The Long-run Human Capital Impacts of Public Childcare Programs in Developing Countries*

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March 1, 2024

Abstract

This paper provides the first evidence that daycare programs through community nurseries in developing countries improve children's long-run outcomes. Using quasi-experimental variation from the expansion of the Colombian program *Hogares Comunitarios de Bienestar (HCBs)* at the zip-code level for the city of Bogota, we show that program had strong positive effects on children's educational attainment, achievement scores, and access to tertiary education. Preliminary analysis also show important gains in labor market outcomes. Our results hold after controlling for mother a fixed effect. Subsample analyses indicate that children from low-income families benefited the most from the intervention. For mothers, the program increased labor force attachment, especially among single mothers.

Keywords: Child care, Poverty, Education, Developing Countries.
JEL codes: J13, I25, I30, I18.

*We would like to thank Jorge Caputo for providing excellent research assistance. All remaining errors are our own. Contact emails: Duque, vduque@american.edu; Sanchez, fasanche@uniandes.edu.co

1 Introduction

Children growing up in poverty can face a life a deprivation (Almond et al. 2018). This is particularly worrisome in developing countries where children receive fewer investments in human capital compared to those in rich nations (Currie and Vogel 2013; Black et al. 2016; Attanasio et al. 2022, Schady et al. 2015). Early childhood investments have proven to help break such developmental trajectories (Berlinski and Schady 2015; Gertler et al. 2014; Walker et al. 2011), yet there is little evidence on whether these interventions have sustained effects.

This paper analyses the long-run effects of public childcare on children's outcomes up to age 25. One of the first examples of public childcare in the developing world is Colombia's Hogares Comunitarios de Bienestar (HCB), established in 1987, aimed to enhance mothers' labor force participation through the provision of childcare, including nutrition and stimulation to pre-school children. According to Bernal and Fernandez (2013), three central features of the modern version of the HCB program are provision of supplemental nutrition (50% to 70% of the daily allowance), and the promotion of children's physical growth, health, social and cognitive development. Participating parents are required to pay a monthly fee not higher than 25% of daily minimum wage (aprox. $2 USD). HCBs are led by a "communitarian mother", a home-based childcare provider in the same community. Each childcare home serves up to 14 children between the ages of 6 months to 5 years in part-time or full-time schedules during weekdays. However, when the program started it had no concrete curriculum, other than some general operational guidelines and basic learning standards, and the communitarian mother was not required to have more than a primary education. However, an evaluation of the program reported that in the majority of HCBs the food was not prepared adequately, the houses were often in poor condition and in over 25% of the homes, the community mothers did not plan any pedagogical activities (WHO, 1999).

The long-run evaluation of HCB has been limited by a lack of detailed information on when the program started across different municipalities in the country.

Because HCB began operating prior to the Colombian Constitution of 1991, the government agency responsible for the program (i.e., the Child and Family Welfare Agency or ICBF in Spanish), was not required to report to Congress detailed accountability records of its operation (Bernal 1991; del Castillo 2008). And given that the program has been in place for over three decades, a credible experimental evaluation of HCB is not feasible. Despite these challenges, researchers have been able to exploit quasi-experimental variation in exposure to the program. Attanasio et al. (2013), for instance, use an instrumental variables strategy to correct for selection into the program using as instruments distance to an HCB-center, fees, and town-level infrastructure capacity to show that the program substantially improved children's nutritional status, especially for those in rural areas. Bernal and Fernandez (2013) use a propensity score matching strategy comparing children exposed for different lengths of time to the program and show that HCB helped improve the cognitive and non-cognitive outcomes of children treated for longer periods.

We use a new empirical strategy to inform about the sustained effects of the program. We leverage detailed information from the first wave of the "Census of the Poor" (SISBEN) to infer the expansion of HCB centers across neighborhoods. The first SISBEN wave was collected from 1994 to 2001. These data are unique by having information on HCB-take up and exact home address of a family.

Our dataset thus links four waves of the Census of the Poor – the instrument through which the government targets welfare programs (e.g., conditional cash transfers, subsidized healthcare, etc.) – for the city of Bogota, into a panel dataset of low-income families that are observed in the early- or mid-1990s (baseline), 2005 (wave II), 2010 (wave III), and 2019-20 (wave IV). The baseline wave of the Census of the Poor includes detailed demographic and socioeconomic variables, and most importantly, the zip code of residence and whether a child was enrolled at the time in HCB vs. another childcare /private preschool vs. was taken care at home by a family member. We identify neighborhoods that switch from not having an HCB center in a year to having one in the next year. Our sample includes 140 zip codes

(out of 596 neighborhoods in Bogota in 1993) that opened an HCB center from 1995 to 1999. All other zip codes either had an HCB (51%) or did not open one during the SISBEN years (10%).

We investigate the long-run effects of HCB by using a staggered difference-indifference model that compares the outcomes of children differentially exposed to HCB before age 6, after controlling for temporal and geographic fixed effects as well as individual and family characteristics. Through this model we address recent econometric concerns with staggered difference-in-differences research designs by showing nessness to the use of a variety of alternative estimators (Roth et al. 2022). In addition, we use a mother fixed-effects strategy that compares the outcomes of siblings who were differentially exposed to the program in their neighborhood of residence due to the opening of a new HCB.

We link a panel of four SISBEN waves to school records, test score data, and tertiary education to analyze HCB-effects on children's outcomes from childhood up to age 25. Our outcomes include educational attainment and achievement scores, college entrance, teen pregnancy, family formation, asset ownership, welfare eligibility, mobility, and labor market outcomes. For mothers, we examine fertility and employment. Because we have data on program take-up and more specifically whether a child attended HCB, private childcare, or no childcare at all (stayed at home with the mother, for instance), we can compare the effects of HCB to these two counterfactuals, which is itself an advantage given that the alternative today is probably not no-childcare but rather than some other type of childcare program (Kline and Walters 2016).

Estimates from the staggered diff-in-diff model suggest that being exposed to HCB for at least one year in early childhood increases program take-up, relative to no childcare, by 12.5 percent. In the medium-term, our intent-to-treat estimates indicate that exposed children are 3.8 percent more likely to complete 9th grade and 5.6 percent to finish high school. HCB also increases educational achievement. The end-of-high school ICFES exam increases by 0.07 SD, which is remarkable given

that students who did not drop out of high school because of the program, are more likely to perform worse than other students. Using the last wave of the Census of the Poor we analyze outcomes around age 25. Regarding mechanisms, we examined mothers' labor market outcomes (Evans et al. 2021).

We contribute to the literature in several ways. First, we provide the first evidence on the long-run impacts of community nurseries. We follow children and families for over 20 years after they were first exposed to the program, an unusually long period of analysis for studies of this kind, especially in low- or middle-income countries. We show that these programs work by improving children's educational attainment and economic prospects. Second, these results come from the evaluation of a widely implemented program that currently serves over one million children in Colombia.

An important limitation of our study is that our data do not allow us to measure quality of HCB centers. However, our assumption following previous research in developing countries, is that the quality of these centers is low or very low (see Bernal and Fernandez 2013 or Attanasio et al. for a discussion of day care center quality in Colombia and in Rio de Janeiro, respectively). Despite this, HCBs seem to boost child development and at a relatively low cost.

This paper is structured as follows. The next section describes the program. Section III presents the administrative data and Section IV the empirical strategy. In Sections V and VI we discuss the findings, mechanisms, and robustness checks. Last, we conclude in Section VII.

2 Data

We use several sources of linked administrative data to analyze the effects of HCBs on children's outcomes.

• Four waves of the SISBEN or the "Census of the Poor." This is a census of Colombia's low-income population which aims to capture the wealth of individu-

als for means tested social programs, such as free health care and conditional cash transfers. The data are collected door-to-door by surveyors and include rich demographic and socioeconomic information of all household members including sex, age, date of birth, education, marital status, occupation, income, household size, dwelling characteristics, and indicators of household wealth (e.g., has a fridge).

Our main results use all waves of the SISBEN – i.e., the first, second, third, and fourth wave – for the city of Bogota, which were conducted in 1994-2001, 2005-06, 2009-10, and 2019-20, respectively. This final dataset is a panel of 850,000 low-income families (3.4 million individuals) that are followed for over 20 years.

The SISBEN I was the country's first attempt to survey low-income families – which roughly represented 23 million people or about 62 percent of the population. Since the SISBEN III specifically targeted poor households, however, the coverage rate for the disadvantaged individuals eligible for public housing is near-universal. We also use the fourth wave of the SISBEN or "SISBEN IV" which was conducted in 2019-20 to compare the post-lottery employment, income, spending, wealth, and housing characteristics of lottery winners and losers.

• Universe of Students in Colombia's Public Schools. This is the core database of the Ministry of Education, which provides information on school progression for all students in public schools. In particular, the data allow us to observe the first year that a child entered the school system (e.g., first grade) up to high school graduation (or dropout) for everyone who was ever enrolled in the public school system. The data indicate whether a student has received a high school diploma as well as the specific school that a child attends each year (although it does not contain information on test scores). We use data up to 2019, the last year available.

• End-of-High School Exam (ICFES). The ICFES is the national high school exit exam administered that is mandatory for all high school seniors (including private schools) who must pass the exam in order to graduate. The exam scores are also used for admission purposes for those who apply to college. The ICFES includes separate tests on math, Spanish, social studies, sciences, and an elective subject.

We aggregate the subject-specific scores into a continuous variable that captures the average score across all individual subjects and standardize these scores to have mean zero and standard deviation one each year. The data are available up to 2019.

• Universe of Students in Tertiary Education (SNIES). This dataset is the National Information System on all students enrolled in any tertiary education institution in the country. This resource provides information on student progression across public and private universities, community colleges, or any other tertiary education agency. The data are available up to 2019. We match the lottery sample to the SNIES to measure college-going.

Sample of interest. We focus on children in Bogota residing in 140 zip codes that during the 1990s switched from not having an HCB to opening one in the next year.

2.1 Identification of HCB Rollout in the SISBEN I

Although HCB was introduced in 1987, the program continued to actively expand throughout the 1990s. We identify the expansion of the program across neighborhoods in Bogota by using the SISBEN I, which has detailed information on a family's neighborhood of residence and on whether a child below age six was attending either a) private, b) public, or c), no childcare.1 Since the SISBEN I was collected in Bogota from 1994 through 2001, we can identify neighborhoods that switched from having families with a child below age 7 (and not enrolled in school) who were not enrolled in HCB to having families with a child below age 7 (and not enrolled in school) enrolled in HCB. This strategy "leaves-one-out", meaning that if a child i is the only "switcher" child in a neighborhood-year, we do not treat this observation as the introduction of HCB in that neighborhood-year. Fortunately, in all cases that we observe switchers, the number of children participating in an HCB is strictly greater than one (with average 10).

2.2 Characteristics of Neighborhoods that Opened an HCB in Bogota the 1990s

Using the (universe or the) population Census of 1993 for the city of Bogota, we investigate what are the characteristics of families residing in neighborhoods in our analytic sample – i.e., neighborhoods that opened an HCB in the 1990s according to the SISBEN data–, and how they differ from other families in Bogota. to learn about the characteristics of neighborhoods in our analytic sample prior to the SISBEN interviews, and we compare these to neighborhoods that already had an HCB by the time the SISBEN and to those that never opened one throughout the 1990s. This exercise is informative about the potential selection of our sample. For instance, are the neighborhoods in our sample different in any significant way from other neighborhoods in terms of observable characteristics? Table 1 shows that

3 Methods

To measure the long-run impacts of HCB, we use the expansion of the program across 140 zip codes in Bogota from 1995 to 2000 as described by the following staggered difference-in-difference model,

$$Y_{izt} = \beta_0 + \gamma AgeHCBrollout_{izt} + \delta X_i + \alpha_z + \alpha_t + \lambda_{l(t)} + \epsilon_{it}\,, \tag{1}$$

where Y_{izt} represents the outcome child i, in zip code z, and at time t (e.g., an indicator for whether a child participated in HCB). The explanatory variable of interest, $AgeHCBrollout_{izt}$, is the age in years at which a child was exposed to HCB from ages -4 to 6 in the zip code of residence. X_i is a vector of family and child characteristics that includes indicators for mother's age (¡20, 20-24, 25- 34, 35-44, 45+), education (less than high school, high school degree, some college, college or more), and an indicator for the mother being married; in terms of child-level controls, we include a dummy for whether the child is a female and age fixed

effects. α_z and α_t are zip code and and SISBEN interview year fixed effects. In some specifications we also add zip-code specific linear time trends and locality*interview year fixed effects. ϵ_{it} is the error term and errors are clustered at the zip code level. The key coefficient is γ, which measures the effect of having a new HCB in the zip code of residence from ages -4 to 6. The identifying assumption for equation (1) is that the variation in HCB openings within zip codes is not correlated with other determinants of HCB participation or child outcomes at the zip code level.

4 Results

First stage: Effects of HCB-exposure on HCB participation

Table 2 shows that exposure to HCB at the zip code level increases the probability of participating in HCB by 2.8 percentage points (pp) per year of exposure to the program. Considering that children in our sample are on average exposed to 2.7 years to HCB in their early childhood (age¡6), this exposure amounts to (2.8 pp * 2.7 years =) 7.6 pp (or 27 percent increase relative to the outcome mean) in the probability of HCB participation. Figure 2 shows the impacts by child's age at rollout suggesting that the earlier a child was exposed to the program in his/her zip code of residence, the more likely he/she would be enrolled in HCB.

Effects of HCB on Education

Table 3 reports estimates of HCB on children's educational attainment. Exposure to HCB is not associated with changes in completing 7th grade, but it does increase the probability of completing 9th grade by 3.8 percent (with outcome mean of 81.7 percent) and of finishing high school by 5.6 percent (with outcome mean of 64.4 percent). The second panel of Table 4 reports the impact of HCB on exam scores from the ICFES. In terms of performance on the exam, we find that children exposed to one additional year of HCB score 0.07 standard deviations higher. We also investigate the math and reading subcomponents of the ICFES and find that HCB increases math and reading scores by 0.03 (p¡0.20) and 0.08 standard devi-

ations (p¡0.05), respectively. It is remarkable that these test score improvements are positive and statistically significant (except for math), given that HCB also increases ICFES-taking and so these estimates are likely contaminated by selection bias – i.e., HCB encourages academically weaker students to remain in school and take the ICFES which could bias test score estimates downward. Figures 3-6 show event-time coefficients on these outcomes suggesting that the earlier a child is exposed to the program, the more likely he/she would benefit in the long-term.

Maternal Employment and Income We find that HCB availability increases maternal employment in the short-term and specially for single mothers by 2.3 percentage points (pp) and 3.6 pp, respectively. Given the corresponding enrollment increases, this would suggest that the probability of being employed increased by 40-50, when their child enrolled in HCB. These impacts are largest among subgroups that have lower baseline employment rates, such as mothers who are less-educated, never married, and from lower socioeconomic strata. However, we find little evidence HCB leads to persistent increases in maternal employment. Our work suggests HCB represent an important policy lever supporting employment of low-income mothers, especially those who are single.

5 Conclusions

Global interest in public investments to improve the development of disadvantaged children has risen in recent decades. Yet, despite millions of children in developing countries accessing early childhood programs, and the potential for these investments to boost children's outcomes in the future, there is still little evidence from low- and middle- income countries on the impact of large-scale public daycare services, and much less is known about their potential sustained effects over time. This study focuses on the evaluating Hogares Comunitarios de Bienestar long-term outcomes, Latin American's first community nursery program that began in 1987 and currently serves over one million children. Using the expansion of HCB across

nearly 200 neighborhoods in Bogota in the mid-1990s and relying on a staggered difference-in-difference and a mother fixed effects model, we study the outcomes of children who participated in the program. We show that being exposed to n HCB early in life in the municipality of residence is positively associated with higher educational attainment and performance in the end-of-high school exam, a higher probability of attending tertiary education, lower teen pregnancy, and higher employment rates and earnings. To our knowledge this is the first paper to document the sustained impacts of daycare services in a developing country.

The fact of using people from the community - Communitarian Mothers- to provide care of children, instead of professional officials of the ICBF, of use the homes of these mothers or spaces in the same community instead of buildings or places of the institute, and having Parent Associations permanently helping in the running of the home, has made it possible to significantly reduce the costs of the program, which together has allowed it to increase the coverage, making it possible for the program to get closer to the coverage goals set at the beginning of the program (Bernal 1991).

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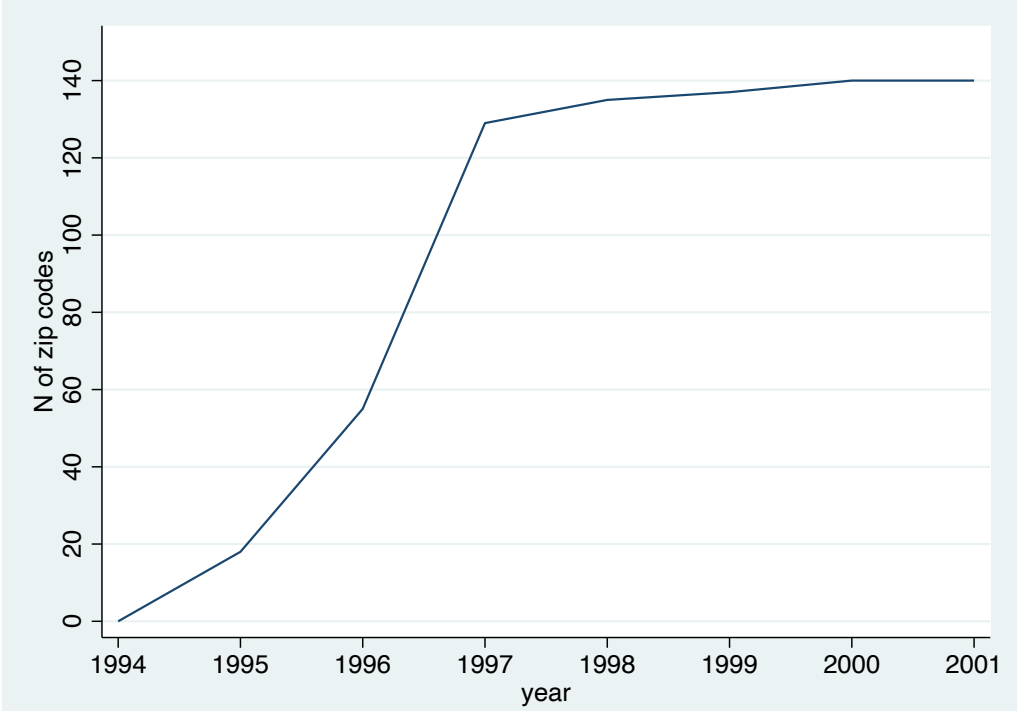
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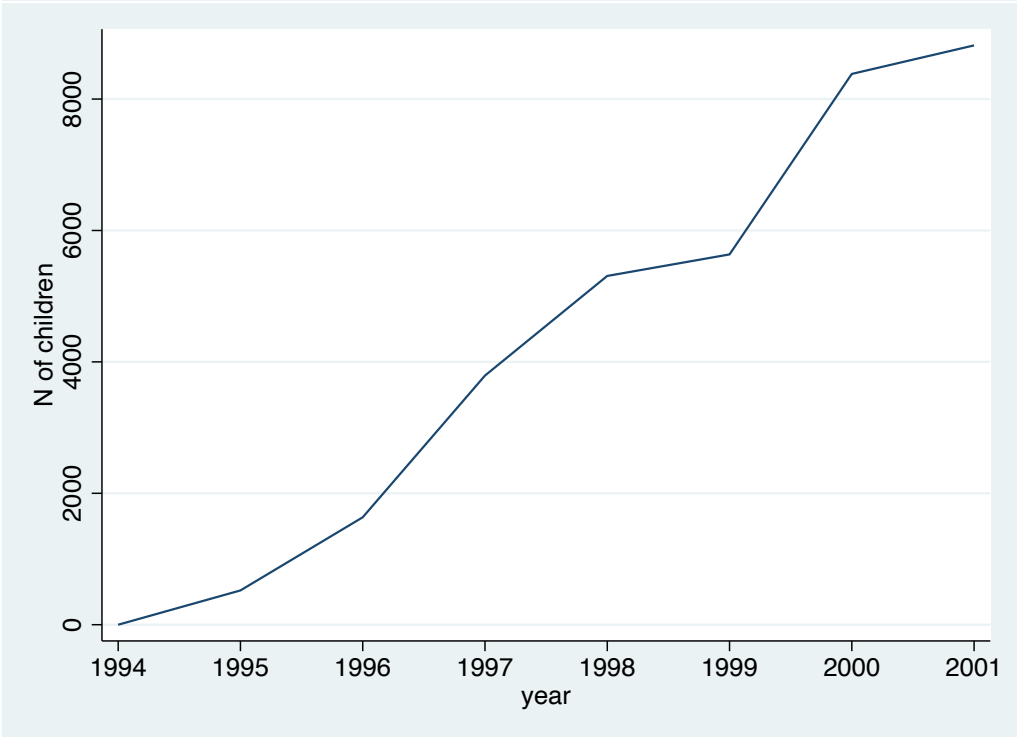
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7 Figures and Tables

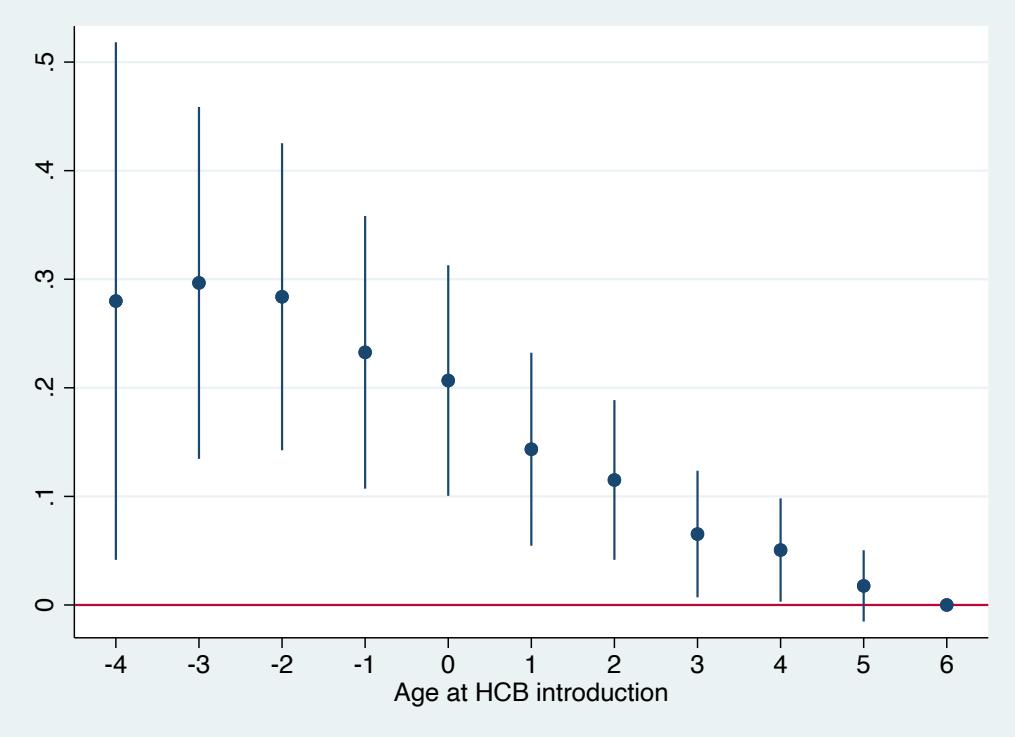
FIGURE 1: Expansion of HCBs Across Zip Codes and N of Children Served





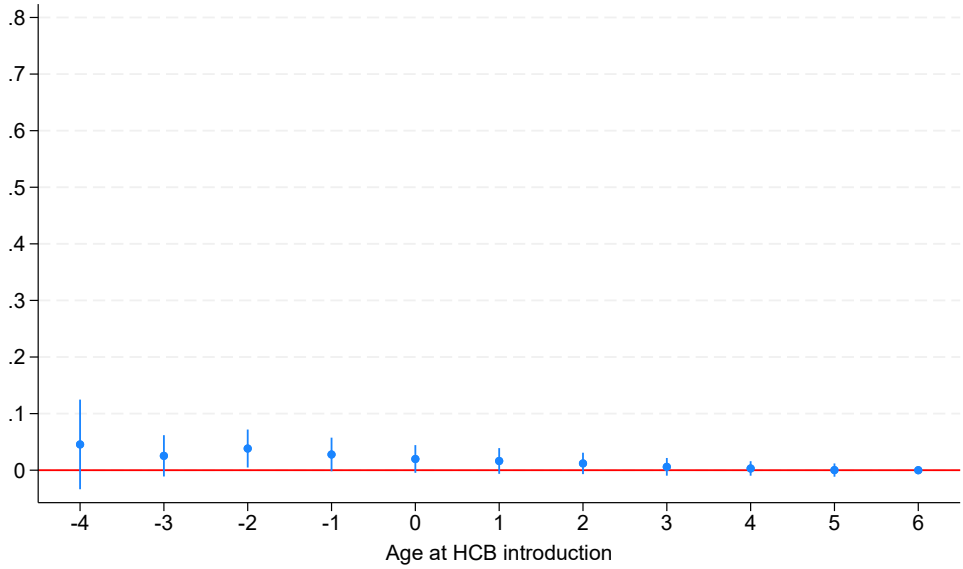
Notes. Authors' calculations using the baseline wave of the Census of the Poor.

FIGURE 2: First-Stage: Effects of HCB Introduction on HCB Take-up (relative to age 6)



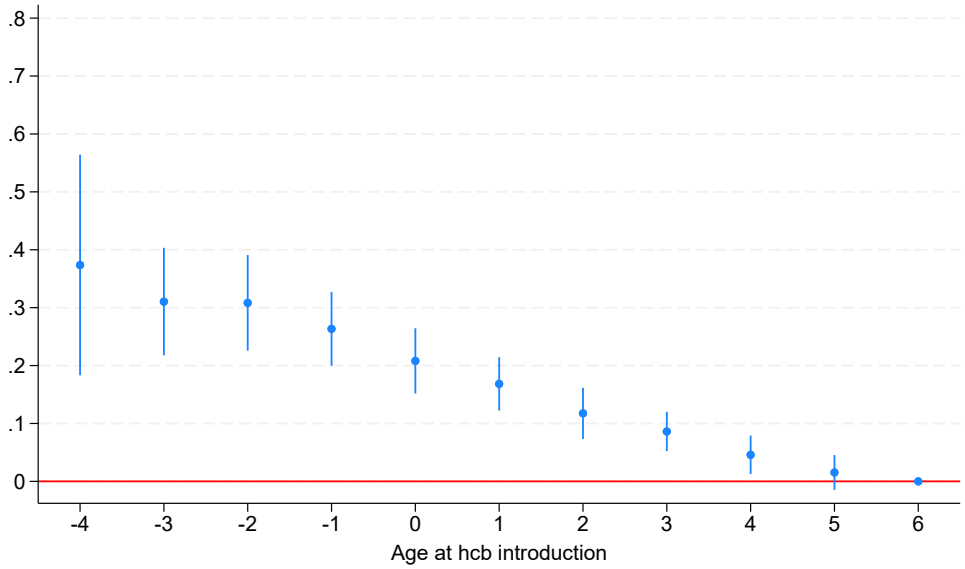
Notes. The figure plots event-study estimates of $beta_1$ for program take-up relative to age 6, using the specification in equation (1). The vertical lines show 95 percent, point-wise confidence intervals.

FIGURE 3: ITT Effects of HCB Introduction on Grade 7 (relative to age 6)



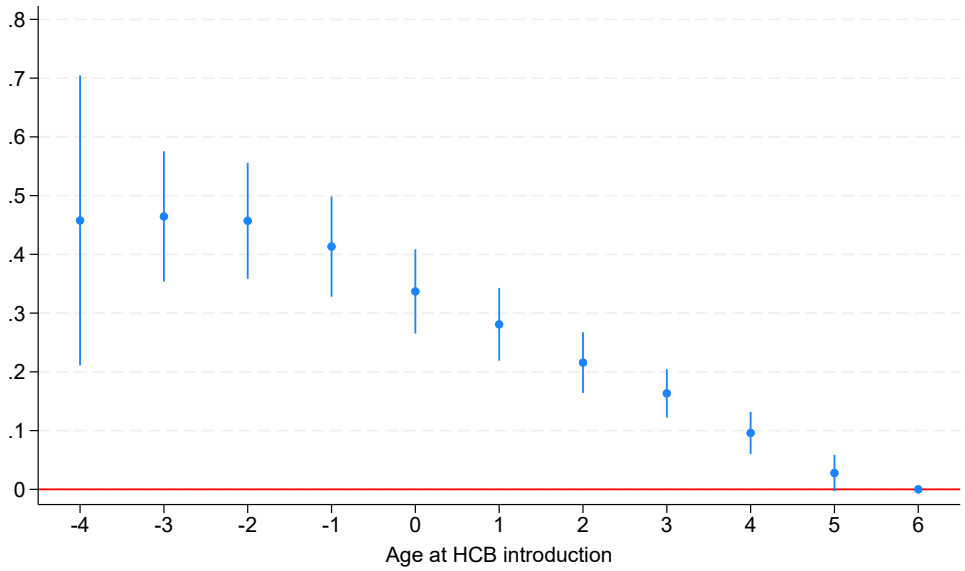
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FIGURE 4: ITT Effects of HCB Introduction on Grade 9 (relative to age 6)



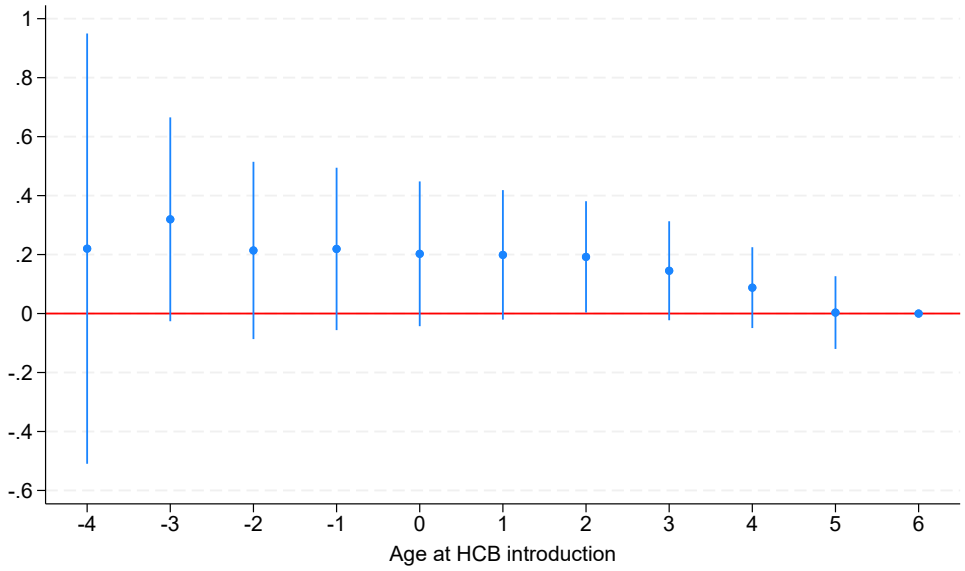
Notes. The figure plots event-study estimates of $beta_1$ for program take-up relative to age 6, using the specification in equation (1). The vertical lines show 95 percent, point-wise confidence intervals.

FIGURE 5: ITT Effects of HCB Introduction on High School Graduation (relative to age 6)



Notes. The figure plots event-study estimates of $beta_1$ for program take-up relative to age 6, using the specification in equation (1). The vertical lines show 95 percent, point-wise confidence intervals.

FIGURE 6: ITT Effects of HCB Introduction on Test Scores at Age 18 (relative to age 6)



Notes. The figure plots event-study estimates of $beta_1$ for program take-up relative to age 6, using the specification in equation (1). The vertical lines show 95 percent, point-wise confidence intervals.

TABLE 1. Characteristics of Neighborhoods With and Without HCB in Census 1993

	With HCB	Without HCB	Introducing an HCB
Head's age	41.22	47.81	42.46
	[13.82]	[14.66]	[14.25]
% heads that are female	0.061	0.069	0.065
% heads w/primary educ or +	0.770	0.963	0.816
% heads w/HS educ or +	0.263	0.816	0.346
% heads employed	0.773	0.733	0.763
HH size	4.25	4.45	4.31
	[1.37]	[1.52]	[1.43]
% ind.'s 14+ who don't read/write	0.030	0.010	0.023
% home owners	0.513	0.739	0.520
% w/access to electricity	0.950	0.995	0.962
% w/access to running water	0.970	0.998	0.986
% w/access to sewage	0.883	0.974	0.925
% w/cement or firm floors	0.868	0.957	0.865
N of zip codes	305	60	140
Population	3,043,712	237,727	1,065,068
N of families	770,390	64,385	271,289
% children<= 5	0.131	0.075	0.119

Notes. Authors calculations using the population Census of 1993 for the city of Bogota.

TABLE 2. First-Stage: Effects of HCB Introduction on HCB Take-up

	HCB take-up			
Age at HCB introduction	-0.031***	-0.029***	-0.036***	-0.036***
	(0.009)	(0.009)	(0.009)	(0.009)
Observations	23,519	23,519	23,519	23,519
Outcome mean	0.37	0.37	0.37	0.37
Zip code FE	Y	Y	Y	Y
Sisben-interview year FE	Y	Y	Y	Y
Age FE	Y	Y	Y	Y
Individual controls		Y	Y	Y
Zip-code linear time trends			Y	Y
Locality*year FE				Y
F-stat	11.05	35.83	30.18	33.62

TABLE 3. ITT Effects of HCB Introduction on Educational Attainment

	Grade 7	Grade 9	Grade 11	End-of-HS Exam Score
Age at HCB introduction	-0.031***	-0.029***	-0.036***	-0.026
	(0.009)	(0.009)	(0.009)	(0.018)
Observations	40,104	40,104	40,104	26,469
Outcome mean	0.37	0.37	0.37	0.02
Zip code FE	Y	Y	Y	Y
Sisben-interview year FE	Y	Y	Y	Y
Individual controls	Y	Y	Y	Y
Zip-code linear time trends	Y	Y	Y	Y
Locality*year FE	Y	Y	Y	Y