CAN PUBLIC PRESCHOOL PARTICIPATION INCREASE SECONDARY SCHOOL COMPLETION AND UNIVERSITY ENROLLMENT IN URUGUAY?
EVIDENCE FROM THE 2011-2014 CONTINUOUS HOUSEHOLD SURVEY

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ABSTRACT

The rapid expansion of the public preschool system in Uruguay has led to increased preschool participation rates throughout the country since 1995. While research in the United States suggests that there is a significant relationship between public preschool participation and higher levels of educational attainment, this relationship has not been thoroughly examined in Uruguay or elsewhere in the Latin America and the Caribbean region. This thesis assesses whether or not public preschool participation in Uruguay can increase secondary school completion rates and university enrollment by the ages of 19 and 20 using data from the Uruguayan Continuous Household Survey from the years 2011 to 2014. The relationships between private preschool participation and the same measures of educational attainment are also estimated to contrast preschool provision between the public and private sectors. Using a matched comparison approach, I find that, compared to no preschool, public preschool participation in Uruguay is significantly associated with higher levels of university enrollment, but not secondary school completion. However, when the sample is broken down into subgroups based on gender and socioeconomic status, public preschool participation is associated with increased secondary school completion rates for males, females, and individuals living below the poverty line, though not for those living above the poverty line. In contrast, private preschool participation, compared to no preschool, is significantly associated with higher levels of both secondary school completion and university enrollment for the overall sample.

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JONATHAN A. BELFORD

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I. INTRODUCTION

Over the past couple of decades, there has been a dramatic increase in the number of public preschool programs throughout Uruguay (Llambí, Mancebo & Zaffaroni, 2014). In 1995, the *Administración Nacional de Educación Pública* (ANEP), or the National Administration of Public Education, began an ambitious expansion of the public preschool system in Uruguay, and public preschool became practically universal by 1999 (Berlinksi, Galiani & Manacorda, 2008). The aim of this expansion was, in part, to reduce high grade repetition and dropout rates for students in both primary and secondary school, especially for students from low-income families (Manacorda, 2006; ANEP, 2000). These negative educational outcomes exist in most countries throughout Latin America and the Caribbean (LAC) and differentiate the education environment in LAC countries from those in more developed countries like the United States (Manacorda, 2006; Urquiola & Calderon, 2004). Since this expansion policy was implemented, public pre-primary program participation in Uruguay rose from around 50,000 students in 1995 to over 80,000 students in 2012, a 60 percent increase (Llambí, Mancebo & Zaffaroni, 2014). Over the same period of time, the Uruguayan population increased only 5.3 percent from 3,224,807 to 3,396,753 people (World Bank, 2015).

Despite the growth in public preschool participation throughout Uruguay, questions remain about whether or not these programs are achieving their goals of reducing grade retention and dropout rates, and raising levels of educational attainment throughout the education system. Berlinksi, Galiani and Manacorda (2008) attempted to explore this issue by examining how any type of preschool participation in Uruguay affects educational attainment using a sibling-based comparison, and found that students who attended preschool completed significantly more years of schooling by the age of 15 and were more likely to be in school than non-participants.

However, there is a lack of research on the degree to which public preschool programs, rather than all preschool programs combined, have an effect on educational attainment in Uruguay. Examining public preschool programs in particular is important because of the Uruguayan government's significant investment of tax-payer dollars in these programs, making them a significant policy priority. Additionally, Berlinksi, Galiani and Manacorda (2008) only examine the effects of preschool participation on educational attainment up to the end of the first cycle of secondary education at age 15 (UNESCO, 2015). There is a lack of research in Uruguay and elsewhere in Latin America that examines how public preschool programs affect educational attainment at higher levels, such as completing secondary school or enrolling in a university program. Both of these outcomes, on average, result in higher earnings for students once they enter the labor market, and an increased number of secondary graduates and university enrollees could raise additional tax revenues and hasten economic development in Uruguay and other LAC countries (Jaeger & Page, 1996; Kane & Rouse, 1993). This thesis uses LPM, Logit, and Propensity Score Matching (PSM) models and data from Uruguay's 2011 to 2014 *Encuesta Continua de Hogares*, the Continuous Household Survey (ECH), to answer the following research question: Does participating in a public preschool program in Uruguay increase the probability of completing secondary school or enrolling in a university program?

II. Literature Review

To answer the research question put forward in this thesis, the previous literature that assesses how preschool participation can affect measures of educational attainment must first be examined. This begins with a review of research in the fields of neuroscience and psychology that examines how early experiences and interactions can affect brain development and future

learning patterns. The literature on early brain development suggests that this process is influenced by genetic factors and personal experiences, and that these experiences can affect both the context in which the brain develops and how linkages form within the brain (Shore, 1997). Additionally, learning is easier during early childhood because increased brain activity and mental development during this period influences the architecture of the brain and the capacity to learn into adulthood (Shore, 1997). Further literature has focused on the environmental factors that can impact early childhood development, finding that the family and community in which children grow up and the childcare they receive all have major implications for brain development (Shonkoff & Phillips, 2000). The conclusions presented in this literature have been used by policymakers as the basis for designing early education programs that focus on building cognitive, socio-emotional, and other capabilities that are important in early childhood development (Shonkoff & Phillips, 2000).

The literature on early education programs in the United States demonstrates that these interventions are not just associated with improved developmental outcomes, but also with increased educational attainment and workforce outcomes. Two of the first preschool programs to be rigorously evaluated were the Perry Preschool program in Ypsilanti, Michigan and the Abecedarian Project in Chapel Hill, North Carolina, which both consisted primarily of African-American and low-income students. The High/Scope Perry Preschool study, conducted between 1962 and 1967, found that participants performed significantly better on language and school achievement tests until at least age 7 than non-participants (Schweinhart, Montie, Xiang, Barnett, Belfield & Nores, 2005). Additionally, the program had significant, positive effects on years of school completed, high school completion, and college enrollment, as well as employment and earnings at the ages of 27 and 40 (Schweinhart et al., 2005). The Abecedarian Project study,

conducted between 1972 and 1977, found that children performed significantly better in infant and child development measures than non-participants (Campbell & Craig, 1995). Later evaluations showed that at age 15, preschool students performed better on reading and math tests, had lower rates of grade retention, were less likely to attend special education programs, and at age 21 had more years of completed education and were more likely to attend college (Campbell & Craig, 1995; Campbell, Ramey, Pungello, Sparling & Miller-Johnson, 2002).

While the Perry and Abecedarian projects were only implemented for a small number of minority children, numerous larger-scale preschool interventions have also been evaluated throughout the United States. The largest of these is Head Start, a federal program started in 1964 that provides matching grants to early childhood education programs in which at least 90 percent of participants are below the federal poverty line (Currie & Thomas, 1995). Studies on Head Start, many of which used sibling-based comparisons, found that there are significant early gains in math and reading scores for participating students, which last until around age 10 (Curry & Thomas, 1995; Deming, 2009). Long-term outcomes of Head Start include lower levels of grade retention, learning disability diagnoses, teenage pregnancy, and crime for students participating in the program, along with increased years of schooling, health outcomes, and earnings once students enter the labor market (Garces, Thomas & Currie, 2000; Deming, 2009). In contrast to Head Start, a recent randomized controlled trial of the Tennessee Voluntary Pre-K Program found that children who attended the program, while initially displaying higher scores on academic achievement tests, actually performed worse than the control group on the same tests by 2nd grade (Lipsey, Farran & Hofer, 2015). However, these programs are not universal like Uruguay's has become during the massive public preschool expansion and focus mainly on disadvantaged and higher-risk children.

Universal preschool, while not available throughout the U.S., is available in the states of Oklahoma, Georgia, and Florida. Evaluations of the universal preschool programs in Oklahoma and Georgia have been performed using regression-discontinuity design, in which participating students have been found to initially perform better in letter-word identification, spelling, counting, and problem-solving over the control group, although fadeout in cognitive skills generally occurs by around the 3rd grade (Gormley, Gayer, Phillips, & Dawson, 2005; Peisner-Feinberg, Schaaf, LaForett, Hildebrandt & Sideris, 2014). While the fadeout of preschool's effects on cognitive skills is always a concern, the success of large-scale preschool programs in the U.S. on raising educational attainment have inspired many other countries to adopt similar interventions at the local or national levels, including countries throughout the LAC region.

The research on early education programs in Latin America has tended to focus on the relationship between household daycare services and early childhood development, or the relationship between preschool enrollment and early academic outcomes once children enter primary or secondary school. The *Proyecto Integral de Desarrollo* (PIDI) program in Bolivia, in which household childcare programs are run by mothers or other caretakers who usually do not have formal training, provides cognitive support and nutritional services to children up to six years old (Behrman, Cheng & Todd, 2004). An evaluation of PIDI indicated that participants had significant improvements in test scores for motor, language, and social skills over non-participants (Behrman, Cheng & Todd, 2004). An evaluation of a similar household-based childcare program in Colombia called *Hogares Comunitarios de Bienestar* (HCB) used PSM and found significant increases in test scores for vocabulary, verbal ability, mathematical reasoning, and general knowledge for children who participated in the program. (Bernal, Fernández, Flores & Gaviria, 2009). To focus on more formal early education, one study assessed the universal

early education program in Buenos Aires, Argentina for children from ages three to five (Berlinksi, Galiani & Gertler, 2009). The results indicate that in the third grade, program participants had significant gains in mathematics and Spanish test scores, as well as self-control (Berlinksi, Galiani & Gertler, 2009). Another study focusing on formal public preschool used the ECH in Uruguay to examine the relationship between preschool participation and early educational attainment (Berlinksi, Galiani & Manacorda, 2008). Using a sibling-based comparison, the study found that participants had significant increases in school attendance and years of education attained through age 15 (Berlinksi, Galiani & Manacorda, 2008). While all of this research is certainly informative, it does not examine how preschool can affect longer-term measures of educational attainment at the secondary and post-secondary schooling levels.

The aim of this thesis is to address the lack of research in Uruguay and throughout Latin America that examines the effects of public preschool participation on secondary school completion and university program enrollment. This is particularly important to study given that many U.S. programs have found fadeout on short-term cognitive outcomes, but positive effects on longer-term non-cognitive outcomes. There is currently no published literature that focuses on this subject in Uruguay, and this study may be the first to examine this relationship in a LAC country. Research on these outcomes is important because there is multi-national evidence that additional years of schooling can lead to higher levels of income once individuals enter the labor market (Card, 1999). Additionally, numerous studies have found that there is a "sheepskin effect" for degree completion, in which earning high school and post-secondary degrees give people a wage premium in the labor market over the equivalent years of schooling for people who do not earn a degree (Jaeger & Page, 1996). One study finds that this premium is around 11 percent for high school degree holders and 31 percent for bachelor degree holders in the U.S.

(Jaeger & Page, 1996). However, even without earning a post-secondary degree, each additional year's worth of college credits earned in the U.S. has been estimated to increase hourly wages in the labor market by around five percent (Kane & Rouse, 1993). These findings demonstrate the effect that graduating from secondary school or enrolling in a university can have on labor market outcomes, and why it is of interest to examine whether public preschool participation in Uruguay has the potential to affect these measures of educational attainment.

III. Conceptual Model & Hypothesis

Based on the literature concerning preschool participation and educational attainment, I hypothesize that participating in a public preschool program in Uruguay will increase the probability of completing secondary school or enrolling in a university program. There are many components of the relationship between preschool participation and educational attainment, and other factors may have an effect on these outcomes. The model for the relationship between preschool participation and increased employment and earnings is represented in Figure 1.

Early childhood is a pivotal time for brain development because this is when many lifelong neural pathways form within the brain (Shore, 1997). The brain is two to three times as active during early childhood, making it an important time for knowledge and skills to be absorbed (Shore, 1997). The two primary elements that impact this early development are the genes that a child is born with and the experiences a child has at an early age (Shore, 1997). These experiences generally come from a child's family environment, community environment, and the environment in which childcare or early education is administered (Shonkoff & Phillips, 2000). The nature of these settings can impact the development of children's cognitive skills, such as math and language skills, and non-cognitive skills, such as motor, social, and behavioral

skills (Shonkoff & Phillips, 2000). Preschool participation in particular can potentially be a strong contributor to the development of these skills in comparison to alternative programs, as suggested by various studies analyzing this relationship for particular preschool programs (Gormley, Gayer, Phillips & Dawson, 2005; Campbell & Craig, 2005). The providers of preschool alternatives like day care programs or home care can also influence these skills in children, but these providers usually lack formal training, and the literature demonstrates that preschool is generally more effective (Behrman, Cheng & Todd, 2004). Finally, a child's parents, along with his or her innate abilities, play a role in whether the child attends preschool and whether they gain admittance into a quality program.

The cognitive and non-cognitive skills gained during preschool are retained as children enter primary school and result in higher student achievement levels. Evaluations of preschool participants have found that they often achieve higher test scores on measures of cognitive and non-cognitive skills early on in primary school (Campbell & Craig, 2005; Currie & Thomas, 1995; Schweinhart et al., 2005). Additionally, preschool participants from some smaller programs have maintained higher cognitive and non-cognitive test scores throughout secondary school and even into adulthood (Campbell et al., 2002; Schweinhart et al., 2005). However, many studies have shown that fadeout can occur in the early difference in math and reading scores between preschool participants and non-participants by the 3rd grade (Currie & Thomas, 1995; Hill, Gormley & Adelstein, 2012). While the persistence in the increased cognitive skills of preschool participants varies by program, it is clear that quality preschool programs have the potential to increase long-term student achievement.

Additionally, research shows that preschool participants generally end up having higher levels of educational attainment than non-participants, which is likely influenced by increased

student achievement (Berlinksi, Galiani & Manacorda, 2008; Schweinhart et al., 2005). This comes in the form of participants having a reduced likelihood of grade retention and dropping out of high school (Garces, Thomas & Currie, 2000; Schweinhart et al., 2005). Preschool participants are also more likely to enroll in college (Campbell et al., 2002; Schweinhart et al., 2005). These findings raise questions concerning how educational attainment can be greater for preschool participants than non-participants even when fadeout in cognitive skills occurs. The main explanation for this phenomenon is that the non-cognitive skills gained in preschool, such as social, emotional, and behavioral skills, are particularly important in achieving these outcomes (Gibbs, Ludwig & Miller, 2001). Finally, it should be mentioned that a student's family can also impact educational attainment directly because child labor is still a prominent practice in Uruguay, and parents can keep their children home from school to work (U.S. Department of Labor, 2011). Regardless, there is a clear theoretical relationship between preschool participation and educational attainment.

Finally, it has been determined that higher levels of educational attainment, especially secondary degree completion and college enrollment, can result in an increased likelihood of being employed and receiving higher earnings in the workforce (Hardin, 1967; Jaeger & Page, 1996; Kane & Rouse, 1993). Additionally, elevated cognitive and non-cognitive skills, regardless of how they affect education levels, can influence employment and earnings outcomes. Having improved cognitive skills would likely be of help in applying to jobs and maintaining employment since employers appreciate these productive skills, and they have also been demonstrated to increase an individual's earnings (National Research Council, 1984; Kerckhoff, Raudenbush & Glennle, 2001). Likewise, increased non-cognitive skills, such as social and behavioral skills, would likely assist in networking and maintaining employment

because they are demanded by employers (National Research Council, 1984). These skills have also been found to be associated with higher earnings (Lleras, 2008). However, one's family and community can also play a role in labor market outcomes by providing connections and networking opportunities. Regardless, there are multiple clear paths through which preschool participation and educational attainment can increase the likelihood of being employed and earnings levels once participants join the workforce.

IV. DATA DESCRIPTION

To test my hypothesis, I use 2011 to 2014 data from Uruguay's ECH. This dataset was prepared by the *Instituto Nacional de Estadística*, or the National Institute of Statistics (INE), which is an entity of the Uruguayan government (INE, 2015). The survey was developed to gather demographic, social, and economic information about private households in Uruguay and the persons within those households (INE, 2015). The datasets and codebook are publically available and downloadable from INE's website.

The ECH is a nationally representative dataset with a repeated cross-sectional structure, although numerous retrospective questions were asked in the survey (INE, 2015). All of the data in ECH were collected between the winter and the fall for the particular year of interest. Any retrospective information, such as data on preschool participation, was collected at this time (INE, 2015). The dataset consists of both household- and individual-level data. In total, there were around 50,000 households and 130,000 individuals within these households sampled in each year that the survey was conducted, with response rates ranging from 86.8 percent to 91.2 percent of sampled households (INE, 2013; INE, 2015). The ECH samples were selected using a stratified two-stage design (INE, 2015). The primary sampling units were between 78 (2011 to

2012) and 81 (2013 to 2014) census areas that were selected using probability proportional to size that is measured by the number of private homes (INE, 2013; INE, 2015). The secondary sampling units were randomly selected private dwellings within each zone (INE, 2015). The person interviewed was a household member above the age of 18 who was able to provide information about the other household members (INE, 2015).

The dependent variables created using the four years of ECH data are whether or not an individual has completed secondary school and whether or not an individual is enrolled in a university program by the ages of 19 and 20. For these ages, the sample includes around 4,600 individuals who completed secondary school and 8,600 who did not. Additionally, for the same ages, the sample includes around 2,900 individuals who were enrolled in a university program and 10,300 individuals who were not. The key independent variable that these data are used for is whether a child participated in a public preschool program or no preschool program, but models are also run that substitute private preschool as the key independent variable for comparison. For the ages from 19 to 20, the sample includes around 9,800 individuals who participated in a public preschool program, around 2,500 individuals who participated in a private preschool program, and around 900 individuals who did not participate in any preschool program. Finally, this dataset contains information on gender, ethnicity, urbanicity, head of household (HOH) education, and family socioeconomic status, all of which I control for in my models. There are four categories of urbanicity: large urban sites, which have greater than 100,000 people (Montevideo), medium urban sites, which have less than 100,000 and greater than 5,000 people, small urban sites, which have less than 5,000 people and basic infrastructure, and rural areas, which have less than 5,000 people and little infrastructure (INE, 2014). The HOH is a parent for around 85 percent of individuals, another relative for around 13 percent of individuals, and a non-relative for less than 2 percent of

individuals. Family socioeconomic status is determined by the official poverty line (PL) in Uruguay, for which a description and a full record from 2011 to 2014 can be found in Figure 2. The summary statistics for all variables are included in Table 1. There are significant differences between preschool participants and non-participants for all of these covariates, making it important to control for them in the models utilized within this thesis.

This analysis omits some individuals from the ECH dataset because, at around the age of 16, study participants start moving out of their guardian's households and begin households of their own. These individuals are not included because there is a lack of important data on them, such as parent or guardian education levels. The number of study participants that begin new households is relatively small for the ages being examined, and only accounts for 10.8 percent of households in which 19 and 20 year olds live. There are significant differences between individuals included in the sample and those not included, as is evidenced in Table 2. This topic is covered in further depth in the Limitations section.

V. EMPIRICAL STRATEGY

The data from the ECH allow us to examine whether or not participating in a public preschool program in Uruguay is associated with an increased probability of graduating from secondary school or enrolling in a university program. The following models are used to capture the relationship between public preschool participation and these measures of educational attainment:

Model 1: Multiple Regression

$$Pr(Y_i = 1|X) = \beta_0 + \beta_1 pubprek + \beta_2 female + \beta_3 ethnicity + \beta_4 urban + \beta_5 poverty + \beta_6 hheduc + \beta_7 birthcohort + \varepsilon$$

Model 1 is a multiple regression model, in which both Logit and Linear Probability Model (LPM) estimates are predicted. Two different dependent variables are estimated, represented by Y_i. The first dependent variable, *secgrad,* is a binary variable indicating whether an individual has received a secondary degree by 19 or 20 years of age. Students should earn their *bachillerato*, the Uruguayan equivalent of a high school degree*,* at around the age of 18 if they do not repeat grades or leave school (NAFSA, 2008). Therefore, this variable represents whether or not an individual has completed secondary school within about zero to two years after their expected graduation date. The second dependent variable, *unienroll*, is a binary variable that indicates whether an individual was enrolled in a university program by the ages of 19 or 20.

In Model 1, *pubprek* is the independent variable of interest and is a binary variable indicating whether a participant has ever participated in a public preschool program in Uruguay. This variable equals one if an individual has participated in any public preschool program, and zero if an individual has not participated in any preschool program. Because a variable for the amount of time that a student attends preschool does not exist in the ECH dataset, the variable broadly represents whether or not an individual has participated in a preschool program regardless of the time enrolled in that program. However, the ages of preschool participation are generally from 3 to 5 years old, and it is likely that many students participated throughout all of these three years given that no-fee, public preschool is universal across Uruguay (Berlinksi, Galiani & Manacorda, 2008). Individuals who participated in the *Centros de Atención a la Infancia y la Familia* (CAIF) program, while listed as participating in a public preschool program in the ECH, are coded as not attending preschool because this is an early intervention program focusing mainly on providing nutrition and childcare for infants from the ages of 0 to 3 (Zaffaroni & Alarcón, 2015). To confirm my hypothesis, the odds ratio for the Logit coefficient

on *pubprek* needs to be greater than one and the LPM coefficient must be greater than zero. Additionally, the coefficients must have statistical significance. If these qualifications are met, it would mean that participating in a public preschool program in Uruguay increases the likelihood of an individual earning a secondary degree or enrolling in a university.

This analysis also examines the relationship between private preschool participation in Uruguay and graduating from secondary school or enrolling in a university program. This will help contrast how participation in private preschool programs differ from participation in public preschool programs in their association with higher levels of educational attainment. For this portion of the analysis, *privprek*, or private preschool participation, is substituted for *pubprek* in Model 1 as the primary independent variable. This variable equals one if an individual has participated in any private preschool program, and zero if an individual has not participated in any preschool program.

There are several covariates included Model 1. The covariates are added to control for possibly confounding factors that may be associated with both whether an individual participates in a preschool program and whether they have graduated from secondary school or enrolled in a university program. The first set of control variables represent individual-level attributes such as gender, ethnicity, and birth cohort. These are included because certain types of people may be more likely to enroll in preschool and may be more likely to achieve higher levels of educational attainment. The second set of control variables represents household characteristics, such as urbanicity, poverty status, and HOH education. Variables concerning household characteristics are necessary to include in this model because the socioeconomic status of one's family would likely be associated with an individual being enrolled in preschool and how many years of schooling he or she completes.

Model 2: **Propensity Score Matching**

Step 1: Generate propensity scores.

$Pr(pubprek) = \beta_0 + \beta_1 female + \beta_2 ethnicity + \beta_3 urban + \beta_4 poverty + \beta_5 hheduc + \beta_6 birthcohort + \varepsilon$

Step 2: Match treatment and control group members with nearest propensity scores.

Step 3: Compare average outcomes for treatment and control group members.

The proportions or mean values of the individual- and household-level characteristics that the covariates aim to control for are significantly different in many cases between individuals who participated in a public preschool program and those who did not attend preschool, as is evidenced in Table 1. This is likely due, in part, to parents self-selecting their children for enrollment in preschool programs. Parents with certain observable and unobservable characteristics will be more likely to enroll their children into preschool programs, and parents are likely to enroll children with certain characteristics into preschool programs over others, which introduces potential selection bias into the estimates. This thesis uses PSM to help better balance the proportions of observed individual- and household-level characteristics between the treatment and control groups. First, using a Logit model, *pubprek* is regressed on the covariates to determine any given individual's propensity to participate in a public preschool program based on his or her observed characteristics, thereby creating propensity scores. Common support is found between the treatment and control groups, meaning that for all propensity score values there are near matches between members of both groups. Next, the propensity score of each individual who participated in a public preschool program is matched to an individual who did not attend preschool who has the nearest propensity score. Finally, the average proportions of the two outcomes, secondary school completion and university enrollment, are compared between

the treatment and control groups.

In this analysis, the average treatment effect (ATE) is estimated, which predicts the effect of moving the whole sample from untreated to treated. Additionally, the propensity scores are matched with replacement, meaning that each individual can be used as a match with another individual more than once. This strategy is recommended by Abadie and Imbens (2006) because allowing for more individuals to be matched ensures that more individuals are included in the sample, and removing individuals from the sample could introduce additional bias into the estimates. However, the analysis does restrict how close propensity scores can be matched, which is referred to as the caliper. Based on recommendations from Austin (2008), this caliper is set to 0.2 standard deviations of the Logit propensity score in order to reduce bias. Even with the caliper restrictions, all individuals in the sample were able to be matched. After performing PSM, there is much better balance between the treatment and control groups for most of the covariates, as can be seen in Tables 3 through 4. However, a couple of the covariates were not as well balanced, which is discussed further in the Results section.

The PSM estimates are also calculated for private preschool participants to contrast how participation in private preschool programs differs from participation in public preschool programs in their association with higher levels of educational attainment. To obtain these estimates, the PSM process is repeated but with *privprek* substituted for *pubprek* in Model 2.

VI. RESULTS

The PSM model employed in this analysis is likely the most reliable estimator when compared to the Logit and LPM models. Therefore, the PSM models that include all covariates are used as the main models to determine whether or not the results in this thesis are statistically significant and for interpreting these results.

a) Main Findings

The PSM results that predict the relationship between participating in a preschool program in Uruguay and graduating from secondary school by the age of 19 or 20 can be found in columns (5) and (10) of Table 5. The overall results suggest that there is not a statistically significant relationship between public preschool participation in Uruguay and secondary school completion. These findings run contrary to the hypothesis, which is that there would be an association between participating in a public preschool program as a child and graduating from secondary school as a young adult. However, there is a significant, positive association ($p<.01$) between private preschool participation in Uruguay and secondary school completion. Participating in a private preschool program is associated with an 11.6 percent increase in the odds of completing secondary school, holding all other variables in the model constant.

The PSM results that predict the relationship between participating in a preschool program in Uruguay and enrolling in a university program by the age of 19 or 20 are reported in columns (5) and (10) of Table 6. The results of this analysis suggest that there is a significant, positive relationship ($p<.01$) between public preschool participation and university enrollment in Uruguay. Participating in a public preschool program in Uruguay is associated with a 4.5 percent increase in the odds of enrolling in a university program, holding all other variables in the model constant. These findings confirm the hypothesis that there is an association between participating in a public preschool program as a child and enrolling in a university program as a young adult. There is also a significant, positive relationship ($p<.05$) between private preschool participation and enrolling in a university. Private preschool participation is associated with a 9.1 percent increase in the odds of university enrollment, holding all other variables in the model constant.

b) Subgroup Findings

In addition to the overall analysis of the relationship between preschool participation and both secondary degree completion and university enrollment, estimates were also calculated by gender and socioeconomic status. For the purpose of this thesis, socioeconomic status is defined as living above or below the official Uruguayan PL, for which a description and a full record from 2011 to 2014 can be found in Figure 2. None of the models could be used for individuals living below the PL in the private preschool participation analysis due to a low sample size and multicollinearity issues with some of the covariates.

The PSM results that predict the relationship between participating in a preschool program in Uruguay and graduating from secondary school for the subgroups can be found in Table 7. The results suggest that, while there is not a significant relationship between public preschool participation in Uruguay and secondary school completion for the overall sample, that there in fact is a significant, positive relationship for males ($p<.1$) and females ($p<.1$), as well as individuals living below the PL ($p<.05$). Participating in a public preschool program is associated with a 4.2 percent increase in the odds of completing secondary school for males, a 6.4 percent increase in the odds for females, and a 3.2 percent increase in the odds for those living below the PL, holding all other variables in the model constant. Additionally, there is a significant, positive relationship between private preschool participation and secondary school completion for males ($p<.05$) and females ($p<.05$), as well as individuals living above the PL ($p<.05$). Participating in a private preschool program is associated with a 14.7 percent increase in the odds of completing secondary school for males, a 14.8 percent increase in the odds for females, and a 9.9 percent increase in the odds for those living above the PL, holding all other variables in the model constant.

The PSM results that predict the relationship between participating in a preschool program in Uruguay and enrolling in university program for the subgroups can be found in Table 8. The results suggest that there is a significant, positive relationship between public preschool participation in Uruguay and university enrollment for all subgroups: males ($p<.1$), females ($p<.01$), individuals living above the PL ($p<.05$), and individuals living below the PL ($p<.01$). Participating in a public preschool program is associated with a 3.1 percent increase in the odds of university enrollment for males, an 8.2 percent increase in the odds for females, a 3.7 percent increase in the odds for individuals living above the PL, and a 2.5 percent increase in the odds for individuals living below the PL, holding all other variables in the model constant. Additionally, there is a significant, positive relationship between private preschool participation and university enrollment for both males ($p<.1$) and females ($p<.05$). Participating in a private preschool program is associated with an 11.3 percent increase in the odds of enrolling in a university program for males and a 10.3 percent increase in odds for females, holding all other variables in the model constant.

c) Robustness Checks

Several robustness checks of the main results are performed to ensure that the estimates maintain their significance levels and magnitudes under different models. First, Logit regressions are run without the covariates to determine the extent of selection bias in the estimates, as can be observed in columns (1) and (6) of Tables 5 and 6. These estimates have much higher magnitudes than those in the models that include covariates, demonstrating that there was significant selection bias that resulted in the estimates without covariates being upwardly biased.

Second, the Logit and LPM models that include covariates in columns (2), (3), (7), and (8) of Tables 5 and 6 were compared to the main PSM models in columns (5) and (10). The

Logit and LPM coefficients all have greater or equal significance levels and magnitudes compared to their respective PSM coefficients. This indicates that selection bias was further reduced for the observed characteristics by using PSM to provide better balance between the treatment and control groups for the covariates.

Finally, new PSM models are created that do not include the covariates that are more unbalanced between the treatment and control groups when PSM is performed, as can be seen in columns (4) and (9) of Tables 5 and 6. For the public preschool participation analyses, the birth cohort covariate is omitted because there is worse balance for the years 1992 and 1993, although there is better balance for the other birth years. For the private preschool participation analyses, the birth cohort covariate is omitted because it is more poorly balanced for all years except for 1992, and gender is also omitted because it is more poorly balanced when matching occurs. For almost all of the main results, the new PSM estimates have greater or equal levels of significance and magnitudes than our main PSM estimates in columns (5) and (10). However, the new PSM estimate did slightly reduce in significance and magnitude for the relationship between public preschool participation and university enrollment compared to the main PSM model. Nevertheless, the reduction in the odds ratio coefficient is only by 0.008, and it is still significant at the 95 percent confidence level. Additionally, the new PSM model is not necessarily a better choice since all but two of the birth years were better matched in the main PSM model.

VII. LIMITATIONS

There are a few limitations of the empirical strategy utilized in this thesis that could hinder its ability to identify the true causal effect of participating in a preschool program on secondary school graduation or university enrollment. First, for the results to be unbiased, any

confounding variables that are associated with the key independent and dependent variables must be included in the models. There may be some confounding individual-level characteristics that are not included in these models, such as innate ability and motivation. A child's ability and motivation are likely associated with whether a child wants to attend preschool, which could influence whether parents enroll the child. Additionally, student ability and motivation are almost certainly correlated with educational attainment. However, any bias found here would probably be small because whether or not a child attends preschool likely has more to do with parent preferences. Parents with certain characteristics, such as those with high levels of participation and motivation, may be more likely to enroll their children in preschool and give additional academic support so that their children will have a higher probability of completing secondary school and enrolling in a university program. These confounding household variables potentially present an issue for this analysis because any systematic differences in whether or not children attend preschool can introduce omitted variable bias and selection bias into the estimates. This problem may be amplified because of the comparatively small sample size of individuals who have not participated in a preschool program, meaning that they are going against the norm. The summary statistics in Table 1 demonstrate that these individuals have characteristics that significantly differentiate them from preschool participants, such as differences in gender, ethnicity, socioeconomic status, and urbanicity. The empirical strategy employed by this thesis controls for these variables, and uses education of the HOH(s) as a proxy for guardian attentiveness and participation. However, even by using PSM, which helps us account for selection bias in our observed variables, the analysis cannot account for the unobserved characteristics for which there are no data. The inability to directly control for variables such as parent participation hinders the ability of this thesis to establish causation.

Another potential issue with the analysis is that it omits some individuals in the ECH dataset, which could potentially bias the results. Around the age of 16, some study participants begin moving out of their guardians' households and begin households of their own. These individuals are not included in the analysis because certain crucial data on them is missing, such as parent or guardian education levels. The number of study participants that begin new households is relatively small for the ages being examined, and only account for 10.8 percent of households in which 19 and 20 year olds live. Nevertheless, there are significant differences between individuals included in the sample and those not included in terms of secondary degree completion, university enrollment, preschool participation, gender, ethnicity, poverty status, urbanicity, and birth cohort, as can be seen in Table 2. To check if this biases the estimates, models are run that add the individuals not originally included in the sample, although by necessity HOH education is omitted as a control. The PSM results, shown in Tables 9 and 10, demonstrate that the inclusion of individuals not previously in the sample generally raises the significance levels and magnitudes of the estimates, and that there are no big reductions in these measures for any of the estimates. However, without the inclusion of HOH education as a covariate, these results only serve as a sensitivity check to ensure that the exclusion of individuals who have started their own household does not significantly bias the results.

VIII. DISCUSSION

The results found in this thesis suggest that there is an overall positive and significant association between public preschool participation and university enrollment in Uruguay, but not secondary school completion. However, public preschool participation is positively associated with secondary school completion for the male, female and below the PL subgroups, the last of

which was a main group targeted by the public preschool expansion in Uruguay. The results also suggest that private preschool participation is significantly associated with higher levels of both secondary school completion and university enrollment for the overall sample.

There is no clear explanation for why public preschool completion would not be associated with secondary school completion for the overall analysis. One possible explanation is that some of the individuals who did not participate in a public or private preschool program were either homeschooled or enrolled in some other sort of intervention that raised their cognitive or non-cognitive abilities to nearly the same levels as children who were enrolled in a public preschool program. These children would currently be listed as non-participants of any preschool program and are included in the counterfactual. However, there is not enough information readily available regarding preschool alternatives in Uruguay to make any conclusive statements regarding the alternatives to preschool participation. Another explanation could be that the quality of public preschool programs suffers in Uruguay. An additional possibility is that teachers may focus more attention on students from families below the PL than more advantaged children, which would explain why there is a significant association for the former but not the later. It is also possible that students from households below the PL acquire skills in public preschool that they are not gaining from their households, while students from households above the PL are already obtaining these skills from their families. Additional research would need to be conducted to examine if one of these possibilities is occurring, or if there is another reason why these results are being observed.

Another question that arises is, given that there is no overall association between public preschool participation and secondary school completion in Uruguay, why is there a positive association between public preschool participation and university enrollment? A possible

explanation for this phenomenon is that the skills gained in public preschool programs primarily benefit or persist in students who already have the motivation to complete secondary school, and that these skills are able to increase the motivation of these students to enroll in higher education programs. Under this scenario, there would not be a sizable difference in secondary school completion between public preschool participants and non-participants, but there would be for university enrollment. This is a hypothesis that will need to be tested in further research before any conclusive statements can be made as to whether this is occurring.

The findings presented in this thesis add to the literature on the relationship between public preschool participation and educational attainment in Uruguay. In particular, it expands upon the findings of Berlinksi et al. (2008), who find that participating in any preschool program in Uruguay can lead to increased years of schooling up to age 15. The results presented in this thesis suggest that, even if mean years of education are higher at around the age of 15 for students that participated in preschool, this difference may not translate into a higher probability of earning a secondary degree for the overall population. Additionally, the findings from Berlinksi et al. (2008) may only be statistically significant because they are analyzing both public and private preschool programs together, rather than examining them separately. Based on the results in this thesis, participation in private preschool programs is more likely to be associated with increased educational attainment than public preschool programs. However, the results also suggest that the association between public preschool participation and higher levels of educational attainment is not absent since there is a positive association between public preschool participation and university enrollment, as well as secondary school completion for the male, female, and below the PL subgroups.

The results presented in this thesis may also have wider implications for countries

throughout the LAC region. The public preschool programs in Uruguay share many characteristics to those that have launched over the past two decades in other LAC countries (Araujo et al., 2013). The Dominican Republic, Peru, Paraguay, Panama, Nicaragua, Mexico, Honduras, Guatemala, El Salvador, Ecuador, Costa Rica, Colombia, Chile, Brazil, Bolivia, and Argentina also have large public preschool programs targeted especially towards families with low-income children (Araujo et al., 2013). The results in this thesis suggest that similar programs may be able to increase educational attainment for these low-income children, but possibly not for more advantaged children. In order for countries that currently have or are considering implementing public preschool programs similar to those in Uruguay to raise educational attainment for all students, they should closely examine both the quality of education and how teacher attention is distributed among students. Through maximizing secondary school completion and university enrollment rates for as many students as possible, these countries should be able to increase the earnings of individuals, which will likely result in increased tax revenues and hastened economic development (Jaeger & Page, 1996; Kane & Rouse, 1993).

IX. APPENDIX

Figure 1: Hypothesized Relationship between Preschool Participation & Educational Attainment

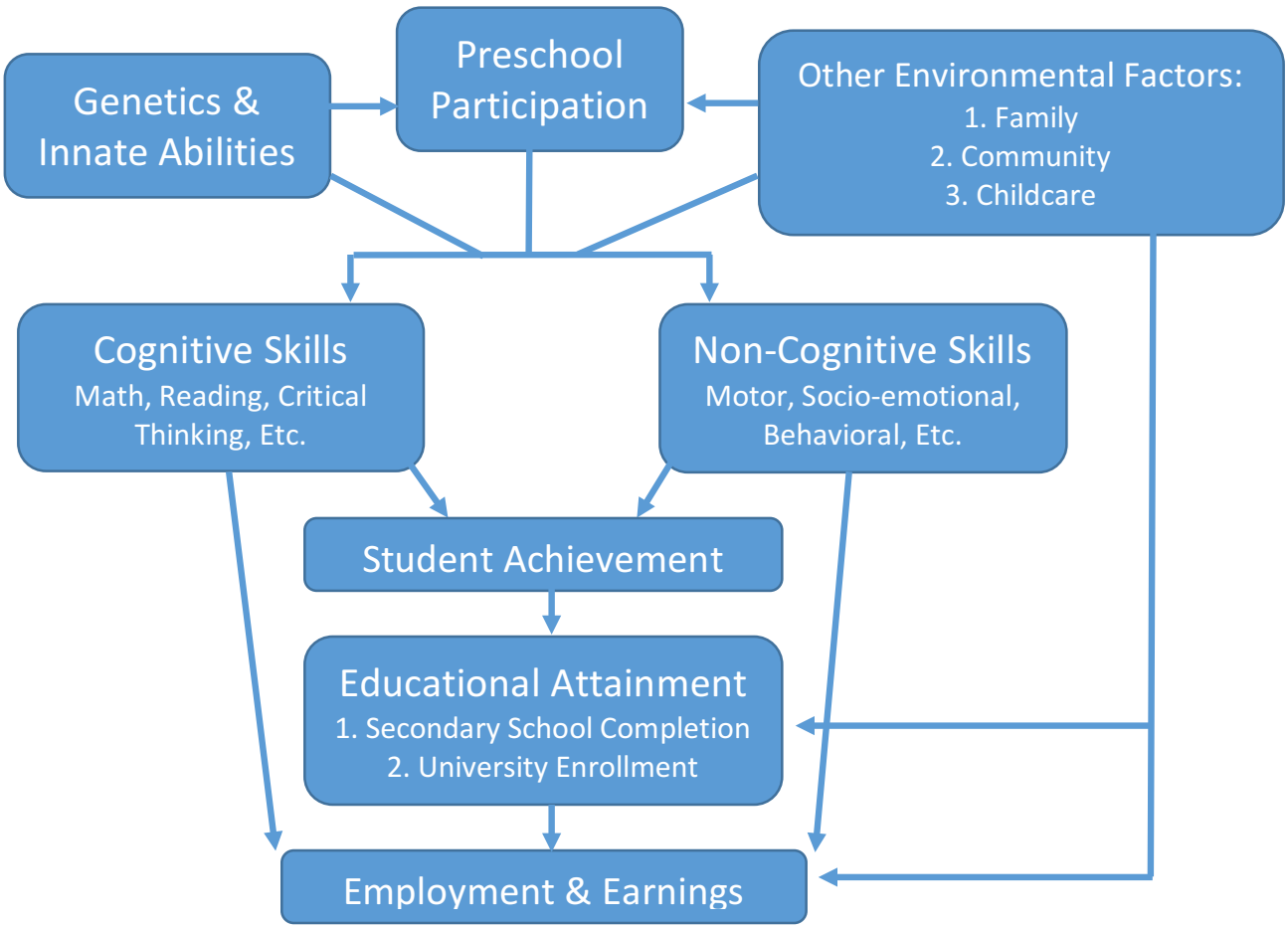
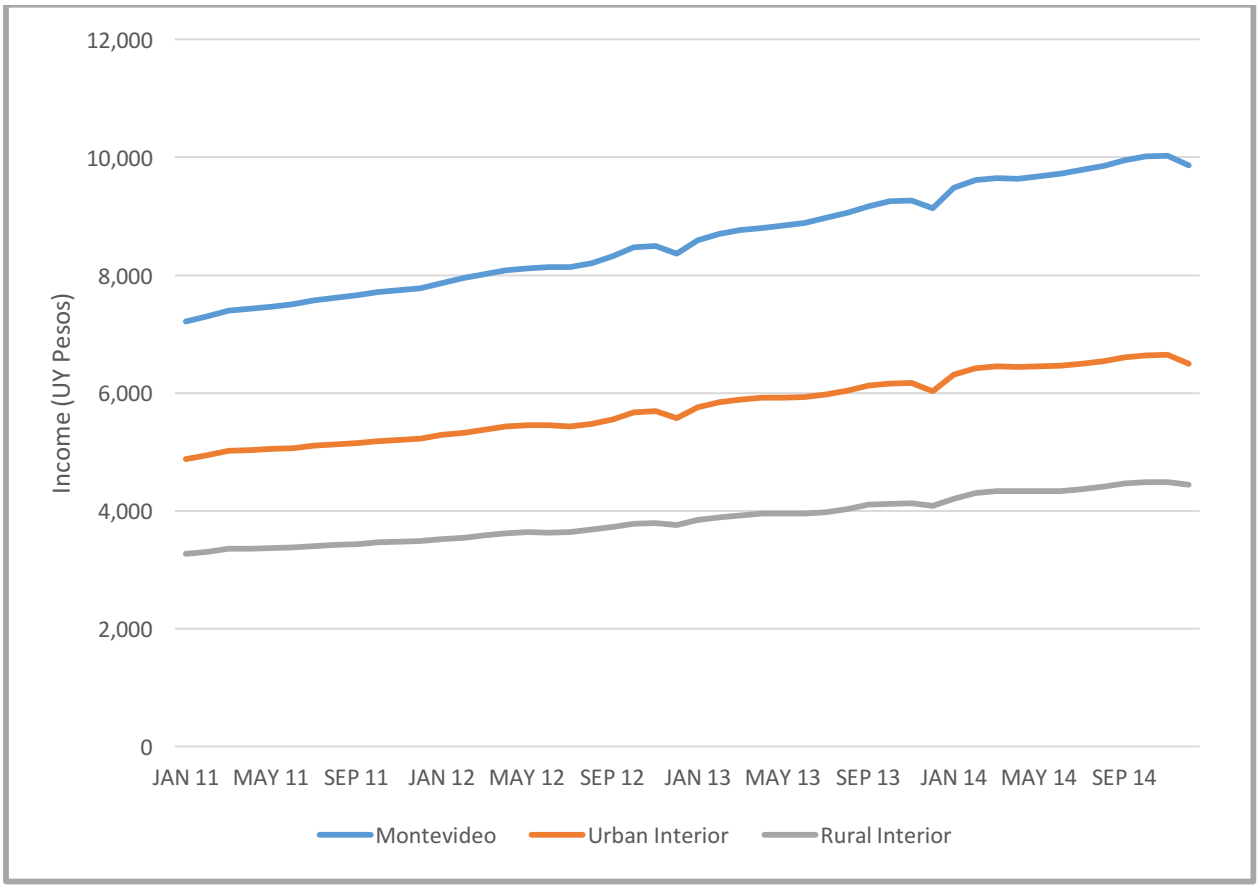


Figure 2: Uruguayan Official Poverty Line from 2011-2014 (Nominal)



Notes: PL data are from the INE (INE, 2016). The official PL in Uruguay is determined monthly and based on household income statistics collected through ongoing ECH surveys (INE, 2006). The PL is calculated by household and varies based on the number of people living in each household. Values shown above are based on a one-person household. The PL includes three categories based on urbanicity: Montevideo, the urban interior and the rural interior.

Table 1: Characteristics of Sample Individuals Aged 19 to 20

	Public Preschool	Private Preschool	No Preschool	Total
Dependent Variable				
Secondary School Completion	0.28***	0.66***	0.15	0.35
University Enrollment	0.15***	0.53***	0.06	0.22
Gender				
Female	0.47*	0.50***	0.44	0.47
Ethnicity				
Non-White	0.06**	0.02***	0.07	0.05
Socioeconomic Status[a]				
Below Poverty Line	0.13***	0.02***	0.23	0.12
Urbanicity[b]				
Large Urban (Montevideo)	0.30***	0.65***	0.22	0.36
Medium Urban	0.56**	0.31***	0.51	0.51
Small Urban	0.10***	0.03***	0.15	0.09
Rural	0.05***	0.01***	0.12	0.05
Birth Cohort				
1991	0.11***	0.14	0.15	0.12
1992	0.23**	0.25	0.27	0.24
1993	0.25	0.23	0.22	0.24
1994	0.26	0.25	0.25	0.26
1995	0.14**	0.12	0.11	0.14
HOH Education (Years)[c]	9.46***	13.91***	7.63	10.18
Observations	9,797	2,482	887	13,166

Notes: *** p<0.01, ** p<0.05, * p<0.1. Reported significance levels for each characteristic are based on t-tests that compare the proportion or mean level of either public or private preschool participants to that of individuals who did not attend preschool. Reference categories are male for gender, white for ethnicity, and above the PL for socioeconomic status.

[a] Socioeconomic status is based on the official Uruguayan PL. A description of the Uruguayan PL and a full record from 2011 to 2014 can be found in Figure 2.

[b] Large urban sites have ≥ 100,000 people (Montevideo), medium urban sites have < 100,000 and ≥ 5,000 people, and small urban sites have < 5,000 people and basic infrastructure. Rural areas have < 5,000 people but little infrastructure.

[c] HOH education is calculated as the average years of education between the HOH and his or her spouse. The HOH is a parent for around 85 percent of individuals, another relative for around 13 percent of individuals, and a non-relative for less than 2 percent of individual.

Table 2: Characteristics of Individuals Aged 19 to 20: Sample vs. Non-Sample

	Sample	Non-Sample
Dependent Variables		
Secondary School Completion	0.35	0.15***
University Enrollment	0.22	0.08***
Preschool Participation		
Public Preschool	0.74	0.84***
Private Preschool	0.19	0.07***
No Preschool	0.07	0.08**
Gender		
Female	0.47	0.32***
Ethnicity		
Non-White	0.05	0.10***
Socioeconomic Status[a]		
Below Poverty Line	0.12	0.22***
Urbanicity[b]		
Large Urban (Montevideo)	0.36	0.34*
Medium Urban	0.51	0.51
Small Urban	0.09	0.10*
Rural	0.05	0.05
Birth Cohort		
1991	0.12	0.14
1992	0.24	0.23
1993	0.24	0.25
1994	0.26	0.28*
1995	0.14	0.10***
Observations	13,166	1,592

Notes: *** p<0.01, ** p<0.05, * p<0.1. Reported significance levels for each characteristic are based on t-tests that compare the proportion or mean level of individuals in the sample to individuals who are not in the sample because they already started their own households. Reference categories are male for gender, white for ethnicity, and above the PL for socioeconomic status. Sample consists of individuals aged 19 to 20.

[a] Socioeconomic status is based on the official Uruguayan PL. A description of the Uruguayan PL and a full record from 2011 to 2014 can be found in Figure 2.

[b] Large urban sites have ≥ 100,000 people (Montevideo), medium urban sites have < 100,000 and ≥ 5,000 people, and small urban sites have < 5,000 people and basic infrastructure. Rural areas have < 5,000 people but little infrastructure.

Table 3: Balance between Control & Treatment Groups in the PSM Models for the Public Preschool Participation Estimates

	Standardized Differences		Variance Ratio	
Characteristic	**Raw**	**Matched**	**Raw**	**Matched**
Gender				
Female	0.065	0.061	1.011	1.012
Ethnicity				
Non-White	-0.072	0.052	0.771	1.239
Socioeconomic Status[a]				
Below PL	-0.243	0.031	0.659	1.070
Urbanicity[b]				
Large Urban (Montevideo)	0.186	0.043	1.226	1.042
Medium Urban	0.084	-0.061	0.987	1.017
Small Urban	-0.158	0.020	0.689	1.056
HOH Education[c]	0.527	-0.006	1.331	0.980
Birth Cohort				
1992	-0.078	-0.032	0.914	0.962
1993	0.052	0.003	1.066	1.003
1994	0.030	-0.046	1.033	0.955
1995	0.090	0.112	1.220	1.297

Notes: N=10,684. Balance is the same for the secondary school completion and university enrollment analyses. Reference categories are male for gender, white for ethnicity, above the PL for socioeconomic status, rural for urbanicity, and 1991 for birth cohort. Sample consists of individuals aged 19 to 20.

[a] Socioeconomic status is based on the official Uruguayan PL. A description of the Uruguayan PL and a full record from 2011 to 2014 can be found in Figure 2.

[b] Large urban sites have ≥ 100,000 people (Montevideo), medium urban sites have < 100,000 and ≥ 5,000 people, and small urban sites have < 5,000 people and basic infrastructure. Rural areas have < 5,000 people but little infrastructure.

[c] HOH education is calculated as the average years of education between the HOH and his or her spouse. The HOH is a parent for around 85 percent of individuals, another relative for around 13 percent of individuals, and a non-relative for less than 2 percent of individuals.

Table 4: Balance between Control & Treatment Groups in the PSM Models for the Private Preschool Participation Estimates

	Standardized Differences		Variance Ratio	
Characteristic	**Raw**	**Matched**	**Raw**	**Matched**
Gender				
Female	0.133	0.204	1.016	1.061
Ethnicity				
Non-White	-0.249	0.022	0.302	1.119
Socioeconomic Status[a]				
Below PL	-0.649	-0.009	0.124	0.974
Urbanicity[b]				
Large Urban (Montevideo)	0.958	0.026	1.328	0.996
Medium Urban	-0.422	-0.017	0.857	0.991
Small Urban	-0.441	0.037	0.202	1.156
HOH Education[c]	1.693	0.005	1.651	1.087
Birth Cohort				
1992	-0.034	0.025	0.963	1.029
1993	0.028	0.194	1.036	1.371
1994	-0.008	-0.369	0.990	0.776
1995	0.034	0.105	1.082	1.336

Notes: N=3,369. Balance is the same for the secondary school completion and university enrollment analyses. Reference categories are male for gender, white for ethnicity, above the PL for socioeconomic status, rural for urbanicity, and 1991 for birth cohort. Sample consists of individuals aged 19 to 20.

[a] Socioeconomic status is based on the official Uruguayan PL. A description of the Uruguayan PL and a full record from 2011 to 2014 can be found in Figure 2.

[b] Large urban sites have ≥ 100,000 people (Montevideo), medium urban sites have < 100,000 and ≥ 5,000 people, and small urban sites have < 5,000 people and basic infrastructure. Rural areas have < 5,000 people but little infrastructure.

[c] HOH education is calculated as the average years of education between the HOH and his or her spouse. The HOH is a parent for around 85 percent of individuals, another relative for around 13 percent of individuals, and a non-relative for less than 2 percent of individuals.

Table 5: Estimates of the Relationship between Preschool Participation and Secondary School Completion

VARIABLES	(1) Logit–OR	(2) Logit–OR	(3) LPM	(4) PSM–OR[a]	(5) PSM–OR	(6) Logit–OR	(7) Logit–OR	(8) LPM	(9) PSM–OR[b]	(10) PSM–OR
Preschool Participation										
Public Preschool	2.187***	1.500***	0.0444***	1.046***	1.033					
	(0.210)	(0.155)	(0.0120)	(0.0169)	(0.0208)					
Private Preschool						10.74***	2.915***	0.197***	1.163***	1.116***
						(1.099)	(0.372)	(0.0213)	(0.0403)	(0.0395)
Gender										
Female		2.911***	0.173***				2.565***	0.150***		
		(0.145)	(0.00784)				(0.229)	(0.0141)		
Ethnicity										
Non-White		0.525***	-0.0737***				0.402***	-0.122***		
		(0.0744)	(0.0137)				(0.118)	(0.0336)		
Socioeconomic Status[c]										
Below Poverty Line		0.294***	-0.115***				0.255***	-0.128***		
		(0.0333)	(0.00871)				(0.0697)	(0.0221)		
Urbanicity[d]										
Large Urban (Montevideo)		0.390***	-0.154***				0.662*	-0.0592*		
		(0.0446)	(0.0196)				(0.148)	(0.0329)		
Medium Urban		0.521***	-0.108***				0.604**	-0.0726**		
		(0.0557)	(0.0188)				(0.133)	(0.0317)		
Small Urban		0.542***	-0.103***				0.777	-0.0402		
		(0.0701)	(0.0214)				(0.227)	(0.0401)		
HOH Education[e]		1.280***	0.0440***				1.281***	0.0435***		
		(0.00983)	(0.00112)				(0.0171)	(0.00186)		
Birth Cohort										
1992		0.941	-0.00756				0.911	-0.0111		
		(0.0815)	(0.0134)				(0.125)	(0.0224)		
1993		0.931	-0.0112				1.029	0.00722		
		(0.0809)	(0.0135)				(0.143)	(0.0227)		
1994		0.953	-0.00789				1.140	0.0244		
		(0.0817)	(0.0134)				(0.159)	(0.0228)		
1995		0.877	-0.0191				0.878	-0.0160		
		(0.0854)	(0.0152)				(0.143)	(0.0266)		

Notes: N=10,684 for public preschool estimates. N=3,369 for private preschool estimates. *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors are in parentheses. PSM models in columns (5) and (10) are the main models. Logit and PSM coefficients are reported in odds ratios (OR). PSM models use all covariates unless noted. Reference categories for Logit and LPM estimates are no preschool for preschool participation, male for gender, white for ethnicity, above the PL for socioeconomic status, rural for urbanicity, and 1991 for birth cohort. Sample consists of individuals aged 19 to 20.

[a] Birth cohort covariate is not included in the PSM model. [b] Birth cohort and gender covariates are not included in the PSM model.

[c] Socioeconomic status is based on the official Uruguayan PL. A description of the Uruguayan PL and a full record from 2011 to 2014 can be found in Figure 2.

[d] Large urban sites have ≥ 100,000 people (Montevideo), medium urban sites have < 100,000 and ≥ 5,000 people, and small urban sites have < 5,000 people and basic infrastructure. Rural areas have < 5,000 people but little infrastructure.

[e] HOH education is calculated as the average years of education between the HOH and his or her spouse. The HOH is a parent for around 85 percent of individuals, another relative for around 13 percent of individuals, and a non-relative for less than 2 percent of individuals.

Table 6: Estimates of the Relationship between Preschool Participation and University Enrollment

VARIABLES	(1) Logit–OR	(2) Logit–OR	(3) LPM	(4) PSM–OR[a]	(5) PSM–OR	(6) Logit–OR	(7) Logit–OR	(8) LPM	(9) PSM–OR[b]	(10) PSM–OR
Preschool Participation										
Public Preschool	2.876***	1.753***	0.0236***	1.037**	1.045***					
	(0.419)	(0.261)	(0.00814)	(0.0149)	(0.0173)					
Private Preschool						18.01***	4.337***	0.150***	1.117***	1.091**
						(2.674)	(0.713)	(0.0181)	(0.0331)	(0.0383)
Gender										
Female		2.788***	0.104***				1.913***	0.101***		
		(0.178)	(0.00631)				(0.169)	(0.0140)		
Ethnicity										
Non-White		0.589***	-0.0332***				0.290***	-0.114***		
		(0.110)	(0.00993)				(0.103)	(0.0263)		
Socioeconomic Status[c]										
Below Poverty Line		0.270***	-0.0513***				0.215***	-0.0571***		
		(0.0483)	(0.00599)				(0.0844)	(0.0169)		
Urbanicity[d]										
Large Urban (Montevideo)		0.612***	-0.0512***				0.717	-0.0278		
		(0.0932)	(0.0157)				(0.186)	(0.0296)		
Medium Urban		0.555***	-0.0612***				0.524**	-0.0809***		
		(0.0811)	(0.0148)				(0.136)	(0.0278)		
Small Urban		0.497***	-0.0621***				0.503*	-0.0698**		
		(0.0912)	(0.0165)				(0.181)	(0.0344)		
HOH Education[e]		1.324***	0.0353***				1.285***	0.0450***		
		(0.0120)	(0.00106)				(0.0172)	(0.00180)		
Birth Cohort										
1992		1.025	0.000812				0.761*	-0.0363		
		(0.113)	(0.0107)				(0.109)	(0.0224)		
1993		1.055	0.00165				0.884	-0.0132		
		(0.115)	(0.0107)				(0.127)	(0.0229)		
1994		1.022	-0.000825				1.033	0.0101		
		(0.111)	(0.0106)				(0.150)	(0.0231)		
1995		0.910	-0.0121				0.851	-0.0159		
		(0.113)	(0.0119)				(0.143)	(0.0268)		

Notes: N=10,684 for public preschool estimates. N=3,369 for private preschool estimates. *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors are in parentheses. PSM models in columns (5) and (10) are the main models. Logit and PSM coefficients are reported in odds ratios (OR). PSM models use all covariates unless noted. Reference categories for Logit and LPM estimates are no preschool for preschool participation, male for gender, white for ethnicity, above the PL for socioeconomic status, rural for urbanicity, and 1991 for birth cohort. Sample consists of individuals aged 19 to 20.

[a] Birth cohort covariate is not included in the PSM model. [b] Birth cohort and gender covariates are not included in the PSM model.

[c] Socioeconomic status is based on the official Uruguayan PL. A description of the Uruguayan PL and a full record from 2011 to 2014 can be found in Figure 2.

[d] Large urban sites have ≥ 100,000 people (Montevideo), medium urban sites have < 100,000 and ≥ 5,000 people, and small urban sites have < 5,000 people and basic infrastructure. Rural areas have < 5,000 people but little infrastructure.

[e] HOH education is calculated as the average years of education between the HOH and his or her spouse. The HOH is a parent for around 85 percent of individuals, another relative for around 13 percent of individuals, and a non-relative for less than 2 percent of individuals.

Table 7: Subgroup Estimates of the Relationship between Preschool Participation and Secondary School Completion

VARIABLES	(1) Male PSM	(2) Female PSM	(3) Above PL PSM[a]	(4) Below PL PSM[a]	(5) Male PSM	(6) Female PSM	(7) Above PL PSM[a]
Public Preschool	1.042*	1.064*	1.032	1.032**			
	(0.0247)	(0.0347)	(0.0249)	(0.0157)			
Private Preschool					1.147**	1.148**	1.099**
					(0.0669)	(0.0618)	(0.0428)
Observations	5,719	4,965	9,182	1,502	1,738	1,631	3,114

Notes: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors are in parentheses. PSM coefficients reported in odds ratios. PSM models include gender, ethnicity, socioeconomic status, urbanicity, HOH education and birth cohort as covariates. Sample consists of individuals aged 19 to 20.
[a] Socioeconomic status is based on the official Uruguayan PL. A description of the Uruguayan PL and a full record from 2011 to 2014 can be found in Figure 2.

Table 8: Subgroup Estimates of the Relationship between Preschool Participation and University Enrollment

VARIABLES	(1) Male PSM	(2) Female PSM	(3) Above PL PSM[a]	(4) Below PL PSM[a]	(5) Male PSM	(6) Female PSM	(7) Above PL PSM[a]
Public Preschool	1.031*	1.082***	1.037**	1.025***			
	(0.0167)	(0.0291)	(0.0168)	(0.00580)			
Private Preschool					1.113*	1.103**	1.064
					(0.0648)	(0.0528)	(0.0438)
Observations	5,719	4,965	9,182	1,502	1,738	1,631	3,114

Notes: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors are in parentheses. PSM coefficients reported in odds ratios. PSM models include gender, ethnicity, socioeconomic status, urbanicity, HOH education and birth cohort as covariates. Sample consists of individuals aged 19 to 20.
[a] Socioeconomic status is based on the official Uruguayan PL. A description of the Uruguayan PL and a full record from 2011 to 2014 can be found in Figure 2.

Table 9: Estimates of the Relationship between Preschool Participation and Secondary School Completion for both Sample & Non-Sample Individuals

VARIABLES	(1) Overall PSM	(2) Male PSM	(3) Female PSM	(4) Above PL PSM[a]	(5) Below PL PSM[a]	(6) Overall PSM	(7) Male PSM	(8) Female PSM	(9) Above PL PSM[a]
Preschool Participation									
Public Preschool	1.105***	1.094***	1.118***	1.120***	1.029**				
	(0.0153)	(0.0178)	(0.0251)	(0.0181)	(0.0148)				
Private Preschool						1.525***	1.521***	1.521***	1.571***
						(0.0345)	(0.0390)	(0.0559)	(0.0378)
Observations	12,159	6,192	5,967	10,335	1,824	3,616	1,819	1,797	3,303

Notes: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors are in parentheses. PSM coefficients are reported in odds ratios. Non-sample individuals are not in the sample because they already started their own households. PSM models include gender, ethnicity, socioeconomic status, urbanicity, HOH education and birth cohort as covariates. Sample consists of individuals aged 19 to 20.

[a] Socioeconomic status is based on the official Uruguayan PL. A description of the Uruguayan PL and a full record from 2011 to 2014 can be found in Figure 2.

Table 10: Estimates of the Relationship between Preschool Participation and University Enrollment for both Sample & Non-Sample Individuals

VARIABLES	(1) Overall PSM	(2) Male PSM	(3) Female PSM	(4) Above PL PSM[a]	(5) Below PL PSM[a]	(6) Overall PSM	(7) Male PSM	(8) Female PSM	(9) Above PL PSM[a]
Preschool Participation									
Public Preschool	1.074***	1.050***	1.099***	1.085***	1.016**				
	(0.0107)	(0.0119)	(0.0182)	(0.0128)	(0.00785)				
Private Preschool						1.471***	1.456***	1.489***	1.516***
						(0.0268)	(0.0288)	(0.0458)	(0.0297)
Observations	12,159	6,192	5,967	10,335	1,824	3,616	1,819	1,797	3,303

Notes: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors are in parentheses. PSM coefficients are reported in odds ratios. Non-sample individuals are not in the sample because they already started their own households. PSM models include gender, ethnicity, socioeconomic status, urbanicity, HOH education and birth cohort as covariates. Sample consists of individuals aged 19 to 20.

[a] Socioeconomic status is based on the official Uruguayan PL. A description of the Uruguayan PL and a full record from 2011 to 2014 can be found in Figure 2.

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