Here, identification means that a consistent estimator of the parameters in equation (S.10) exists. Let us assume the model (S.10) represents a social equilibrium, so that the reduced form can be derived.

Proposition 3 *Under a partial population design, the parameters of model (S.10) are identified if the share of eligible agents varies across groups.*

Proof of Proposition 3.

Let us take the expected value of the peer outcome conditional on the treatment status:

$$E(G_cY_c|T_c) = G_cM_c^{-1}T_c\delta.$$

When the matrix M_c is invertible, i.e. when $\phi < 1$, we have that $(I - \phi G_c)^{-1} = \sum_{j=0}^{\infty} \phi^j G_c^j$, and thus

$$E(G_cY_c|T_c) = G_c \sum_{j=0}^{\infty} \phi^j G_c^j T_c\delta. \tag{S.13}$$

Plugging (S.11) in (S.13), we have

$$E(G_cY_c|T_c) = G_c \sum_{j=0}^{\infty} \phi^j \frac{1}{(m_c-1)^j} J_c^j T_c\delta.$$

By exploiting the fact that $G_cT_c = \begin{bmatrix} 1_{e_c}\frac{(e_c-1)}{(m_c-1)} \\ 1_{n_c}\frac{e_c}{(m_c-1)} \end{bmatrix} = share_c$, where 1_l is a $l \times 1$ vector of ones, one can rewrite the model as follows

$$E(G_cY_c|T_c) = 1_{m_c} share_c\delta + G_c \sum_{j=1}^{\infty} \phi^j \frac{1}{(m_c-1)^j} J_c^j T_c\delta. \tag{S.14}$$

Similar to the case when peer effects are assumed to be heterogeneous, one can show that $\frac{1}{(m_c-1)^j} J_c^j T_c$ is a nonlinear function of $\frac{e_c}{(m_c-1)}$ and $\frac{(e_c-1)}{(m_c-1)}$ (as in Proposition 1). More formally, we have that

$$
\begin{aligned}
E(G_cY_c|T_c) &= 1_{m_c} share_c \delta + \sum_{j=2}^{\infty} \frac{1}{(m_c-1)^j} \phi^{(j-1)} J_c^j T_c \delta \\
&= 1_{m_c} share_c \delta + \sum_{j=2}^{\infty} \phi^{(j-1)} \frac{1}{m_c} \left[\frac{\left[(m_c-1)^j - (-1)^j\right]}{(m_c-1)^j} J_c + \frac{\left[(m_c-1)^j + (m_c-1)(-1)^j\right]}{(m_c-1)^j} I_{m_c} \right] T_c \delta \\
&= 1_{m_c} share_c \delta + \sum_{j=2}^{\infty} \phi^{(j-1)} \delta \left\{ \begin{array}{l} 1_{e_c} \left[\frac{e_c-1}{m_c} \frac{\left[(m_c-1)^j-(-1)^j\right]}{(m_c-1)^j} + \frac{1}{m_c} \frac{\left[(m_c-1)^j+(m_c-1)(-1)^j\right]}{(m_c-1)^j} \right] \\ 1_{n_c} \left[\frac{e_c}{m_c} \frac{\left[(m_c-1)^j-(-1)^j\right]}{(m_c-1)^j} \right] \end{array} \right\} \\
&= 1_{m_c} share_c \delta + \sum_{j=2}^{\infty} \phi^{(j-1)} \delta \left\{ \begin{array}{l} 1_{e_c} s_{c,j,e} \\ 1_{n_c} s_{c,j,n} \end{array} \right\} \\
&= 1_{m_c} share_c \delta + \sum_{j=2}^{\infty} \phi^{(j-1)} \delta S_{c,j}. \qquad \text{(S.15)}
\end{aligned}
$$

The fact that $J_c^j = \frac{1}{m_c}\left[(m_c-1)^j - (-1)^j\right]$ if $i \neq j$ and $J_c^j = \frac{1}{m_c}\left[(m_c-1)^j + (m_c-1)(-1)^j\right]$ if $i = j$ is proved by Stanley (2013, page 13). From (S.15) it is clear that identification is achieved when the share of eligibles varies. If the shares do not vary, $share_c$ and $S_{c,j}$ are constant across groups. Observe that in equation (S.14) the fraction of eligible peers ($share_c$), which is the instrument used by Lalive and Cattaneo (2009), is just one of the available exclusion restrictions. ■

Empirical Instrumental Variables

In this section, we detail the construction of the instrumental variables introduced in Section 3.2 and used in Section 3.3 and 5, and define the notation used in Tables 2, S.11 and S.12. For the eligibles in group c, we propose the following matrices:

$$
Q_{Ec} = [q_{E1c}, q_{E2c}, q_{E3c}, q_{E4c}] = \left[\frac{e_c-1}{m_c-1}, \frac{(e_c-1)^2}{(m_c-1)^2}, \frac{n_c e_c (e_c-1)}{(m_c-1)^3}, \frac{(e_c-1)e_c n_c (n_c-1)}{(m_c-1)^4} \right] 1_{e_c,1},
$$

$$
Q_{ENc} = [q_{EN1c}, q_{EN2c}, q_{EN3c}, q_{EN4c}] = \left[\frac{n_c e_c}{(m_c-1)^2}, \frac{(n_c e_c)^2}{(m_c-1)^4}, \frac{(n_c-1) e_c n_c}{(m_c-1)^3}, \frac{(n_c-1)^2 e_c n_c}{(m_c-1)^4} \right] 1_{e_c,1}.
$$

Each matrix is composed by four vectors with length equal to e_c. If we stack all the groups we have the following matrices:

$$Q_E = [q_{E1}, q_{E2}, q_{E3}, q_{E4}], \quad Q_{EN} = [q_{EN1}, q_{EN2}, q_{EN3}, q_{EN4}].$$

Each matrix is composed by four vectors with length equal to $\sum_{c=1}^{\bar{c}} e_c$, where $q_{Ew} = [q'_{Ew1}, ..., q'_{Ewc}, ..., q'_{Ew\bar{c}}]'$ and $q_{ENw} = [q'_{ENw1}, ..., q'_{ENwc}, ..., q'_{ENw\bar{c}}]'$, for $w = 1, 2, 3, 4$. For the ineligibles in group c, we propose the following matrices:

$$Q_{Nc} = [q_{N1c}, q_{N2c}, q_{N3c}, q_{N4c}] = \left[\frac{e_c(n_c-1)}{(m_c-1)^2}, \frac{e_c(n_c-1)(e_c-1)}{(m_c-1)^3}, \frac{e_c(n_c-1)^2}{(m_c-1)^3}, \frac{e_c(n_c-1)^3}{(m_c-1)^4}\right] 1_{n_c,1},$$

$$Q_{NEc} = [q_{NE1c}, q_{NE2c}, q_{NE3c}, q_{NE4c}] = \left[\frac{e_c}{m_c-1}, \frac{e_c(e_c-1)}{(m_c-1)^2}, \frac{e_c(e_c-1)^2}{(m_c-1)^3}, \frac{e_c^2(e_c-1)n_c}{(m_c-1)^4}\right] 1_{n_c,1}.$$

Each matrix is composed by four vectors with length equal to n_c. If we stack all the groups we have the following matrices:

$$Q_N = [q_{N1}, q_{N2}, q_{N3}, q_{N4}], \quad Q_{NE} = [q_{NE1}, q_{NE2}, q_{NE3}, q_{NE4}].$$

Each matrix is composed by four vectors with length equal to $\sum_{c=1}^{\bar{c}} n_c$. where $q_{Nw} = [q'_{Nw1}, ..., q'_{Nwc}, ..., q'_{Nw\bar{c}}]'$ and $q_{NEw} = [q'_{NEw1}, ..., q'_{NEwc}, ..., q'_{NEw\bar{c}}]'$, for $w = 1, 2, 3, 4$.

When we use the share of eligible girls in the same group ($ef_c = m_c - nf_c$) as an additional instrument, the set changes as follows:

$$Q_{Efc} = [q_{Ef1c}, q_{Ef2c}, q_{Ef3c}, q_{Ef4c}] = \left[\frac{ef_c-1}{m_c-1}, \frac{(ef_c-1)^2}{(m_c-1)^2}, \frac{nf_c ef_c(ef_c-1)}{(m_c-1)^3}, \frac{(ef_c-1)ef_c nf_c(nf_c-1)}{(m_c-1)^4}\right] 1_{e_c,1},$$

$$Q_{ENfc} = [q_{ENf1c}, q_{ENf2c}, q_{ENf3c}, q_{ENf4c}] = \left[\frac{nf_c ef_c}{(m_c-1)^2}, \frac{(nf_c ef_c)^2}{(m_c-1)^4}, \frac{(nf_c-1)ef_c nf_c}{(m_c-1)^3}, \frac{(nf_c-1)^2 ef_c nf_c}{(m_c-1)^4}, \right] 1_{e_c,1}.$$

Each matrix is composed by four vectors with length equal to e_c. If we stack all the groups we have the following matrices:

$$Q_{Ef} = [q_{Ef1}, q_{Ef2}, q_{Ef3}, q_{Ef4}], \quad Q_{ENf} = [q_{ENf1}, q_{ENf2}, q_{ENf3}, q_{ENf4}].$$

Each matrix is composed by four vectors with length equal to $\sum_{c=1}^{\bar{c}} e_c$, where

$$q_{Efw} = [q'_{Efw1}, ..., q'_{Efwc}, ..., q'_{Efw\bar{c}}]'$$

and

$$q_{ENfw} = [q'_{ENfw1}, ..., q'_{ENfwc}, ..., q'_{ENfw\bar{c}}]',$$

for $w = 1, 2, 3, 4$. For the ineligibles in group c, we propose the following matrices:

$$Q_{Nfc} = [q_{Nf1c}, q_{Nf2c}, q_{Nf3c}, q_{Nf4c}] = \left[\frac{ef_c(nf_c - 1)}{(m_c - 1)^2}, \frac{ef_c(nf_c - 1)(ef_c - 1)}{(m_c - 1)^3}, \frac{ef_c(nf_c - 1)^2}{(m_c - 1)^3}, \frac{ef_c(nf_c - 1)^3}{(m_c - 1)^4}\right] 1_{n_c,1},$$

$$Q_{NEfc} = [q_{NEf1c}, q_{NEf2c}, q_{NEf3c}, q_{NEf4c}] = \left[\frac{ef_c}{m_c - 1}, \frac{ef_c(ef_c - 1)}{(m_c - 1)^2}, \frac{ef_c(ef_c - 1)^2}{(m_c - 1)^3}, \frac{ef_c^2(ef_c - 1)nf_c}{(m_c - 1)^4}\right] 1_{n_c,1}.$$

Each matrix is composed by four vectors with length equal to n_c. If we stack all the groups we have the following matrices:

$$Q_{Nf} = [q_{Nf1}, q_{Nf2}, q_{Nf3}, q_{Nf4}], \quad Q_{NEf} = [q_{NEf1}, q_{NEf2}, q_{NEf3}, q_{NEf4}].$$

Each matrix is composed by four vectors with length equal to $\sum_{c=1}^{\bar{c}} n_c$, where

$$q_{Nfw} = [q'_{Nfw1}, ..., q'_{Nfwc}, ..., q'_{Nfw\bar{c}}]'$$

and

$$q_{NEfw} = [q'_{NEfw1}, ..., q'_{NEfwc}, ..., q'_{NEfw\bar{c}}]',$$

for $w = 1, 2, 3, 4$.

Derivation of Estimands: Additional Details

ATE. From equation (33) we have that

$$\begin{aligned} & E[Y_c^E(T^{i,c,1})] - E[Y_c^E(T^{i,c,0})] \\ = \; & E[M_c^{E(-1)}(\phi^{EN} G_c^{EN} J^N \theta^N B + \theta^E A + \delta T^{i,c,1})] \\ - \; & E[M_c^{E(-1)}(\phi^{EN} G_c^{EN} J^N \theta^N B + \theta^E A + \delta T^{i,c,0})] \\ = \; & E[M_c^{E(-1)}(\phi^{EN} G_c^{EN} J^N \theta^N B + \theta^E A + \delta (T^{i,c,1} - T^{i,c,0}))] \\ = \; & E[M_c^{E(-1)}(\phi^{EN} G_c^{EN} J^N \theta^N B + \theta^E A + \delta 1_{i,c})] \\ = \; & E[Y_c^E | 1_{i,c}], \end{aligned} \tag{S.16}$$

where $1_{i,c}$ is a $e_c \times 1$ vector of zeros with only the i_{th} element equal to one. From (41) and (40), we can see that

$$\begin{aligned} E[Y_c^E | T_c] & \approxeq \sum_{\substack{v=0 \\ r>0}}^{\infty} \sum_{\substack{r=0 \\ if s>0}}^{\infty} \sum_{s=0}^{\infty} \frac{(e_c-1)^v (e_c n_c)^s (n_c-1)^r}{(m_c-1)^{2s+r+v}} 1_{e,1} \psi_{vrsq} \\ = \; & \sum_{\substack{v=0 \\ r>0}}^{\infty} \sum_{\substack{r=0 \\ if s>0}}^{\infty} \sum_{s=0}^{\infty} \frac{[(e_c-1)\phi^E]^v (e_c n_c \phi^{EN} \phi^{NE})^s [(n_c-1)\phi^N]^r}{(m_c-1)^{2s+v+r}} 1_{e,1} \delta. \end{aligned} \tag{S.17}$$

From (S.17) and noting that $G_c^E T_c = \frac{(e_c-1)}{(m_c-1)} 1_{e,1}$, $G_c^{NE} T_c = \frac{e_c}{(m_c-1)} 1_{n,1}$, $G_c^E 1_{i,c} = \frac{1}{(m_c-1)} 1_{e,1}$ and $G_c^{NE} 1_{i,c} = \frac{1}{(m_c-1)} 1_{n,1}$, we have that

$$\begin{aligned} & E[Y_{i,c}^E | 1_{i,c}] \approxeq \delta \\ + \; & \left(\frac{(e_c-1)(\phi^E)^2}{(m_c-1)^2} + \frac{n_c \phi^{EN} \phi^{NE}}{(m_c-1)^2} \right) \sum_{\substack{v=0 \\ r>0}}^{\infty} \sum_{\substack{r=0 \\ if s>0}}^{\infty} \sum_{s=0}^{\infty} \frac{[(e_c-1)\phi^E]^v (e_c n_c \phi^{EN} \phi^{NE})^s [(n_c-1)\phi^N]^r}{(m_c-1)^{2s+v+r}} \delta. \end{aligned} \tag{S.18}$$

ITE. From equation (34) we have that

$$\begin{aligned} & E[Y_c^N(1)] - E[Y_c^N(0)] \\ = \; & E[M_c^{N(-1)}(\phi^{NE} G_c^{NE} J^E(\theta^E A + \delta T_c) + \theta^N B)] \\ - \; & E[M_c^{N(-1)}(\phi^{NE} G_c^{NE} J^E(\theta^E A) + \theta^N B)] \\ = \; & E[M_c^{N(-1)}(\phi^{NE} G_c^{NE} J^E \delta T_c)] \\ = \; & E[Y_c^N | T_c]. \end{aligned} \tag{S.19}$$

From (39) and (40), we can see that

$$E[Y_{i,c}^N | T_c] \approxeq \left(\frac{(n_c - 1)\phi^N}{(m_c - 1)} + 1 \right) \sum_{v=0}^{\infty} \sum_{s=0}^{\infty} \sum_{q=0}^{\infty} \frac{e_c (e_c n_c \phi^{EN} \phi^{NE})^s [(e_c - 1)\phi^E]^q [(n_c - 1)\phi^N]^v}{(m_c - 1)^{2s+q+v+1}} \delta.$$

Appendix S2: Additional Tables and Figures

Table S.1: Monte Carlo simulations - sample size and parameters value -

Panel (a) sample size	(1) TIV	(2) EIV	(3) OLS
N = 500			
$\phi^E = 0.8$	0.798(0.058)[0.058]	0.817(0.045)[0.048]	0.832(0.032)[0.045]
$\phi^{EN} = 0.9$	0.883(0.282)[0.283]	0.980(0.192)[0.208]	1.074(0.100)[0.200]
$\delta = 1.7$	1.743(0.727)[0.729]	1.471(0.509)[0.558]	1.226(0.283)[0.552]
$\phi^N = 0.8$	0.780(0.088)[0.091]	0.808(0.074)[0.075]	0.837(0.062)[0.073]
$\phi^{NE} = 0.9$	0.906(0.033)[0.033]	0.899(0.030)[0.030]	0.893(0.027)[0.028]
N = 1000			
$\phi^E = 0.8$	0.797(0.027)[0.027]	0.809(0.024)[0.025]	0.826(0.019)[0.032]
$\phi^{EN} = 0.9$	0.892(0.085)[0.086]	0.932(0.074)[0.081]	1.003(0.051)[0.115]
$\delta = 1.7$	1.723(0.253)[0.254]	1.601(0.222)[0.243]	1.401(0.160)[0.339]
$\phi^N = 0.8$	0.798(0.037)[0.037]	0.810(0.035)[0.037]	0.844(0.031)[0.054]
$\phi^{NE} = 0.9$	0.901(0.026)[0.026]	0.895(0.026)[0.026]	0.879(0.024)[0.032]
N = 3000			
$\phi^E = 0.8$	0.800(0.014)[0.014]	0.803(0.014)[0.014]	0.832(0.011)[0.034]
$\phi^{EN} = 0.9$	0.898(0.047)[0.047]	0.910(0.045)[0.046]	1.016(0.029)[0.120]
$\delta = 1.7$	1.704(0.134)[0.134]	1.667(0.130)[0.134]	1.353(0.087)[0.358]
$\phi^N = 0.8$	0.799(0.025)[0.025]	0.804(0.024)[0.024]	0.848(0.020)[0.052]
$\phi^{NE} = 0.9$	0.901(0.015)[0.015]	0.899(0.015)[0.015]	0.884(0.014)[0.022]
Panel (b) parameters' values			
$\phi^E = 0.8$	0.800(0.014)[0.014]	0.803(0.014)[0.014]	0.832(0.011)[0.034]
$\phi^{EN} = 0.9$	0.898(0.047)[0.047]	0.910(0.045)[0.046]	1.016(0.029)[0.120]
$\delta = 1.7$	1.704(0.134)[0.134]	1.667(0.130)[0.134]	1.353(0.087)[0.358]
$\phi^N = 0.8$	0.799(0.025)[0.025]	0.804(0.024)[0.024]	0.848(0.020)[0.052]
$\phi^{NE} = 0.9$	0.901(0.015)[0.015]	0.899(0.015)[0.015]	0.884(0.014)[0.022]
$\phi^E = 0.7$	0.697(0.030)[0.030]	0.707(0.028)[0.029]	0.759(0.019)[0.062]
$\phi^{EN} = 0.8$	0.793(0.103)[0.103]	0.828(0.096)[0.100]	1.022(0.051)[0.227]
$\delta = 1.5$	1.514(0.159)[0.159]	1.456(0.150)[0.156]	1.150(0.086)[0.360]
$\phi^N = 0.7$	0.697(0.057)[0.057]	0.716(0.054)[0.057]	0.803(0.040)[0.110]
$\phi^{NE} = 0.8$	0.801(0.026)[0.026]	0.795(0.025)[0.025]	0.773(0.022)[0.035]
$\phi^E = 0.5$	0.498(0.032)[0.032]	0.504(0.031)[0.031]	0.544(0.027)[0.052]
$\phi^{EN} = 0.9$	0.895(0.091)[0.092]	0.913(0.088)[0.089]	1.081(0.062)[0.191]
$\delta = 1.6$	1.606(0.114)[0.114]	1.581(0.110)[0.111]	1.385(0.083)[0.231]
$\phi^N = 0.5$	0.497(0.065)[0.065]	0.513(0.062)[0.064]	0.590(0.050)[0.102]
$\phi^{NE} = 0.9$	0.901(0.031)[0.031]	0.895(0.030)[0.031]	0.874(0.027)[0.038]

Notes. Point estimate (standard error) [root mean squared error]. $\sigma = 1$, number of replications = 3000, group size = 50, max number of eligibles per group = 49, min number of eligibles per group = 1, probability of being in a treated group = 0.7. In *Panel (b)* number of observations = 3000.

Table S.2: Descriptive evidence

	Eligible children				Ineligible children			
Panel (a)	Population	Control village	Treated village	Difference	Population	Control village	Treated village	Difference
School attendance in 1997	0.7875 (0.4091)	0.7771 (0.4163)	0.7948 (0.4039)	0.0177 (0.0222)	0.7848 (0.4110)	0.7683 (0.4221)	0.7968 (0.4025)	0.0285 (0.0238)
School attendance in 1998	0.7594 (0.4275)	0.7173 (0.4504)	0.7891 (0.4080)	0.0718*** (0.0270)	0.7448 (0.4361)	0.7161 (0.4510)	0.7654 (0.4239)	0.0493* (0.0275)
Change school attendance	-0.0280 (0.3571)	-0.0598 (0.3752)	-0.0057 (0.3421)	0.0541*** (0.0147)	-0.0401 (0.3391)	-0.0521 (0.3300)	-0.0313 (0.3453)	0.0208 (0.0138)
Panel (b)								
Girl	0.5044 (0.5000)	0.5007 (0.5001)	0.5070 (0.5000)	0.0063 (0.0154)	0.5026 (0.5001)	0.5105 (0.5001)	0.4969 (0.5001)	-0.0136 (0.0182)
Completed grade 4	0.2369 (0.4252)	0.2494 (0.4328)	0.2280 (0.4196)	-0.0214 (0.0185)	0.2188 (0.4135)	0.2346 (0.4239)	0.2074 (0.4056)	-0.0272 (0.0170)
Completed grade 5	0.2142 (0.4103)	0.2148 (0.4108)	0.2138 (0.4100)	-0.0010 (0.0162)	0.2270 (0.4190)	0.2107 (0.4080)	0.2388 (0.4264)	0.0281 (0.0171)
Completed grade 6	0.3041 (0.4601)	0.2957 (0.4565)	0.3099 (0.4625)	0.0142 (0.0219)	0.3426 (0.4747)	0.3454 (0.4757)	0.3406 (0.4741)	-0.0048 (0.0221)
Mother's education: Primary school or higher	0.3069 (0.4605)	0.3072 (0.4603)	0.3067 (0.4608)	-0.0005 (0.0307)	0.3147 (0.4638)	0.3007 (0.4586)	0.3248 (0.4674)	0.0240 (0.0281)
Father's education: Primary school or higher	0.3468 (0.4581)	0.3492 (0.4569)	0.3451 (0.4589)	-0.0041 (0.0334)	0.3365 (0.4481)	0.3316 (0.4460)	0.3401 (0.4497)	0.0086 (0.0296)
Father information missing	0.0774 (0.2673)	0.0872 (0.2822)	0.0705 (0.2561)	-0.0167 (0.0112)	0.1026 (0.3035)	0.1021 (0.3029)	0.1029 (0.3039)	0.0008 (0.0136)
Secondary school in village	0.3499 (0.4770)	0.3726 (0.4836)	0.3340 (0.4717)	-0.0386 (0.0309)	0.3536 (0.4781)	0.3657 (0.4818)	0.3448 (0.4754)	-0.0208 (0.0325)
Floor: Cement	0.3109 (0.4629)	0.2998 (0.4583)	0.3188 (0.4661)	0.0190 (0.0386)	0.6131 (0.4871)	0.6148 (0.4868)	0.6118 (0.4875)	-0.0030 (0.0381)
Roof: Tin	0.2668 (0.4423)	0.2571 (0.4371)	0.2736 (0.4459)	0.0165 (0.0363)	0.3056 (0.4607)	0.3179 (0.4658)	0.2968 (0.4569)	-0.0211 (0.0461)
Roof: Asbestos	0.1524 (0.3594)	0.1474 (0.3546)	0.1559 (0.3628)	0.0085 (0.0279)	0.1833 (0.3870)	0.1839 (0.3876)	0.1829 (0.3867)	-0.0011 (0.0348)
Roof: Tiles	0.1125 (0.3160)	0.0921 (0.2893)	0.1268 (0.3328)	0.0347 (0.0335)	0.0941 (0.2920)	0.0978 (0.2971)	0.0914 (0.2883)	-0.0063 (0.0250)
Roof: Cement blocks	0.1142 (0.3180)	0.1312 (0.3377)	0.1022 (0.3029)	-0.0291 (0.0246)	0.2437 (0.4294)	0.2136 (0.4100)	0.2654 (0.4417)	0.0518 (0.0354)
Observations	5,387	2,225	3,162	5,387	3,295	1,381	1,914	3,295

Notes. Means and standard deviations (in parentheses) are reported. T-test for differences between means are performed. * : $p < 0.10$; **: $p < 0.05$; ***: $p < 0.01$.

Table S.3: Descriptive evidence - Lalive and Cattaneo (2009) sample -

	Eligible children				Ineligible children			
Panel (a)	Population	Control village	Treated village	Difference	Population	Control village	Treated village	Difference
School attendance in 1997	0.7968	0.7907	0.8005	0.0098	0.7891	0.7768	0.7975	0.0207
	(0.4024)	(0.4069)	(0.3997)	(0.0152)	(0.4080)	(0.4165)	(0.4020)	(0.0201)
School attendance in 1998	0.7645	0.7207	0.7907	0.0700***	0.7474	0.7229	0.7642	0.0413*
	(0.4243)	(0.4487)	(0.4068)	(0.0190)	(0.4345)	(0.4477)	(0.4246)	(0.0234)
Change school attendance	-0.0323	-0.0701	-0.0098	0.0603***	-0.0417	-0.0539	-0.0333	0.0206*
	(0.3554)	(0.3772)	(0.3398)	(0.0104)	(0.3428)	(0.3338)	(0.3486)	(0.0122)
Panel (b)								
Girl	0.5055	0.4997	0.5090	0.0093	0.5028	0.5056	0.5008	-0.0048
	(0.5000)	(0.5001)	(0.5000)	(0.0116)	(0.5001)	(0.5001)	(0.5001)	(0.0164)
Completed grade 4	0.2437	0.2504	0.2397	-0.0108	0.2251	0.2303	0.2216	-0.0087
	(0.4293)	(0.4333)	(0.4269)	(0.0093)	(0.4177)	(0.4212)	(0.4154)	(0.0125)
Completed grade 5	0.2182	0.2271	0.2130	-0.0141	0.2389	0.2309	0.2443	0.0134
	(0.4131)	(0.4190)	(0.4094)	(0.0085)	(0.4264)	(0.4215)	(0.4298)	(0.0140)
Completed grade 6	0.2686	0.2604	0.2735	0.0132	0.3260	0.3280	0.3247	-0.0033
	(0.4433)	(0.4389)	(0.4458)	(0.0119)	(0.4688)	(0.4696)	(0.4683)	(0.0173)
Mother's education: Primary school or higher	0.2846	0.2902	0.2812	-0.0089	0.3130	0.3077	0.3166	0.0090
	(0.4505)	(0.4528)	(0.4491)	(0.0243)	(0.4631)	(0.4614)	(0.4643)	(0.0252)
Father's education: Primary school or higher	0.3183	0.3262	0.3136	-0.0126	0.3293	0.3299	0.3290	-0.0009
	(0.4457)	(0.4491)	(0.4437)	(0.0254)	(0.4448)	(0.4451)	(0.4447)	(0.0261)
Father information missing	0.0841	0.0849	0.0836	-0.0013	0.1050	0.1030	0.1063	0.0033
	(0.2776)	(0.2788)	(0.2768)	(0.0095)	(0.3066)	(0.3041)	(0.3083)	(0.0124)
Secondary school in village	0.3341	0.3450	0.3276	-0.0174	0.3376	0.3570	0.3243	-0.0327
	(0.4717)	(0.4754)	(0.4694)	(0.0250)	(0.4729)	(0.4793)	(0.4682)	(0.0285)
Floor: Cement	0.2778	0.2607	0.2880	0.0274	0.5998	0.6122	0.5913	-0.0209
	(0.4479)	(0.4391)	(0.4529)	(0.0291)	(0.4900)	(0.4874)	(0.4917)	(0.0338)
Roof: Tin	0.2783	0.2627	0.2877	0.0250	0.3152	0.3274	0.3068	-0.0206
	(0.4482)	(0.4402)	(0.4527)	(0.0301)	(0.4646)	(0.4694)	(0.4613)	(0.0407)
Roof: Asbestos	0.1317	0.1293	0.1332	0.0039	0.1736	0.1735	0.1737	0.0002
	(0.3382)	(0.3356)	(0.3398)	(0.0214)	(0.3788)	(0.3788)	(0.3789)	(0.0306)
Roof: Tiles	0.1207	0.0978	0.1344	0.0366	0.1019	0.1012	0.1023	0.0010
	(0.3258)	(0.2971)	(0.3411)	(0.0265)	(0.3025)	(0.3017)	(0.3031)	(0.0227)
Roof: Cement blocks	0.0931	0.1039	0.0866	-0.0173	0.2328	0.2208	0.2411	0.0202
	(0.2905)	(0.3052)	(0.2812)	(0.0174)	(0.4227)	(0.4149)	(0.4278)	(0.0304)
Observations	9,155	3,426	5,729	9,155	4,153	1,689	2,464	4,153

Notes. Means and standard deviations (in parentheses) are reported. T-test for differences between means are performed. * : $p < 0.10$; **: $p < 0.05$; ***: $p < 0.01$.

Table S.4: Descriptive evidence - our sample versus Lalive and Cattaneo (2009) sample -

	Eligible children			Ineligible children		
	Our sample	LC sample	Difference	Our sample	LC sample	Difference
School attendance in 1997	0.0177	0.0098	0.0261	0.0285	0.0207	0.0434
	(0.0222)	(0.0152)	(0.0336)	(0.0238)	(0.0201)	(0.0415)
School attendance in 1998	0.0718***	0.0700***	0.0059	0.0493*	0.0413*	0.0425
	(0.0270)	(0.0190)	(0.0382)	(0.0275)	(0.0234)	(0.0472)
Change school attendance	0.0541***	0.0603***	-0.0202	0.0208	0.0206*	-0.0009
	(0.0147)	(0.0104)	(0.0224)	(0.0138)	(0.0122)	(0.0287)
Girl	0.0063	0.0093	-0.0073	-0.0136	-0.0048	-0.0444
	(0.0154)	(0.0116)	(0.0248)	(0.0182)	(0.0164)	(0.0416)
Completed grade 4	-0.0214	-0.0108	-0.0231	-0.0272	-0.0087	-0.0871*
	(0.0185)	(0.0093)	(0.0399)	(0.0170)	(0.0125)	(0.0477)
Completed grade 5	-0.0010	-0.0141	0.0368	0.0281	0.0134	0.0858
	(0.0162)	(0.0085)	(0.0343)	(0.0171)	(0.0140)	(0.0586)
Completed grade 6	0.0142	0.0132	-0.0196	-0.0048	-0.0033	-0.0238
	(0.0219)	(0.0119)	(0.0397)	(0.0221)	(0.0173)	(0.0523)
Mother's education: Primary school or higher	-0.0005	-0.0089	0.0084	0.0240	0.0090	0.0743
	(0.0307)	(0.0243)	(0.0378)	(0.0281)	(0.0252)	(0.0485)
Father's education: Primary school or higher	-0.0041	-0.0126	0.0047	0.0086	-0.0009	0.0408
	(0.0334)	(0.0254)	(0.0383)	(0.0296)	(0.0261)	(0.0481)
Father information missing	-0.0167	-0.0013	-0.0356**	0.0008	0.0033	-0.0102
	(0.0112)	(0.0095)	(0.0161)	(0.0136)	(0.0124)	(0.0291)
Secondary school in village	-0.0386	-0.0174	-0.0645	-0.0208	-0.0327	0.0446
	(0.0309)	(0.0250)	(0.0395)	(0.0325)	(0.0285)	(0.0522)
Floor: Cement	0.0190	0.0274	-0.0429	-0.0030	-0.0209	0.0777
	(0.0386)	(0.0291)	(0.0457)	(0.0381)	(0.0338)	(0.0630)
Roof: Tin	0.0165	0.0250	-0.0154	-0.0211	-0.0206	0.0072
	(0.0363)	(0.0301)	(0.0517)	(0.0461)	(0.0407)	(0.0741)
Roof: Asbestos	0.0085	0.0039	-0.0009	-0.0011	0.0002	-0.0163
	(0.0279)	(0.0214)	(0.0329)	(0.0348)	(0.0306)	(0.0521)
Roof: Tiles	0.0347	0.0366	-0.0008	-0.0063	0.0010	-0.0294
	(0.0335)	(0.0265)	(0.0371)	(0.0250)	(0.0227)	(0.0449)
Roof: Cement blocks	-0.0291	-0.0173	-0.0432	0.0518	0.0202	0.1487***
	(0.0246)	(0.0174)	(0.0280)	(0.0354)	(0.0304)	(0.0497)
Observations	5,387	9,155		3,295	4,153	

Notes. We report differences of means and standard deviations (in parentheses) of variables between treated and control villages. T-test for differences between (differences of) means are performed. * : $p < 0.10$; **: $p < 0.05$; ***: $p < 0.01$.

Table S.5: Effect of PROGRESA transfers on eligible and ineligible children

Dependent variable: change in attendance for	Eligible children	Ineligible children
Village with PROGRESA	0.0546***	0.0213*
	(0.0100)	(0.0118)
Girl	-0.0026	-0.0024
	(0.0095)	(0.0115)
Completed grade 4	-0.0148	-0.0129
	(0.0091)	(0.0110)
Completed grade 5	-0.1617***	-0.1645***
	(0.0140)	(0.0169)
Completed grade 6	0.0381***	0.0255*
	(0.0123)	(0.0133)
Mother's education: Primary school or higher	-0.0105	0.0069
	(0.0104)	(0.0120)
Father's education: Primary school or higher	0.0184*	0.0298**
	(0.0104)	(0.0131)
Father information missing	-0.0079	-0.0182
	(0.0176)	(0.0186)
Floor: Cement	-0.0005	0.0035
	(0.0121)	(0.0135)
Roof: Tin	0.0035	0.0074
	(0.0125)	(0.0189)
Roof: Asbestos	0.0259	0.0045
	(0.0159)	(0.0214)
Roof: Tiles	-0.0017	0.0038
	(0.0183)	(0.0259)
Roof: Cement blocks	0.0033	0.0057
	(0.0180)	(0.0209)
Secondary school in village	-0.0128	-0.0400***
	(0.0103)	(0.0124)
Constant	-0.0497*	-0.0013
	(0.0274)	(0.0404)
State effects	Yes	Yes
Observations	5,387	3,295

Notes. Standard errors are clustered at the village level. * : $p < 0.10$; **: $p < 0.05$; ***: $p < 0.01$.

Table S.6: Externalities of PROGRESA for eligible and ineligible children
- complete set of control variables -

	Panel (a)		*Panel (b)*	
Dependent variable: change in attendance for	Eligible children		Ineligible children	
	(1) IV	(2) LIML	(3) IV	(4) LIML
Change in peer group attendance for				
Ineligible children	0.8874**	1.0761**	0.8750***	0.8536***
	(0.4117)	(0.4404)	(0.3001)	(0.3067)
Eligible children	0.7343*	0.7290*	0.3966*	0.3781*
	(0.4077)	(0.4286)	(0.2376)	(0.2242)
Village with PROGRESA	0.0232*	0.0228*		
	(0.0135)	(0.0131)		
Girl	-0.0008	-0.0008	0.0053	0.0039
	(0.0106)	(0.0106)	(0.0103)	(0.0103)
Completed grade 4	-0.0107	-0.0093	-0.0004	0.0008
	(0.0077)	(0.0079)	(0.0079)	(0.0079)
Completed grade 5	-0.0298	-0.0182	-0.0637*	-0.0712*
	(0.0454)	(0.0479)	(0.0359)	(0.0371)
Completed grade 6	0.0136	0.0130	0.0061	0.0065
	(0.0145)	(0.0149)	(0.0103)	(0.0104)
Mother's education: Primary school or higher	-0.0076	-0.0064	0.0041	0.0082
	(0.0106)	(0.0107)	(0.0113)	(0.0115)
Father's education: Primary school or higher	0.0094	0.0079	0.0335**	0.0285**
	(0.0118)	(0.0119)	(0.0140)	(0.0142)
Father information missing	-0.0019	0.0019	-0.0235	-0.0235
	(0.0154)	(0.0157)	(0.0168)	(0.0168)
Floor: Cement	0.0013	0.0012	0.0046	0.0047
	(0.0119)	(0.0119)	(0.0126)	(0.0126)
Roof: Tin	0.0120	0.0135	0.0018	0.0035
	(0.0133)	(0.0133)	(0.0183)	(0.0184)
Roof: Asbestos	0.0292**	0.0252*	0.0029	0.0018
	(0.0148)	(0.0151)	(0.0202)	(0.0203)
Roof: Tiles	0.0140	0.0156	0.0103	0.0077
	(0.0176)	(0.0177)	(0.0231)	(0.0231)
Roof: Cement blocks	0.0036	0.0045	0.0073	0.0090
	(0.0168)	(0.0168)	(0.0190)	(0.0190)
Secondary school in village	-0.0153	-0.0144	-0.0310**	-0.0297**
	(0.0104)	(0.0104)	(0.0133)	(0.0133)
Constant	-0.0340	-0.0354	-0.0132	-0.0025
	(0.0243)	(0.0245)	(0.0387)	(0.0390)
State effects	Yes	Yes	Yes	Yes
Observations	5,387	5,387	3,295	3,295

Notes. Standard errors are clustered at the village level. * : $p < 0.10$; **: $p < 0.05$; ***: $p < 0.01$. See notes to Table 2.

Table S.7: Externalities of PROGRESA for eligible and ineligible children
- alternative set of instruments -

	Panel (a)		*Panel (b)*	
Dependent variable: change in attendance for	Eligible children		Ineligible children	
	(1) IV	(2) LIML	(3) IV	(4) LIML
Change in peer group attendance for				
Ineligible children	0.7298*	0.8448*	0.9039***	0.9096***
	(0.4210)	(0.4413)	(0.2664)	(0.2689)
Eligibles children	0.5909*	0.5944*	0.4581**	0.4599**
	(0.3125)	(0.3243)	(0.2201)	(0.2232)
Village with PROGRESA	0.0291**	0.0290**		
	(0.0124)	(0.0128)		
Girl	-0.0013	-0.0012	0.0044	0.0045
	(0.0105)	(0.0106)	(0.0103)	(0.0103)
Completed grade 4	-0.0117	-0.0104	0.0016	0.0016
	(0.0077)	(0.0078)	(0.0079)	(0.0079)
Completed grade 5	-0.0553	-0.0469	-0.0600*	-0.0594*
	(0.0378)	(0.0394)	(0.0327)	(0.0331)
Completed grade 6	0.0193	0.0178	0.0049	0.0049
	(0.0129)	(0.0131)	(0.0100)	(0.0100)
Mother's education: Primary school or higher	-0.0083	-0.0071	0.0081	0.0081
	(0.0106)	(0.0108)	(0.0115)	(0.0115)
Father's education: Primary school or higher	0.0113	0.0100	0.0279**	0.0279**
	(0.0118)	(0.0119)	(0.0142)	(0.0142)
Father information missing	-0.0028	0.0001	-0.0248	-0.0249
	(0.0149)	(0.0151)	(0.0169)	(0.0169)
Floor: Cement	0.0007	0.0008	0.0054	0.0055
	(0.0117)	(0.0117)	(0.0124)	(0.0124)
Roof: Tin	0.0106	0.0114	0.0026	0.0026
	(0.0132)	(0.0134)	(0.0182)	(0.0182)
Roof: Asbestos	0.0300**	0.0253*	-0.0001	-0.0002
	(0.0147)	(0.0151)	(0.0199)	(0.0199)
Roof: Tiles	0.0100	0.0122	0.0075	0.0075
	(0.0180)	(0.0182)	(0.0227)	(0.0227)
Roof: Cement blocks	0.0027	0.0042	0.0085	0.0085
	(0.0171)	(0.0172)	(0.0190)	(0.0190)
Secondary school in village	-0.0157	-0.0141	-0.0288**	-0.0288**
	(0.0102)	(0.0105)	(0.0132)	(0.0132)
Constant	-0.0336	-0.0380	-0.0031	-0.0032
	(0.0251)	(0.0255)	(0.0377)	(0.0376)
State effects	Yes	Yes	Yes	Yes
Observations	5,387	5,387	3,295	3,295

Notes. Standard errors are clustered at the village level. * : $p < 0.10$; **: $p < 0.05$; ***: $p < 0.01$. See notes to Table 2.

Table S.8: Externalities of PROGRESA for eligible and ineligible children
- model specification with contextual treatment effects -

	Panel (a)		*Panel (b)*	
Dependent variable: change in attendance for	Eligible children		Ineligible children	
	(1)	(2)	(3)	(4)
	IV	LIML	IV	LIML
Change in peer group attendance for				
Ineligible children	0.9977**	1.1720**	1.2064***	1.2378***
	(0.4322)	(0.4710)	(0.1924)	(0.2298)
Eligible children	0.7486**	0.7583*	0.6803***	0.7629***
	(0.3812)	(0.4052)	(0.2444)	(0.2546)
Share of eligible children in the village	-0.0187	-0.0231	-0.0265	-0.0331*
	(0.0270)	(0.0288)	(0.0175)	(0.0182)
Village with PROGRESA	0.0336**	0.0340**		
	(0.0136)	(0.0141)		
Girl	0.0015	0.0024	0.0070	0.0080
	(0.0099)	(0.0099)	(0.0103)	(0.0104)
Completed grade 4	-0.0041	-0.0035	0.0022	0.0042
	(0.0071)	(0.0072)	(0.0072)	(0.0072)
Completed grade 5	-0.0213	-0.0082	0.0111	0.0196
	(0.0406)	(0.0428)	(0.0321)	(0.0353)
Completed grade 6	0.0138	0.0113	-0.0040	-0.0043
	(0.0136)	(0.0141)	(0.0096)	(0.0098)
Mother's education: Primary school or higher	-0.0096	-0.0086	0.0026	0.0071
	(0.0104)	(0.0104)	(0.0115)	(0.0117)
Father's education: Primary school or higher	0.0122	0.0101	0.0254*	0.0218
	(0.0110)	(0.0112)	(0.0147)	(0.0148)
Father information missing	-0.0125	-0.0123	-0.0375**	-0.0380**
	(0.0169)	(0.0169)	(0.0173)	(0.0185)
Floor: cement	0.0010	0.0009	0.0131	0.0126
	(0.0114)	(0.0115)	(0.0129)	(0.0130)
Roof: tin	0.0113	0.0121	-0.0063	-0.0050
	(0.0132)	(0.0132)	(0.0177)	(0.0178)
Roof: Asbestos	0.0253*	0.0237	-0.0133	-0.0144
	(0.0144)	(0.0145)	(0.0195)	(0.0197)
Roof: Tiles	0.0110	0.0112	0.0055	0.0033
	(0.0169)	(0.0170)	(0.0213)	(0.0214)
Roof: Cement blocks	0.0059	0.0072	0.0003	-0.0008
	(0.0164)	(0.0164)	(0.0188)	(0.0188)
Secondary school in village	-0.0154	-0.0142	-0.0255*	-0.0229*
	(0.0102)	(0.0105)	(0.0132)	(0.0137)
Constant	-0.0339	-0.0324	0.0076	0.0138
	(0.0217)	(0.0220)	(0.0321)	(0.0318)
State Effects	Yes	Yes	Yes	Yes
F-test for ineligible children' equation	7.23		7.3	
F-test for eligible children' equation	6.51		9.65	
Observations	5,387	5,387	3,295	3,295

Notes. Standard errors are clustered at the village level. * : $p < 0.10$; **: $p < 0.05$; ***: $p < 0.01$. See notes to Table 2.

Table S.9: Externalities of PROGRESA for eligible and ineligible children
- model specification with contextual effects -

	Panel (a)		*Panel (b)*	
Dependent variable: change in attendance for	Eligible children		Ineligible children	
	(1) IV	(2) LIML	(3) IV	(4) LIML
Change in peer group attendance for				
Ineligible children	0.8897**	1.0843**	1.3003***	1.3020***
	(0.4235)	(0.4655)	(0.2376)	(0.2614)
Eligible children	0.7887**	0.7906**	0.7965***	0.8164***
	(0.3657)	(0.3908)	(0.2878)	(0.3011)
Share of eligible Children in the village	-0.0393	-0.0411	-0.0269	-0.0283
	(0.0280)	(0.0297)	(0.0200)	(0.0206)
Village with PROGRESA	0.0436*	0.0427*		
	(0.0238)	(0.0258)		
Girl	0.0012	0.0022	0.0064	0.0072
	(0.0099)	(0.0099)	(0.0102)	(0.0103)
Completed grade 4	-0.0043	-0.0037	0.0032	0.0046
	(0.0068)	(0.0068)	(0.0083)	(0.0084)
Completed grade 5	-0.0253	-0.0115	-0.0025	-0.0007
	(0.0395)	(0.0417)	(0.0356)	(0.0383)
Completed grade 6	0.0142	0.0110	-0.0096	-0.0088
	(0.0133)	(0.0138)	(0.0114)	(0.0118)
Mother's education: Primary school or higher	-0.0085	-0.0077	0.0055	0.0089
	(0.0103)	(0.0103)	(0.0118)	(0.0119)
Father's education: Primary school or higher	0.0119	0.0101	0.0308**	0.0283*
	(0.0114)	(0.0115)	(0.0152)	(0.0152)
Father information missing	-0.0125	-0.0124	-0.0321*	-0.0322*
	(0.0167)	(0.0167)	(0.0172)	(0.0180)
Floor: cement	0.0011	-0.0002	0.0104	0.0101
	(0.0125)	(0.0127)	(0.0139)	(0.0140)
Roof: tin	0.0108	0.0125	-0.0050	-0.0015
	(0.0154)	(0.0155)	(0.0216)	(0.0218)
Roof: Asbestos	0.0309*	0.0287*	-0.0122	-0.0122
	(0.0160)	(0.0161)	(0.0224)	(0.0227)
Roof: Tiles	0.0287	0.0285	0.0017	-0.0017
	(0.0199)	(0.0200)	(0.0268)	(0.0271)
Roof: Cement blocks	0.0224	0.0226	-0.0024	-0.0029
	(0.0176)	(0.0177)	(0.0218)	(0.0220)
Roof: Cement blocks	0.0170	0.0174	-0.0061	-0.0050
	(0.0177)	(0.0178)	(0.0220)	(0.0221)
Secondary school in village	-0.0143	-0.0139	-0.0274**	-0.0262*
	(0.0108)	(0.0108)	(0.0132)	(0.0135)
Fraction of girls in the group			0.0030	0.0042
			(0.0294)	(0.0297)
Fraction of children in the group with				
Father's education: Primary school or higher	0.0051	0.0009	-0.0503	-0.0516
	(0.0219)	(0.0222)	(0.0291)	(0.0299)
Floor: cement	0.0109	0.0162	-0.0168	-0.0217
	(0.0249)	(0.0258)	(0.0255)	(0.0259)
Roof: tin	-0.0038	-0.0073	0.0036	0.0033
	(0.0248)	(0.0252)	(0.0284)	(0.0289)
Roof: Asbestos	-0.0203	-0.0174	0.0127	0.0117
	(0.0283)	(0.0285)	(0.0331)	(0.0334)
Roof: Tiles	-0.0502	-0.0502	0.0098	0.0133
	(0.0320)	(0.0330)	(0.0329)	(0.0331)
Roof: Cement blocks	-0.0929**	-0.0913**	0.0655*	0.0690*
	(0.0369)	(0.0378)	(0.0386)	(0.0392)
Constant	0.0124	0.0139	0.0135	0.0179
	(0.0296)	(0.0299)	(0.0413)	(0.0414)
State Effects	Yes	Yes	Yes	Yes
F-test for eligible children' equation	6.32		6.03	
F-test for ineligible children' equation	6.27		6.66	
Observations	5,387	5,387	3,295	3,295

Notes. Standard errors are clustered at the village level. * : $p < 0.10$; **: $p < 0.05$; ***: $p < 0.01$. See notes to Table 2.

Table S.10: Externalities of PROGRESA for eligible and ineligible children
- model specification with heterogeneous contextual effects -

	Panel (a)		*Panel (b)*	
Dependent variable: change in attendance for	Eligible children		Ineligible children	
	(1) IV	(2) LIML	(3) IV	(4) LIML
Change in peer group attendance for				
Ineligible children	0.8025*	1.0515**	1.3671***	1.4185***
	(0.4553)	(0.5191)	(0.2514)	(0.2672)
Eligible children	0.8081**	0.8055**	0.5749*	0.6466*
	(0.3534)	(0.3836)	(0.3384)	(0.3593)
Share of eligible Children in the village	-0.0292	-0.0332	-0.0137	-0.0221
	(0.0370)	(0.0373)	(0.0243)	(0.0255)
Village with PROGRESA	0.0404	0.0406		
	(0.0270)	(0.0274)		
Girl	0.0007	0.0022	0.0048	0.0072
	(0.0099)	(0.0100)	(0.0102)	(0.0102)
Completed grade 4	-0.0040	-0.0030	0.0003	0.0021
	(0.0067)	(0.0068)	(0.0077)	(0.0078)
Completed grade 5	-0.0299	-0.0131	-0.0185	-0.0099
	(0.0392)	(0.0418)	(0.0375)	(0.0402)
Completed grade 6	0.0136	0.0101	-0.0064	-0.0076
	(0.0129)	(0.0135)	(0.0111)	(0.0115)
Mother's education: Primary school or higher	-0.0084	-0.0075	0.0034	0.0080
	(0.0103)	(0.0104)	(0.0115)	(0.0118)
Father's education: Primary school or higher	0.0126	0.0110	0.0307**	0.0275*
	(0.0115)	(0.0116)	(0.0150)	(0.0152)
Father information missing	-0.0129	-0.0124	-0.0295*	-0.0318*
	(0.0168)	(0.0169)	(0.0175)	(0.0181)
Floor: cement	0.0017	0.0006	0.0098	0.0104
	(0.0125)	(0.0126)	(0.0138)	(0.0139)
Roof: tin	0.0107	0.0127	-0.0028	0.0013
	(0.0154)	(0.0155)	(0.0199)	(0.0201)
Roof: Asbestos	0.0285*	0.0259*	-0.0124	-0.0104
	(0.0149)	(0.0150)	(0.0222)	(0.0224)
Roof: Tiles	0.0261	0.0253	0.0004	-0.0003
	(0.0198)	(0.0198)	(0.0267)	(0.0269)
Roof: Cement blocks	0.0176	0.0179	-0.0023	-0.0020
	(0.0180)	(0.0181)	(0.0212)	(0.0213)
Secondary school in village	-0.0143	-0.0139	-0.0308**	-0.0266**
	(0.0108)	(0.0108)	(0.0131)	(0.0133)

Fraction of girls for eligible children			0.0436	0.0401
			(0.0380)	(0.0388)
Fraction of girls for ineligible children			0.0077	0.0126
			(0.0298)	(0.0301)
Fraction of eligible children with				
Father's education: Primary school or higher	0.0117	-0.0040	-0.0779	-0.0862
	(0.0434)	(0.0453)	(0.0489)	(0.0501)
Floor: cement	0.0304	0.0505	-0.0164	-0.0150
	(0.0529)	(0.0567)	(0.0412)	(0.0414)
Roof: tin	0.0006	-0.0122	-0.0100	-0.0029
	(0.0495)	(0.0507)	(0.0348)	(0.0356)
Roof: Asbestos	0.0015	0.0042	0.0017	0.0082
	(0.0495)	(0.0503)	(0.0411)	(0.0417)
Roof: Tiles	-0.0307	-0.0237	-0.0176	-0.0117
	(0.0368)	(0.0379)	(0.0443)	(0.0447)
Roof: Cement blocks	-0.0093	-0.0059	-0.0102	-0.0055
	(0.0516)	(0.0519)	(0.0456)	(0.0463)
Fraction of ineligible children with				
Father's education: Primary school or higher	-0.0145	-0.0164	-0.0092	-0.0153
	(0.0259)	(0.0262)	(0.0314)	(0.0318)
Floor: cement	-0.0197	-0.0223	-0.0012	-0.0144
	(0.0329)	(0.0335)	(0.0272)	(0.0281)
Roof: tin	-0.0111	-0.0114	0.0133	0.0050
	(0.0343)	(0.0353)	(0.0539)	(0.0557)
Roof: Asbestos	-0.0532	-0.0687	0.0216	0.0162
	(0.0555)	(0.0571)	(0.0617)	(0.0632)
Roof: Tiles	-0.0307	-0.0237	-0.0176	-0.0117
	(0.0368)	(0.0379)	(0.0443)	(0.0447)
Roof: Cement blocks	-0.1412**	-0.1485**	0.0950**	0.1061**
	(0.0625)	(0.0636)	(0.0479)	(0.0499)
Constant	0.0074	0.0107	0.0067	0.0102
	(0.0284)	(0.0288)	(0.0373)	(0.0373)
State Effects	Yes	Yes	Yes	Yes
F-test for eligible children' equation	6.1		5.6	
F-test for ineligible children' equation	6		5.7	
Observations	5,387	5,387	3,295	3,295

Notes. Standard errors are clustered at the village level. * : $p < 0.10$; **: $p < 0.05$; ***: $p < 0.01$. See notes to Table 2.

Table S.11: Externalities of PROGRESA for eligible and ineligible children - first stage and IV reduced form -

	Panel (a) Eligible equation			*Panel (a)* Ineligible equation		
Dependent variable	Change in peer group attendance Ineligible children	Change in peer group attendance Eligible children	Change in school attendance	Change in peer group attendance Ineligible children	Change in peer group attendance Eligible children	Change in school attendance
q_{Ef1}	0.0455***	0.0444**	0.1051**			
	(0.0174)	(0.0217)	(0.0482)			
q_{Ef3}	0.0722	-0.4416***	-0.0881			
	(0.1244)	(0.1246)	(0.2531)			
q_{EN3}	-1.1429**	-1.1433***	-1.4256			
	(0.5541)	(0.4225)	(0.9819)			
q_{EN4}	0.7112**	0.8563***	1.2112**			
	(0.3139)	(0.3062)	(0.6154)			
q_{NE3}				0.0349***	0.0652***	0.0343
				(0.0128)	(0.0238)	(0.0404)
q_{N1}				-0.2477***	-0.0664	-0.3229**
				(0.0838)	(0.0690)	(0.1535)
q_{N4}				1.0148***	0.7413**	1.7825**
				(0.3907)	(0.3613)	(0.7520)
Village with PROGRESA	-0.0059	0.0093	0.0183			
	(0.0078)	(0.0128)	(0.0200)			
Girl	-0.0385**	0.0263*	-0.0567	-0.0042	-0.0026	-0.0015
	(0.0170)	(0.0146)	(0.0367)	(0.0028)	(0.0039)	(0.0116)
Completed grade 4	-0.0011	-0.0035	-0.0129	0.0023	-0.0097	-0.0131
	(0.0042)	(0.0053)	(0.0094)	(0.0050)	(0.0064)	(0.0121)
Completed grade 5	-0.0676***	-0.0955***	-0.1611***	-0.0657***	-0.0976***	-0.1627***
	(0.0088)	(0.0132)	(0.0197)	(0.0091)	(0.0109)	(0.0203)
Completed grade 6	0.0059	0.0268***	0.0380**	0.0088	0.0163*	0.0247*
	(0.0057)	(0.0096)	(0.0154)	(0.0071)	(0.0093)	(0.0149)
Mother's education: Primary school or higher	0.0016	-0.0067*	-0.0097	0.0004	0.0014	0.0124
	(0.0034)	(0.0036)	(0.0118)	(0.0036)	(0.0048)	(0.0123)
Father's education: Primary school or higher	0.0049	0.0088**	0.0197	0.0058	0.0040	0.0330**
	(0.0031)	(0.0044)	(0.0124)	(0.0038)	(0.0052)	(0.0136)
Father information missing	-0.0014	-0.0106*	-0.0072	0.0113**	0.0104	-0.0187
	(0.0049)	(0.0060)	(0.0167)	(0.0053)	(0.0065)	(0.0188)
Floor: Cement	0.0002	-0.0010	0.0008	-0.0078**	-0.0035	0.0003
	(0.0035)	(0.0042)	(0.0123)	(0.0038)	(0.0054)	(0.0149)
Roof: Tin	-0.0073*	-0.0036	0.0035	0.0028	0.0083	0.0150
	(0.0040)	(0.0059)	(0.0145)	(0.0056)	(0.0070)	(0.0210)
Roof: Asbestos	-0.0010	0.0008	0.0235	0.0134**	0.0143	-0.0137
	(0.0044)	(0.0075)	(0.0175)	(0.0067)	(0.0089)	(0.0228)
Roof: Tiles	-0.0048	-0.0184	-0.0033	0.0133	-0.0058	-0.0037
	(0.0076)	(0.0171)	(0.0276)	(0.0082)	(0.0123)	(0.0333)
Roof: Cement blocks	0.0002	-0.0018	0.0023	0.0117**	-0.0018	-0.0023
	(0.0058)	(0.0083)	(0.0204)	(0.0053)	(0.0084)	(0.0215)
Secondary school in village	0.0015	0.0005	-0.0128	-0.0067*	-0.0055	-0.0419***
	(0.0034)	(0.0040)	(0.0116)	(0.0037)	(0.0046)	(0.0132)
Constant	-0.0027	-0.0173	-0.0477	0.0045	-0.0297	-0.0189
	(0.0158)	(0.0258)	(0.0390)	(0.0196)	(0.0234)	(0.0224)
State effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5,387	5,387	5,387	3,295	3,295	3,295

Notes. Standard errors are clustered at the village level. * : $p < 0.10$; **: $p < 0.05$; ***: $p < 0.01$. See notes to Table 2. The IV vectors (q) are defined above.

Table S.12: Externalities of PROGRESA for eligible and ineligible children - alternative set of instruments - first stage and IV reduced form

	Panel (a) Eligible equation			*Panel (a)* Ineligible equation		
Dependent variable	Change in peer group attendance Ineligible children	Change in peer group attendance Eligible children	Change in school attendance	Change in peer group attendance Ineligible children	Change in peer group attendance Eligible children	Change in school attendance
q_{Ef2}	0.9436	5.3071***	0.1719*			
	(1.4318)	(1.6555)	(0.0943)			
q_{Ef3}	-0.1759	-0.5633***	-0.1844			
	(0.1299)	(0.1506)	(0.3298)			
q_{E4f}	0.3003*	-0.1296	-0.4055			
	(0.1652)	(0.2058)	(0.6946)			
q_{EN4}	-0.4784*	-0.2667	-0.0820			
	(0.2517)	(0.1718)	(0.4436)			
q_{EN2}	0.2200**	0.2237**	0.3033**			
	(0.0891)	(0.1074)	(0.1514)			
q_{NE1}				0.0194***	0.0323***	0.0222
				(0.0068)	(0.0119)	(0.0203)
q_{N1}				-0.2255***	-0.0289	-0.2976*
				(0.0826)	(0.0719)	(0.1567)
q_{N4}				0.8434**	0.4490	1.5906**
				(0.3843)	(0.3721)	(0.7670)
Village with PROGRESA	-0.0185	-0.0002	0.0042			
	(0.0119)	(0.0186)	(0.0294)			
Girl	0.0097	0.0890***	-0.0790	-0.0042	-0.0028	-0.0017
	(0.0192)	(0.0194)	(0.0812)	(0.0028)	(0.0039)	(0.0116)
Completed grade 4	-0.0010	-0.0032	-0.0132	0.0026	-0.0093	-0.0125
	(0.0042)	(0.0054)	(0.0094)	(0.0050)	(0.0064)	(0.0120)
Completed grade 5	-0.0678***	-0.0957***	-0.1614***	-0.0656***	-0.0976***	-0.1625***
	(0.0088)	(0.0132)	(0.0197)	(0.0091)	(0.0109)	(0.0203)
Completed grade 6	0.0058	0.0252***	0.0364**	0.0092	0.0167*	0.0253*
	(0.0057)	(0.0095)	(0.0153)	(0.0071)	(0.0093)	(0.0149)
Mother's education: Primary school or higher	0.0015	-0.0065*	-0.0093	0.0004	0.0013	0.0124
	(0.0035)	(0.0036)	(0.0118)	(0.0036)	(0.0048)	(0.0123)
Father's education: Primary school or higher	0.0048	0.0080*	0.0189	0.0059	0.0042	0.0332**
	(0.0031)	(0.0044)	(0.0125)	(0.0038)	(0.0052)	(0.0136)
Father information missing	-0.0013	-0.0102*	-0.0067	0.0111**	0.0100	-0.0189
	(0.0050)	(0.0059)	(0.0166)	(0.0052)	(0.0064)	(0.0188)
Floor: Cement	0.0002	-0.0009	0.0009	-0.0077**	-0.0034	0.0005
	(0.0035)	(0.0042)	(0.0122)	(0.0037)	(0.0053)	(0.0149)
Roof: Tin	-0.0078*	-0.0036	0.0040	0.0025	0.0077	0.0147
	(0.0040)	(0.0059)	(0.0145)	(0.0056)	(0.0070)	(0.0210)
Roof: Asbestos	-0.0010	0.0009	0.0237	0.0134**	0.0143	-0.0136
	(0.0044)	(0.0074)	(0.0174)	(0.0067)	(0.0089)	(0.0229)
Roof: Tiles	-0.0053	-0.0179	-0.0027	0.0129	-0.0066	-0.0039
	(0.0076)	(0.0170)	(0.0274)	(0.0083)	(0.0123)	(0.0333)
Roof: Cement blocks	-0.0002	-0.0025	0.0019	0.0117**	-0.0021	-0.0023
	(0.0058)	(0.0083)	(0.0204)	(0.0053)	(0.0083)	(0.0215)
Secondary school in village	0.0012	-0.0005	-0.0137	-0.0063*	-0.0048	-0.0412***
	(0.0035)	(0.0038)	(0.0116)	(0.0037)	(0.0046)	(0.0132)
Constant	-0.0034	-0.0179	-0.0479	0.0024	-0.0308	-0.0218
	(0.0152)	(0.0258)	(0.0391)	(0.0194)	(0.0236)	(0.0222)
State effects (7)	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5,387	5,387	5,387	3,295	3,295	3,295

Notes. Standard errors are clustered at the village level. * : $p < 0.10$; **: $p < 0.05$; ***: $p < 0.01$. See notes to Table 2.

Figure S.1: Distribution of peer groups by share of eligible households

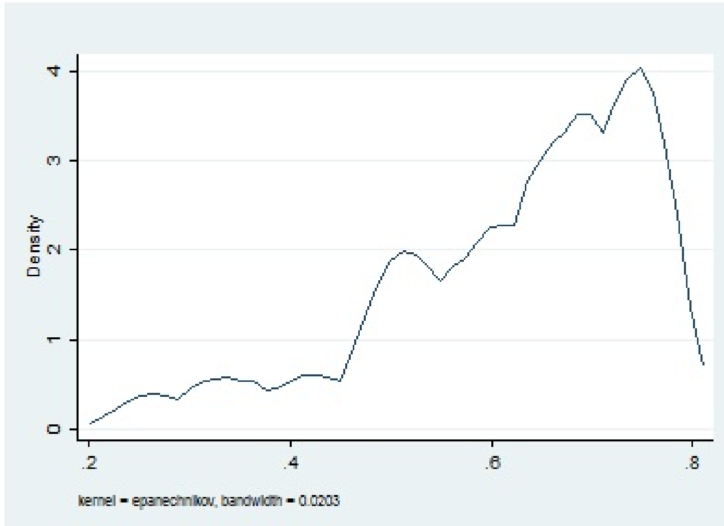
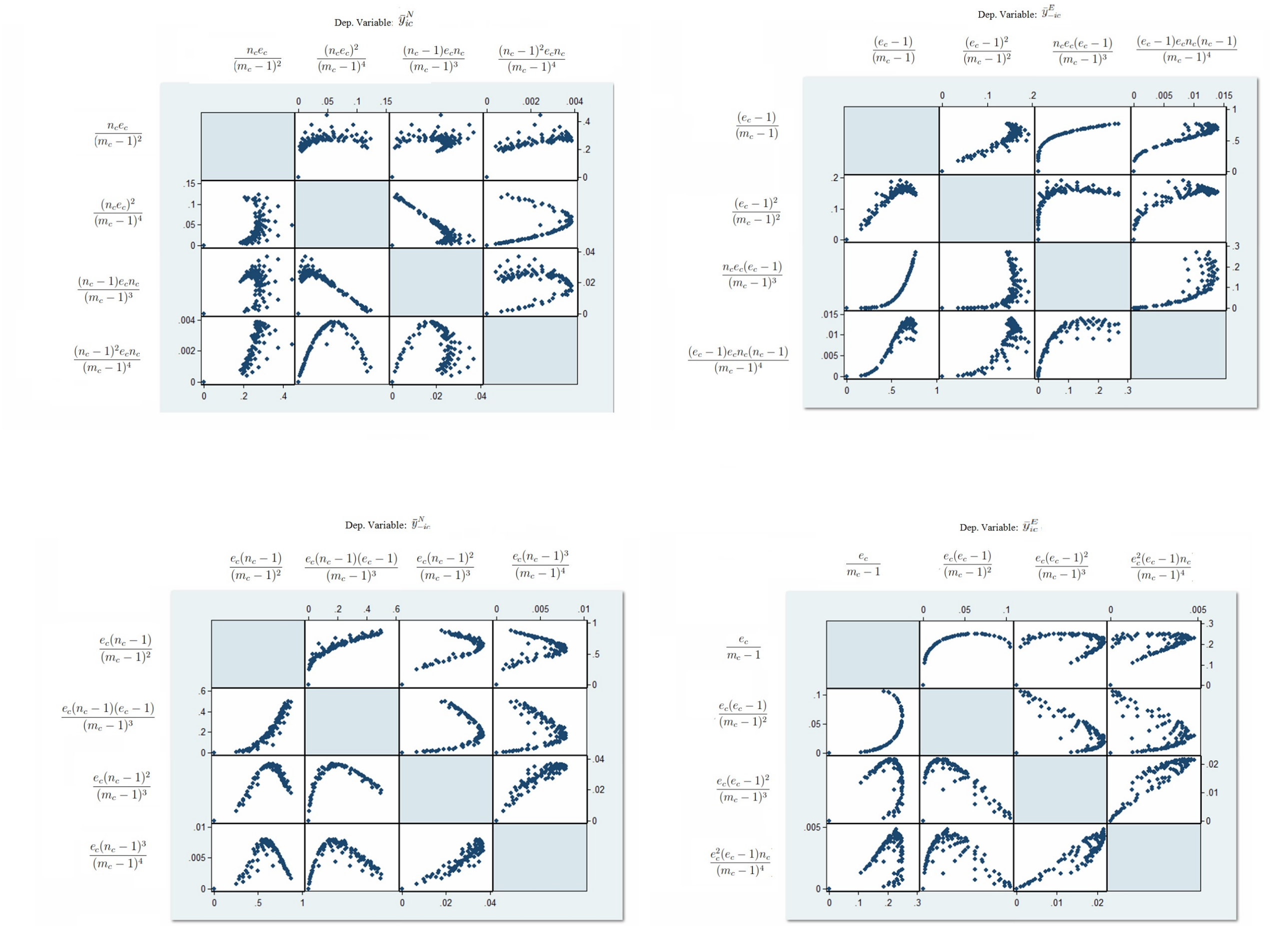


Figure S.2: Empirical non-linearity of eligible and ineligible households IVs



Notes. The empirical instruments are the same used in the Monte Carlo simulations. The formula used to construct the four vectors are represented in (12)-(15).

References

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