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ABSTRACT

I develop a model in which a child's acquisition of a given form of human capital incentivizes adults in his household to either learn from him (if children act as teachers then adults' cost of learning the skill falls) or lean on him (if children's human capital substitutes for that of adults in household production then adults' benefit of learning the skill falls). I exploit regional variation in two shocks to children's human capital and examine the effect on adults. The rapid introduction of primary education for black children in the South during Reconstruction not only increased literacy of children but also of adults living in the same household ("learning" outweighs "leaning"). Conversely, the 1998 introduction of English immersion in California public schools appears to have increased the English skills of children but discouraged adults living with them from acquiring the language ("leaning" outweighs "learning"). Whether family members learn from or lean on each other has implications for the externalities associated with education policies.

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1 Introduction

Parents are often a child's first teachers, and economic models have long recognized the role parents play in passing on human capital to their children (see Becker and Tomes 1979, Becker and Tomes 1986 as well as the response by Goldberger 1989). In contrast, these models generally assume that children's human capital has little contemporaneous effect on parents and other adults in their household; it generally does not enter into the household production function and is not transferred to adults by peer effects or some other form of learning.[1] The empirical treatment of intergenerational transmission of human capital has followed the theoretical literature in focusing chiefly on the transmission from parents to children (see, for example, Behrman and Rosenzweig 2002, Sacerdote 2002, Plug 2004, Black *et al.* 2005, and Oreopoulos *et al.* 2006).

In this paper, I model the transfer of human capital from children to adults. In contrast to the classic models of intergenerational human capital transmission, which find that, all else equal, an increase in parents' human capital leads to an increase in that of their children, I show that children's human capital investment can either increase or decrease that of the adult members of their household. The sign of the effect depends on the household production function and the learning technology.

Suppose a child exogenously acquires a new skill. On the one hand, an adult can *learn* from the child, as the cost to adults of learning the skill will fall if their children can teach it to them. This "learning effect" suggests positive human capital spillovers from children to adults. On the other hand, an adult can *lean* on the child, as the benefit to adults of acquiring the skill will fall if children's human capital can substitute for that of adults in the household production function. This "leaning effect" suggests negative spillovers. Moreover, the model I present offers a framework for predicting which types of human capital lend themselves to "leaning" versus "learning." The higher the cost of alternative methods of acquiring the

[1] Ehrlich and Lui (1991) assume children's human capital affects parents in their old-age and thus parents invest in their children's human capital because they will one day depend on their children's income. But the direction of the investment in this model is still from parents to children.

skill, the more adults will learn from their children. The more children's human capital can directly increase adults' consumption, the more adults will lean on their children.

The empirical work focuses on two examples where children received a plausibly exogenous shock to their human capital and estimates its effect on the human capital investment of the adults living with them. During the Reconstruction era following the U.S. Civil War, the federal government created the Freedmen's Bureau to administer thousands of schools for black children in the South. Whereas essentially no black children in the Confederacy had access to formal schooling before the Civil War, over ten percent of those between the ages of ten and twelve were enrolled in school during the 1869-1870 school year.[2] Using household-level variation based on children's ages interacted with county-level variation in the educational levels of black children, I find that living with a literate child increased the probability a black adult would be literate himself. Thus, on net, Reconstruction-era Southern blacks appear to have *learned* from their literate children.

In 1998, California voters passed Proposition 227, which replaced bilingual education with English immersion in public schools. When classes ended for the summer in 1998, 29 percent of English-learners received core academic instruction in their native languages; when classes resumed that September, only 11 percent did. Using geographic variation in compliance with Proposition 227 across California, I find that although children living in highly compliant areas are more likely to speak English after the reform, the adults living with children in these areas are less likely to be English proficient. Thus, on net, immigrant parents appear to *lean* on their English-proficient children. In both this and the Reconstruction context, the results are driven by households with children of school-going age, suggesting that children's human capital acquisition, and not some omitted variable, is driving the effect on adults.

The results in this paper may interest a variety of researchers and policy-makers. First, the model I present highlights the possibility of "negative" human capital spillovers, which has received little attention among economists studying peer effects. Of course, economists

[2]My calculations from the 1870 Integrated Public Use Microdata Series (IPUMS).

have studied free-riding in the context of public-goods games and team work effort, but, in the context of human capital, have generally assumed individuals learn from their peers.

Second, as most educational policies target children, determining the extent of human capital spillovers to older members of the household would allow policy-makers to better compare the marginal social benefits and costs of these policies. In the case of English acquisition, gains to children may be tempered by the negative spillovers on adults. My results suggest that if policy-makers wish to assimilate entire immigrant *families*, separate programs may need to target adults as teaching only children may in fact slow adults' progress. In contrast, the literacy patterns of Reconstruction-era Southern blacks suggest, as in Miguel and Kremer (2004), that program evaluations that consider only the effects on a policy's prime targets may systematically underestimate its social benefits.

Third, the transmission of human capital from children to adults likely plays an especially important role in developing countries. Unlike many developed countries in which average educational attainment has plateaued, educational attainment in developing countries is still rising with each successive cohort, so children often have more total years of schooling than their parents and thus opportunities to teach them new information and skills. To my knowledge, few if any development economics papers have examined whether interventions that target children affect the adults with whom they live. Given the scarcity of resources of governments and NGOs in developing countries, promoting investments with positive spillovers to parents and addressing situations with negative spillovers could lead to important welfare gains.

Fourth, even in cases where parents and children have the same level of formal education, children often invest more in learning how to use new technologies (e.g., computers).[3] Thus, in settings with rapid technology growth, child-to-adult spillovers may play an especially

[3]I have found very little academic research on the implications of age-specific technology adoption. However, marketing research suggests that one-half of U.S. children have helped their parents use the Internet to shop at online stores, plan vacations, get driving directions, or download tax forms. See Gardner (2007).

important role.

Finally, the results in this paper might interest researchers and policy-makers in the area of bilingual education and immigration reform. Although Proposition 227 remains controversial in California, Massachusetts and Arizona have since passed similar initiatives (*The Economist*, 2008). Taking the opposite approach, districts in Georgia and Utah have hired teachers from Mexico to conduct classes in Spanish to their growing population of Hispanic students (Thompson, 2009). Between 1979 and 2006, the number of students K-12 speaking a foreign language at home has tripled, and the trend shows no sign of reversing (United States Department of Education, 2008). Understanding the effects of different educational philosophies on immigrant students and their families is likely to remain essential to optimally crafting public policy for many years to come; indeed, both Presidents Bush and Obama have stressed English proficiency requirements in their comprehensive immigration reform proposals.

The paper is organized as follows. Section 2 presents a simple model to illustrate the interactions between children's and adults' human capital investments. Section 3 provides background on Reconstruction and the Freedmen's Bureau, as well the data, empirical strategy and results for the literacy analysis. Section 4 is the analogue to Section 3 but focuses on Proposition 227 and English acquisition of immigrants in California. Section 5 concludes and offers directions for further research.

2 Model

2.1 Overview

This section provides a simple model of how adults' optimal level of human capital investment depends on the human capital of their children. As in the standard model of human capital investment (e.g., Ben Porath 1967; Becker 1964), adults weigh the benefit of the investment (the increase in consumption) against its price (the time, opportunity or psychic cost).

Children change the standard model in two ways. On the one hand, children can decrease the cost of human capital investment for their relatives. For example, suppose that in order to learn English immigrant parents can either study at home with their proficient child or attend an English as a Second Language (ESL) class. Not only can they save money and time if their child acts as their private tutor, they may also "save face" as they can avoid making potentially embarrassing mistakes in front of strangers. This decrease in the *price* of investment leads parents to invest *more* in human capital acquisition. I call this phenomenon the "learning effect."

On the other hand, if children's human capital can substitute for that of adults in household production, then proficient children provide many of the benefits adults would enjoy from acquiring the human capital themselves. For example, a literate or English-proficient child can read contracts, bills or coupons, and confer with landlords, doctors and teachers on behalf of their family members; children's human capital may even assist adults in finding better jobs.[4] The ability of children's human capital to directly increase adults' consumption decreases adults' incentive to invest in human capital themselves. I call this phenomenon the "leaning effect."

2.2 Mechanics

I modify the classic returns-to-education model with the above ideas in mind. Adults maximize a separable utility function positive and concave in consumption and negative and convex in the cost of investment.[5] Adults' consumption y is a positive and concave function of both their own human capital k and their children's human capital c, so $y = y(k, c)$. Adults' human capital k is a positive and concave function of their investment in human capital, which I denote by e, as one can think of investment in this context as "effort" or

[4]Basu *et al.* (2001) use data from Bangladesh to show that having a literate member of the household is associated with higher wages for non-literate members.

[5]The convex, negative relationship between cost of investment and utility follows from the standard assumption that marginal utility diminishes with any "good;" in this case, the "good" would be lack of investment costs.

"education."

The cost of investment λ is increasing and convex in e. Importantly, there is a complementarity between adults' investment e and their children's level of human capital c, so that $\lambda_{ec} < 0$. As described above, having a proficient child can reduce the per-unit psychic or monetary cost of investment e.

With the above assumptions in mind, I specify adults' utility as:

$$\psi(y(k(e), c)) - \lambda(e, c). \tag{1}$$

As described above, y_k, y_c, k_e, λ_e, λ_{ee} are positive and λ_{ec} is negative. As utility is a positive, concave function of consumption, $\psi' > 0$ and $\psi'' < 0$.

Adults choose e^* so as to satisfy the following first-order condition:

$$\psi' y_k k_e = \lambda_e \tag{2}$$

Equation (2) yields the standard result that individuals set e^* so that the utility gain due to the increase in consumption associated with a marginal increase in e (the left-hand side of the equation) equals the increase in disutility associated with higher investment costs (right-hand side).

The main comparative static addressed in the empirical work is the effect of children's human capital on the human capital of adult household members, or $\frac{\partial k(e^*)}{\partial c}$. On the one hand, e^*, and thus $k(e^*)$, will increase with c because of the "learning effect." Having a proficient child serve as a tutor decreases parents' per-unit cost of investment (more formally, recall that $\lambda_{ec} < 0$). As the right-hand side of the equation falls with an increase in c, individuals must increase e to satisfy the first-order condition.

On the other hand, e^* will decrease with c because of the "leaning effect." An increase in children's human capital directly increases adults' consumption by y_c, thus lowering adults' marginal utility of consumption ψ'. Therefore, adults will decrease investment so as to equalize the marginal utility of consumption and the marginal dis-utility of investments costs in

equation 2. All else equal, if adults can rely on children's human capital to increase household consumption they will invest less in human capital themselves.

The idea of competing incentives is expressed more formally below:

Proposition. *The effect of children's human capital on that of adults in the household,* $\frac{\partial k(e^*)}{\partial c}$*, can be positive or negative. It is a positive function of* $(-\lambda_{ec})$*. This term represents the extent to which learning from proficient children can lower the per-unit cost of adults' human capital investment (the "learning effect"). It is a negative function of* y_c*, the direct contribution of children's human capital to adults' consumption (the "leaning effect").*

Proof. See appendix. ∎

While the model does not specify the sign of the effect, it does suggest when the sign is likely to be positive or negative. The learning effect is especially strong when the alternative to learning from one's children is especially costly. For example, as I discuss in the next section, very few black adults in the former Confederacy had access to schooling themselves. So even if they incurred some psychic cost related to the embarrassment of learning from a child, there did not exist a viable alternative.

Conversely, the leaning effect is likely to be especially important if the ψ term of utility were a function only of simple items such as food or clothing, as their consumption value should be independent of an individual's human capital. However, the marginal utility of other consumption items may depend on one's own human capital stock. For example, the consumption value of movies or newspapers depends on having not only the resources to purchase the ticket or paper but also proficiency in the local language. Individuals might also derive utility directly from the sense of personal accomplishment gained from learning a new skill. In such cases, having a proficient child is a poor substitute for acquiring human capital oneself.

2.3 Discussion

The model obviously makes many simplifying assumptions and is meant mostly for illustrative purposes. For example, I make no real distinction between household production and adults' consumption and implicitly assume that parents' consumption increases even when the increase in household production is due entirely to their children's efforts. Instead, children may refuse to contribute to household production if they want their parents to learn the skill themselves. Similarly, children's human capital acquisition may change the bargaining power within the household. These effects would act to dampen any "leaning" incentive.

Moreover, the model assumes children's human capital is determined outside the model. Instead, children may simply refuse to invest in human capital if they know their parents will free-ride off of them, thus making children's human capital endogenous to parents' expected behavior. If children only learn when they believe their parents will learn as well, then the leaning mechanism is effectively shut off.

Obviously, identifying plausibly exogenous sources of variation is essential for estimating the key comparative statics in the model and is the focus of the remainder of the paper. The variation I exploit arises from educational interventions that target children. Children exposed to the intervention acquire higher levels of human capital and I use this variation to estimate the effects on adults' human capital investment. Moreover, the children most affected are often quite young and thus may be less likely to act strategically in deciding how much effort to invest at school.

3 Did former slaves learn from their literate children?

The empirical analysis begins with an investigation of literacy spillovers within Southern black households during Reconstruction. I start by providing some historical context, first on the incentives for black adults to learn to read and write, and then on the educational opportunities provided by the Freedmen's Bureau. I then describe the individuals I sample

from the 1870 Census as well as my empirical strategy and results. I conclude the section with a series of robustness checks.

3.1 Background

Reconstruction and the Freedmen's Bureau

One of the goals of Reconstruction—which generally refers to the policies implemented in the South by the federal government after the Civil War—was to address the economic needs of former slaves. This process actually began before the war ended: any time Union soldiers captured Southern territory they had to decide how to treat individuals held as slaves, especially after the Emancipation Proclamation of 1863 officially declared such individuals free. As captured territory grew, the Department of War officially established the Bureau for Refugees, Freedmen and Abandoned Lands on March 3, 1865, more than a month before the Confederate surrender. The Freedmen's Bureau, as it became known, was one of the key institutions of the Reconstruction era and provided former slaves in the Confederacy with basic food rations, medical care, job placement, and, most famously, education.

Instead of directly running schools for Southern blacks, the Bureau funded religious and philanthropic organizations to do so. For example, the American Missionary Association alone was responsible for the instruction of over 40,000 students by 1866 (Butchart, 1980). By the time of its first full school year in 1865-1866, the Bureau supported 964 schools and 90,000 pupils. Those numbers increased to 2,677 and 150,000, respectively, by the 1869-1870 school year (Jones, 1980, p. 224). However, enrollment fell after 1870 as the federal government disbanded the Freedmen's Bureau and began to bring Reconstruction to a close.[6]

[6]By the terms of the Supplementary Freedmen's Bureau Act of 1866 (passed to continue and extend the authority created in the original act of 1865), the Freedmen's Bureau was to be disbanded during the summer of 1868. A last-minute bill was passed to extend its general authority until January 1869 and to continue its educational mandate indefinitely. However, educational funding was severely cut and the federal role in the education of Southern blacks effectively ended by the close of 1870 (Morris, 1981, p. 243). By the early 1870s Northern support for reconstruction had waned and the 1876 "compromise" that granted Republican Rutherford Hayes the presidency in exchange for the withdrawal of federal troops from the South officially ended Reconstruction

Historical evidence of leaning and learning

Southern black adults during Reconstruction had many incentives to learn to read and write from their children. Collins and Margo (2006) estimate an eleven percent labor-market return to literacy for blacks in the South in 1870, using occupational status as a proxy for income. There may have been an even higher return with respect to wealth and consumption, conditional on occupation, as literacy protected former slaves from signing exploitative contracts. "[T]he ability to read was also crucial for the freed people as they became involved in labor contracts and as they tried to acquire property. Former slaves recognized the importance of being able to read contracts, as one recalled, 'so they would know how to keep some of them white folks from gittin' land 'way from 'em if they did buy it' " (Cornelius, 1991, p. 143).

Moreover, children often acted as teachers to both their parents and other members of the community. Historian Heather Williams writes of the black schoolchild: "as soon as he learned a lesson, he became responsible for teaching it to someone else" (Williams, 2006, p. 139). Freedmen's Bureau officials noted this phenomenon in each of their semi-annual reports. By the third report, the Commissioner tries to estimate the extent of these spillover effects:

> Adults have acquired confidence that they also can learn; even the aged are peering into these printed pages with some hope that knowledge is for them. Thousands of children who have become advanced are teaching parents and older members of the family; so that nearly every freedman's home in the land is a school-house...[and] whole families have become pupils...We scarcely dare estimate the number who are at the present time in some process of elementary learning. To say that half a million of these poor people are now studying...would be a very low estimate (Alvord, *Third Semi-annual Report*, 1867, p. 5).

Conversely, former slaves might have relied on their children not to teach but to perform tasks that required literacy. Learning to read and write likely exacted a lower pecuniary, opportunity and psychological cost for children, and adults may have found it more efficient to have their children specialize in literacy-intensive tasks. A former slave testifying before

(Woodward, 1991, pp. 197-198).

a Congressional committee in 1871 stated: "I have a son I sent to school when he was small. I make him read all my letters and do all my writing. I keep him with me all the time" (Williams, 2006, p. 103).

In short, the rapid education of black children provided adults incentives to both learn and lean, and the rest of this section empirically assesses which incentive outweighed the other.

3.2 Data

I use data from the Integrated Public Use Microdata Series (IPUMS) sample of the 1870 Census. I focus on black individuals ages 25 through 60, as younger individuals might themselves have been school children between 1865 and 1870 and I wish to isolate as much as possible the learning-through-children effect from any effect of adults themselves attending formal classes. I further restrict my sample to those born in any state of the slave-holding South and residing at the time of the Census in the former Confederacy, reflecting the fact that Reconstruction did not apply to the slave-holding border states that remained in the Union.[7] Although not all Southern blacks were slaves at the time of the Civil War, the vast majority of the individuals I sample would have been, though I return to the issue of free blacks in the pre-bellum period in robustness checks.[8] Finally, I restrict attention to those counties in which at least 100 black individuals are sampled in the 1870 IPUMS, as some of the empirical work uses county-level averages of black literacy and this restriction reduces the noise in this measure.

Table 1 reports summary statistics for both the sample of adults described above as well as children between the ages of ten and eighteen who otherwise meet the sample re-

[7]Results are robust to restricting the sample to those actually born in the Confederacy or including those currently residing in slave-holding non-Confederate states.

[8]Based on tabulated data from the 1860 Census, which reported both slave and free black populations by state, I estimate that 96 percent of my sample would have been slaves in the pre-bellum period. My estimates coincide with those of Cramer (1997), who calculates that 3.74 percent of blacks in the Confederacy were free in 1860.

strictions. Note that children's literacy is almost twice that of adults, though is still only about 19 percent. Most adults have at least one child in their household, but less than half live with a child of "school-going age" (which I define as between ten and fourteen, as in my sample children of those ages have the highest enrollment rates). Over nine percent of children "attended or were enrolled in school" at some point in the last twelve months. The corresponding number for adults is 0.2 percent, a fact to which I will return at the end of this section.[9]

One of the key explanatory variables used in this section is the county-level literacy rate among black children. (Note that I will often just use the term "child literacy rate" in the interest of brevity but, unless otherwise noted, this term refers specifically to the county-level literacy rate of *black* children. The same convention applies to the use of "adult literacy rate.") I estimate this measure directly from the IPUMS by calculating for each county the literate share of all black children between the ages of 10-18 (the 1870 Census only asks the literacy question of children over nine years of age).

3.3 Empirical strategy

Although the model relates adults' literacy to that of their children, regressing an indicator for whether an adult is literate on an indicator for whether he lives with a literate child is likely to produce a positively biased coefficient on the latter variable, via any number of endogeneity scenarios. For example, an intrinsic aptitude or desire for learning to read may "run in the family." Similarly, adults can teach children, which is after all the more traditional route of human capital transmission.

Instead, I proxy the probability of living with a literate child with the interaction between the literacy rate of black children in the respondent's county and an indicator variable for whether the respondent is living with a child, which suggests the following differences-in-

[9]The 1870 Census has no other education measure, such as highest grade completed or total years of schooling.

differences estimation:

$$Literate_{ic} = \beta Child\text{-}in\text{-}house_i \times Black\text{-}child\text{-}lit\text{-}rate_c + \mu_{ic} + \gamma X_i + \varepsilon_{ic}, \tag{3}$$

where i indexes individuals and c indexes counties; $Literate_{ic}$ is an indicator variable for whether person i in county c reports being able to read; $Black\text{-}child\text{-}lit\text{-}rate_c$ is the estimated literacy rate among black children in county c; $Child\text{-}in\text{-}house_i$ is coded as one if a child lives in individual i's household; μ_{ic} is a vector of the two main effects of the interaction term; X_i is a vector of individual covariates; and ε_{ic} is the error term.[10] Loosely speaking, living in a county with high levels of child literacy is the treatment, and adults living with and without children are, respectively, the treatment and control groups. In other regressions, adults living with school-age children and all other adults living with children serve as the respective treatment and control groups.

Note that I do not have any variation across time as no literacy information exists for black slaves or their children in the 1860 Census. Although teaching slaves to read was explicitly outlawed in all confederate states except Tennessee (Frasier, 2002, p. 99), anecdotal evidence suggests that some slaves managed to acquire literacy in the pre-bellum South and literacy rates among free Southern blacks in the 1860 IPUMS appear to be about thirty percent (though recall this group accounted for only four percent of all Southern blacks).[11]

Though I cannot rely on variation across time, the cross-sectional variation I use arises from pre-determined characteristics at the county level interacted with pre-determined characteristics at the household level. In fact, there is likely some random component to geographic variation in black children's literacy. Bureau officials and aid societies often established schools in areas where union soldiers were located at the time of the Confederate

[10] I use a linear probability model instead of a probit model because I eventually estimate a county-fixed-effects model and want to guard against the incidental parameters problem (even when I eliminate counties with few observations in the IPUMS, I am left with over two hundred counties). However, in practice, using a probit model and including the fixed effects does not change any of the results.

[11] Collins and Margo (2006) estimate that up to ten percent of slaves may have been literate in the late ante-bellum period. Also see Cornelius (1991).

surrender, an allocation that appears plausibly exogenous with respect to literacy patterns (Berlin *et al.*, 1998, pp. 40, 154, 161). Moreover, that variation is interacted with an additional source of variation (age structure of the individual's household). Ideally, these interactions would not only be positively correlated with having a literate child, but also unrelated to adult literacy outside of my proposed mechanism, and potential endogeneity scenarios are discussed in detail later in the section.

3.4 Results

Raw trends

Before turning to the regression analysis, I examine the relationship between adult and child literacy rates graphically. On the x-axis of Figure 1, I plot the literacy rate of black children for each county. Figure 1 suggests that this measure has considerable variation across counties, though many appear clustered at zero.

Against this county-level child literacy rate I plot county-level literacy rates for three groups of black adults: those without children in their household, those with children in their household but none of whom are of school-going age (ages ten to fourteen), and those with school-age children in their household. All three series show a strong, positive correlation with the county-level literacy rates of black children, which is not surprising given the omitted-variables scenarios discussed in the previous subsection. The first series highlights this point: even though these adults do not live with children and thus are very unlikely to be subject to my proposed mechanism, their literacy rates are still strongly correlated with those of the children in their county.

Evidence in support of learning-from-children hypothesis cannot be found by looking at the overall correlation of county-level adult and child literacy rates, but by comparing that correlation for different sets of adults. The hypothesis predicts that the correlation should be strongest for adults who have significant contact with children and especially those who have contact with children of school-going age. Indeed, Figure 1 shows that compared to

adults who do not live with children, the literacy rates of adults who live with children appear more closely linked to the county-level child literacy rate. Moreover, the strongest correlation exists between child literacy rates and the literacy rates of adults who live with children of school-going age.

Regression results

Table 2 shows the results from estimating equation (3). As additional controls, I include dummy variables for age, gender and urban-versus-rural in all regressions. The estimated coefficient on the child-literacy-rate variable suggests that living in a county where all black children are literate increases the probability that a black adult is literate by 45.8 percentage points, relative to his counterpart in a county where no children are literate. Equivalently, moving from a county with a five percent child literacy rate (the 25^{th} percentile for this variable) to one with a twenty-five percent rate (the 75^{th} percentile) is associated with a 9.2 percentage point (0.458*(0.25-0.05) = 0.092) increase.

Importantly, the interaction between the indicator for having a child in the household and the child literacy rate is positive and significant. The point estimate suggests that for an adult living with a child, moving from the 25th-percentile to the 75th-percentile county increases the likelihood he is literate by an additional 3.7 percentage points (0.187*0.20=0.0374), or 36.3 percent, given a baseline probability of 0.103. Col. (2) adds county-level fixed effects, which reduces the coefficient on *Child-in-house* $\times$ *Black-child-lit-rate*, though it remains positive and statistically significant.

The results in the first two columns are consistent with adults learning from children. If learning is actually driving the results, then the effect should be driven by children of school-going age, as, say, a two-year-old child is unlikely to serve as a teacher to her parents. Col. (3) is the analogue to col. (1) except that adults living with school-age children (ages 10 to 14) serve as the treatment group and all other adults living with children as the control group. The coefficient on the interaction term suggests that an adult living with a school-age

child in a county where all children are literate is roughly 14 percentage points more likely to be literate than is his neighbor who lives with children not of school-going age. In col. (4), adding county fixed effects slightly reduces the coefficient on the interaction term, but it remains positive and significant.

I take the regression represented in col. (4) as my preferred specification. Whether someone lives with a child may obviously be correlated with many observable and unobservable traits that could be correlated with literacy, but the variation in the exact ages of the children in a household has at least some plausibly exogenous component. Moreover, I interact this information with the county-level child literacy rate, which has an independent, geographic dimension of variation. The validity of the results from my preferred specification depends on whether this interaction term is orthogonal to other factors that could determine adult's literacy, which I explore in the subsection below.

3.5 Alternative hypotheses

Differential reactions to county characteristics

Obviously, there are important differences, both observable and unobservable, between counties with high and low black child literacy rates. For example, the return to education might be higher in the former, and thus parents and other adults living with children might decide to invest more in education on their own, without any influence or assistance from their children. Similarly, counties with educational opportunities for black children might attract relatively educated or education-minded black parents. Of course, the specifications in Table 2 start to address that possibility, by comparing adults with and without children and with and without children of school-going age, but it could still be the cases that adults with children are simply more responsive to human capital returns and educational opportunities than other adults.

One check on the likelihood of these scenarios is to explore whether literacy of white adults who otherwise meet the selection criteria exhibit the same patterns with respect to

black child literacy rates. Of course, whites are a highly imperfect comparison group, as even in the same county they inhabited different economic and social environments. For example, the overall white literacy rates in my sample are 80 percent for adults and 65 percent for children, compared with 11 and 19 percent, respectively, for blacks. However, Reconstruction, which was at its height at the time of the Census, created a temporary moment when the economic and social opportunities for Southern blacks and whites were more similar than they had ever been before and would be for decades, and thus some of the same county-level factors that might have motivated blacks to invest in education or attracted educated blacks would have had the same effect on whites. As such, examining white literacy patterns can at a minimum serve as basic falsification tests.

The regression reported in col. (5) of Table 2 is identical to col. (4) except that white adults with children in their household serve as the sample group. The coefficient on *School-age-child-in-house* $\times$ *Black-child-lit-rate* is insignificant and in fact negative (though very close to zero). Thus, the literacy differences between white adults with school-age children and other whites with children have no apparent relationship to the black child literacy rate, in stark contrast to black adults.

Finally, I explore the relationship between black adult literacy rates and white child literacy rates. The specification in col. (6) is identical to that in col. (4) except for an added $White\text{-}child\text{-}literacy\text{-}rate \times School\text{-}age\text{-}child\text{-}in\text{-}house$ interaction term. The coefficient on this term is insignificant, close to zero and in fact negative, and, moreover, the coefficient on the *School-age-child-in-house* $\times$ *Black-child-lit-rate* is unchanged from that in col. (4). Thus, black adults' literacy rates respond to factors highly correlated to black child literacy rates, not child literacy rates more generally.

Adults taught children

Another alternative explanation is that adults were teaching children, instead of children teaching adults.[12] Some Southern blacks had indeed attained literacy by the end of the Civil War, obviously independently of any effect the Freedmen's Bureau would later have on their children. I thus try to eliminate from the regression sample adults who were potentially literate by the end of the war, in order to shut off this potential source of reserve causality.

Many Southern black men learned to read while fighting in the Union Army (Berlin *et al.*, 1998). Therefore, col. (2) of Table 3 includes all women, but only men too old or young to have served. The point-estimate is essentially identical to that in Table 2 (which I reprint in col. (1) for ease of comparison).

Similarly, another group of Southern blacks who gained some literacy before the end of the War were freemen (and women). While it was illegal to teach a slave how to read in all states but Tennessee, no such restrictions existed for free Southern blacks. Assuming free blacks were indeed more likely to have been literate by the end of the Civil War (see subsection 3.3 for a discussion of literacy rates of free blacks), in col. (3) I exclude the three states with the highest free share of blacks as of the 1860 census (Louisiana, North Carolina, and Virginia). Again, the point-estimate appears largely invariant to this sampling choice, and actually increases several percentage points.

Adults attended school themselves

While the analysis has generally assumed that adults learned at home from children who passed on what they had learned in school, many adults attended classes themselves during Reconstruction. Indeed, a common image from the period is that of adults and students sitting side-by-side in classrooms. If adults with school-age children are more likely to attend

[12]Comparing the children of former slaves with the children of free northern blacks, Sacerdote (2005) finds significant intergenerational correlation with respect to literacy, though does not claim a causal interpretation. He shows evidence that by the second generation born after the Civil War the outcomes of the grandchildren of former slaves have almost fully converged with those of pre-bellum black freemen.

school themselves, then this direct-education mechanism could be driving the results reported so far. While one could view this mechanism as a positive spillover from children to adults, if it entirely drove the effect then the results found in this context may not be generalizable to situations where adults did not themselves have access to schooling.

Col. (4) shows the results from estimating the preferred specification but substituting school attendance as the dependent variable. The coefficient on the variable of interest is essentially zero. The results cast some doubt on the common image of mixed-generation schoolhouses. Indeed, Freedmen's Bureau reports emphasize that, if anything, adults attended Sunday schools and night schools (which the Census did not record in their definition of being "in school"), which tended to focus on religious education and home economics.[13]

One might worry that adults that attended part-time with their children might not report doing so to Census takers. The group most frequently cited as attending alongside children were not parents, but grandparents.[14] In the final column, I examine whether these older individuals could be driving the results by sampling only adults between 20 and 40 years old, and the coefficient on the interaction term in fact increases slightly.

3.6 Discussion

This section has presented a variety of evidence suggesting that during Reconstruction black children passed on literacy skills to their parents. First, living in a county where black children have relatively high literacy rates correlates with higher rates for black adults, even higher

[13]The report filed for Mississippi in 1866 praises the idea of Sunday schools but concedes that most of the instruction is oral and religious, and that the schools are generally "after the pattern of those existing in the time of slavery" (Alvord, Second Semi-Annual Report, 1866, p. 8). The following year, the Freedman's Bureau commissioner recommends a more practical and less academic education for adults. "We propose, therefore, a wider, more general educational effort: the instruction of freedmen in civil affairs; the improvement of home life and the family condition; the encouragement of intelligent thrift, industry and the accumulation of property" (Alvord, Third Semi-Annual Report, 1867, p. 37).

[14]For example: "Tottering old men and women sat side by side with their children and grandchildren endeavoring to learn their letters. Adult freedmen used every spare minute to learn. It was not uncommon to see them studying the alphabet during rest periods and after work" (Meyers, 1971, p. 163).

rates for black adults who have a child in their house, and even higher rates for black adults living with a school-age child. The effect does not seem to be driven by adults teaching children. Very few adults would have been literate at the end of the Civil War and when I eliminate the groups most likely to be literate the result does not change.

The section also explored whether having a child, and especially a school-age child, increased the likelihood that an adult would attend school himself. The census in 1870 does not inquire about night school, but there is no evidence that adults living with children in high literacy counties are more likely to attend day school. Furthermore, the results hold even after eliminating older individuals, the group historians most often mention as attending school alongside children.

Of course, the result that children's literacy rates tend to increase those of adults depends on factors such as the specific household production technology and the nature of the educational intervention. I next investigate the relationship between adults and children's human capital in a very different context.

4 Do immigrant adults "lean" on their English-speaking children?

In this section, I explore English-language spillovers from children to adults in immigrant families. I first review some past work on language acquisition as well as provide background on the policy experiment used to identify the effect of children's learning English on older household members. I then present the data, empirical strategy and results.

4.1 Background and past work

In U.S. immigrant households, children are often the first to become English proficient. This tendency is likely due to their exposure to public schooling as well as the greater ability of the young to learn new languages, especially during the so-called "critical period" (after infancy but before puberty) when for neural or behavioral reasons humans seem much more

adept at language acquisition.[15]

Immigrant adults have many incentives to learn English, from their children or otherwise. There is a large literature linking immigrants' wages to their English skills, with almost all papers finding a strong, positive relationship.[16] For example, instrumenting for an immigrant's English proficiency with whether he arrived in the U.S. during his "critical period," Bleakley and Chin (2004) find that speaking English "well" as opposed to "poorly" (according to Census classifications) earns a 33 percent wage premium. Moreover, not only do English skills bring labor-market returns, they might also enhance consumption: adults can more carefully choose which items to purchase at a store or a restaurant and can more fully enjoy American movies or music or other forms of entertainment.[17]

However, there is also much sociological and ethnographic work on how immigrant children can minimize adults' need to learn English. Scholars have created the term "language brokering" for the practice of children in immigrant families negotiating the English-speaking world for their older relatives. Orellana *et al.* (2003) provides a description from a daughter of Mexican immigrants:

> As a kid I translated phone calls, TV shows, bills, letters from the welfare department, visits to the doctor, visits with social workers, interviews; and I filled

[15]See Newport (2002) for a review of research on the "critical" or "sensitive" period hypothesis first developed by Lennenberg (1967). Functional magnetic resonance imaging evidence even suggests that adults and children use different parts of the brain when acquiring a new language.

[16]While a chief concern is omitted-variables bias (e.g., a standard "ability bias" scenario would likely lead to a positively biased coefficient on English skills), Chiswick and Miller (1995), Angrist and Lavy (1997) and Dustmann and van Soest (2002) all attempt to address this endogeneity problem. Bleakley and Chin (2004) review these and other papers.

[17]Note that some of these benefits may be muted in California, the setting I study. A quarter of the state's population was born outside the U.S., its cities contain large ethnic neighborhoods and employers depend on immigrant labor (documented or otherwise). Thus, perhaps more than in any other state, California's immigrants might well be able to find employment, enjoy leisure activities such as movies, music and television, and read newspapers and books without ever learning English. Lazear (1999) shows that the probability an immigrant speaks English is inversely related to the share of the local population that speaks his native language. Moreover, Hall and Farkas (2008) find that return to human capital to be lower for Hispanics—the majority of California's immigrants—than other immigrants, and speculate that lack of legal residency or citizenship may prohibit them from getting certain higher-paying jobs (for which English proficiency would presumably be more necessary).

> out applications for health care, welfare and social security benefits. I did this because I was the only one who could do it. I was the only one in my family who could communicate in both English and Spanish. I became the key to accessing the resources my family needed.

To the best of my knowledge there has been no attempt to systematically gauge how widespread this practice is across the US, but sociologists have conducted small surveys in a variety of localities that include questions on language brokering. In a survey of 64 students from a "major metropolitan high school" born primarily in China and Vietnam, Tse (1996) finds that 59 students report translating for their parents (and four of the five who report not doing so indicate they have older siblings who do). Orellana *et al.* (2003) report that "almost all" of the 236 Spanish-speaking students they survey in a Chicago elementary school act as language brokers, and specifically report that 73 percent have brokered for their mothers.[18] They suggest that this share is remarkably high given that a significant share of the children's parents had been living in the US for much of their lives. Finally, some evidence suggests children are highly effective translators: in a small study of sixteen Puerto Rican elementary-school students from an "extremely low socioeconomic" neighborhood in New Haven, Malakoff and Hakuta (1991) find that children make very few errors when translating, though display slightly higher accuracy when translating from Spanish to English than vice versa.

Thus, there appears to be strong incentives for immigrant adults in both the "leaning" and "learning" directions. As I will discuss in greater detail, an OLS estimate of adults' English skills on those of their children is likely to be positively biased via any number of endogeneity scenarios and thus unhelpful in determining which incentive dominates. Being unable to randomly assign adults to households with or without English-speaking children, I turn instead to quasi-experimental variation generated by an abrupt policy shift in California.

[18]The data are not presented in a disaggregated manner so I cannot calculate what share have language brokered for family members in general.

4.2 Proposition 227

In 1998, Californians passed Proposition 227, which declared that "all public school instruction be conducted in English." Though some exceptions were allowed and a year of "bridge" programs was offered to some students, the overall effect of the policy was a sudden shift from traditional "bilingual" education (in which students are taught subjects such as math and science in their native language and further development of the native language is often an explicit goal) to English immersion. During the 1997-1998 school year, 29 percent of limited-English proficiency (LEP) students were being taught at least two academic subjects in their native language. By the fall of 1998, only eleven percent were.

Proposition 227 contains strong language with few grounds for exceptions, but some schools found ways to limit and at times avoid the implementation of the policy. The law allowed parents to petition for waivers to keep their children in bilingual programs, and if more than twenty students speaking a given foreign language in a school presented waivers, that school could provide bilingual education in that language. However, these waivers had to be certified by the local schools, so students who attended a school whose administrators were in favor of Proposition 227 were less likely to have their waivers certified than those who attended an anti-Proposition-227 school.

Past research has explored heterogeneity in compliance with Proposition 227. Garcia and Curry-Rodriguez (2000) find that schools that had a large share of limited-English-proficient students in bilingual education programs in the pre-227 period were more likely to certify waivers and thus retain bilingual education programs. Compliance also seems to depend on institution size: Bali (2003) finds that larger districts were more likely to notify parents of their right to petition for a waiver.

Evaluations of Proposition 227, like most research related to the bilingual-versus-English-immersion debate, have focused on how the policy has affected students' academic achievement, as opposed to whether it improved their English proficiency. Overall, the evidence has been inconclusive. Using compliance with Proposition 227 as a source of quasi-experimental

variation, Hoxby and Gordon (2004) find that bilingual education improves test scores in several subjects among students in early grades. Most papers, however, do not directly address potential endogeneity issues. Amselle and Allison (2000) highlight large post-227 gains on the state's Stanford 9 achievement exam for LEP students, while Butler *et al.* (2000) point out that non-LEP students enjoyed the same gains. The state's own evaluation of Proposition 227 found insignificant effects of bilingual education on math and reading scores (Parrish *et al.*, 2006), though the authors acknowledge that their hierarchical model may not control for non-random selection into bilingual versus English-immersion classrooms. The lack of consensus regarding Proposition 227's effect on academic achievement mirrors that of the bilingual-versus-English-immersion debate more generally. Both Matsudaira (2005) and Jepsen (2010) provide excellent reviews.

Perhaps because there is a strong *a priori* assumption that English immersion would be superior to bilingual education with respect to the specific goal of *improving English proficiency*, research has not focused on this outcome.[19] An important exception is Jepsen (2010). Using data from the California English Language Development Test (CELDT) in 2003 and 2004, he finds that, relative to English immersion, bilingual education lowers students' English proficiency. His results are consistent across OLS, propensity-score matching, and IV estimates (using electoral support for 227 as an instrument). The effect is especially large among English learners with relatively low baseline English skills. As I focus on newly arrived immigrant students, his results suggest that the gains to English proficiency associated with English immersion should be especially pronounced among the students in my sample.[20]

[19]It is difficult to extrapolate from the academic achievement literature to English proficiency. While English proficiency no doubt helps students perform well on a general achievement test, the skill sets are distinct in many ways. Butler *et al.* (2000) argue that in particular the state's Stanford 9 exam is unable to measure English proficiency.

[20]He cannot look before and after Proposition 227 as the CELDT was only established in 2001. While not as germane to the current study, other economists have also used quasi-experimental variation in studies on language instruction outside of the Proposition-277 context. Matsudaira (2005) uses a regression-discontinuity design and finds that assignment into an English-immersion classroom does not improve math or reading test scores. Unfortunately, he cannot measure changes in English proficiency per se as those assigned to English-immersion classes never retake the English proficiency exam. Angrist *et al.* (2006) find that exposure to English instruction in Puerto Rican

4.3 Data

Individual-level census data

I use IPUMS census data from 1990 and 2000 to examine the English skills of immigrant household members before and after the passage of Proposition 227. Every person five years and older is asked whether he can speak English, and, if so, if he speaks well or very well. A more objective measure of English skills would be preferable, but this self-report is the best measure available in the data, and Kominski (1989) finds it to be reliable, at least in earlier censuses.

I make several sampling restrictions. First, I only include immigrants from non-English speaking countries. Second, to ensure that children in the treatment period would have spent most of their years in the US under the English-emersion regime, I include only those who arrived in the U.S. within three years of being observed in the census.[21] As in the previous section, I choose a group of adults ages 25-60 so that none of them would have received K-12 education themselves in California. For similar reasons, I also exclude adults who report attending school themselves at the time of the Census.

Summary statistics appear in Table 4, separately for children (5-18 years old) and adults (25-60 years old). Recently arrived immigrant children are more likely to speak English than adults, consistent with the research cited earlier. The Hispanic share is higher for children, suggesting perhaps that Hispanic families are more likely to immigrate with children compared to other large immigrant groups in California. Both samples are roughly equally divided by gender.

public schools did not have lasting effects on English proficiency thirty to forty years later. Of course, their example differs from the Proposition 227 setting in that in Puerto Rico English was not the official language.

[21]The Census also places each immigrant in categories indicating the year they immigrated (e.g., "1987-1990"), so I chose the most recent category consistent across both census years, which happens to be "arrived within three years."

School-level Proposition 227 compliance data

I complement the IPUMS data with annual school-level data from the California Department of Education Language Census data files.[22] These data provide the total number of "English learners" as well as the educational programs in which they are enrolled.

The variable I generally use from these data is the number of students in what the CDE terms "English Language Development and Academic Subjects Through the Primary Language (L1)."[23] Students in this program receive at least two core academic subjects in their native language. For each school, I calculate the percentage-point change between 2000 and 1998 in the share of English learners enrolled in this program. As mentioned earlier, this share falls from 29 percent during the 1997-1998 school year to 11 percent during the 1998-1999 school year, where it remains during the 1999-2000 school year. For convenience, I generally refer to this percentage-point change as the "compliance" rate. However, it really is simply the change in the probability that an English learner will experience traditional, primary-language bilingual education. Thus, for schools that had no primary-language instruction before and after 1998, the "compliance" measure will be zero even though they were perfectly compliant both before and after Proposition 227 was passed.[24]

I weight this compliance measure by the total English-learner attendance in that school and take the weighted average for each Public Use Microdata Area (PUMA) in the Census data. While I would ideally like to match each student in the Census data with the school he attends, such geographic precision is not available in the IPUMS and the PUMA is the most disaggregated level at which I can match students to compliance rates.[25]

Fortunately, as I document graphically in a later subsection, there is great variation in compliance across PUMAs. The typical student lives in a PUMA that saw the share of English

[22]These data can be accessed via the California Department of Education at the following url: `http://www.cde.ca.gov/ds/sd/sd/fslc01p234.asp`.

[23]This variable is called ELD_{L1} in the CDE dataset from the previously-noted url.

[24]This measure of compliance is also used in Hoxby and Gordon (2004).

[25]I actually use the $CPUMA$ variable—"consistent PUMA"—in the IPUMS, which are areas that are defined consistently between the 1990 and 2000 Censuses.

learners in "L1" instruction fall by 13 percentage points, whereas the most "compliant" PUMA saw its share fall by 26 percentage points and the least compliant slightly increased its share.

4.4 Empirical strategy

Simply regressing parents' English skills on those of their children would almost surely yield a positively biased coefficient on the latter variable. As in the previous section, any number of omitted-variables or reverse-causality scenarios exist. An inherent facility for learning foreign languages may "run in the family;" an adult expressing embarrassment due to their inability to speak English may render his children timid in their efforts to learn and practice the language; and, of course, parents fluent in English can teach their children, as in Bleakley and Chin (2008).

As such, instead of directly regressing parents' English skills on those of their children, I exploit variation generated by the uneven compliance with Proposition 227. The treatment effect I seek to estimate is having an English-proficient child in one's household. Assuming Proposition 227 compliance increases children's English proficiency (a claim I support in the next subsection), the treatment effect can be estimated by the following differences-in-differences-in-differences equation:

$$Speak_{ipt} = \beta Child\text{-}in\text{-}house_i \times Compliance_p \times After_t + \lambda_p + \mu_{ipt} + \gamma X_i + \varepsilon_{ipt}, \quad (4)$$

where i denotes the individual, p the PUMA, and t the year (either 1990 or 2000); $Child\text{-}in\text{-}house$ is a dummy for whether the adult lives in a household with a child; $Compliance_p$ is the percentage-point decrease in bilingual-education enrollment at the average school in PUMA p; $After_t$ is an indicator for whether the subject is observed after passage of the proposition (i.e., in the 2000, as opposed to 1990, census); λ_p is a vector of PUMA dummies (which controls for PUMA-level differences in $Compliance$); μ_{ipt} is a vector of all the lower-order terms of $Child\text{-}in\text{-}house_i \times Compliance_p \times After_t$; X_i is a vector of covariates; and ε_{ipt} is

the error term.

If adults lean on (learn from) their children, then β should be less (greater) than zero. The treatment effect represents the differential effect living in a Proposition-227-compliant PUMA has on adults who live with children relative to those who do not. Using variation across time should control for unobserved heterogeneity at the PUMA level; using the control group of adults without children should control for unobserved heterogeneity at the PUMA-year level, such as migration patterns or changes in industry composition, which might correlate with adults' English acquisition. The identifying assumption is that this unobserved heterogeneity has the same effect on adults with and without children.

While equation (4) illustrates the spirit of the estimation, similar to the previous section, my preferred specification actually compares adults living with children between the ages of seven and fifteen with all other adults living with children. Children in this age range are old enough to begin to take some responsibility for language brokering; they are also young enough to be required to attend school and to have arrived in the US not long beyond their own "critical period" for learning English.[26]

4.5 Results

Basic trends

Before turning to regression results, I graph the basic relationships between a PUMA's level of English proficiency and its compliance with Proposition 227. Specifically, for each PUMA, I plot the percentage-point change between 1990 and 2000 in the share of immigrant children who speak English against the percentage-point change in the probability they were taught in their primary language, that is, the "compliance rate." If, as in Jepsen (2010), English immersion is associated with greater English proficiency, then the change in the share of immigrant children who speak English should be most positive in the areas most compliant with Proposition 227. Figure 2 shows that the change in the share of children who speak

[26] As I document later in the section, changing the age range slightly does not affect the results.

English is indeed a positive function of compliance.

Figure 2 also displays this relationship for adults, both those living with and without children between the ages of seven and fifteen. There is little relationship between PUMA compliance and changes in the probability that adults living without such children speak English. However, there is a negative relationship for adults living with children in this age range. In PUMAs that saw little change in the probability children would receive primary-language instruction, the probability that this group of adults would speak English barely changed; in PUMAs where children were much more likely to be instructed in English, this group of adults became less likely to speak English in 2000 than in 1990.

To summarize, between 1990 and 2000, children's English proficiency improved in areas that saw the largest shift away from bilingual education. However, this shift appears to have the opposite effect on the adults these school children live with, and has very little if any effect on other adults. Thus, Figure 2 provides graphical evidence consistent with adults "leaning" on their children's improved English skills.

Regression results

Here, I estimate the regression analogues of Figure 2. I first focus on the effect of compliance with Proposition 227 on the English proficiency of children by estimating the following differences-in-difference equation on the sample of children described in Table 4:

$$Speak_{ipt} = \beta Compliance_p \times After_t + \lambda_p + \phi After_t + \gamma X_i + \varepsilon_{ipt}, \tag{5}$$

where all notation follows from equation (4).

The first three columns of Table 5 show the results from estimating variants of equation (5). All regressions in these and other columns include dummy variables for age in years, gender, race, Hispanic origin, and the region of the country of origin.[27]

[27]The regions are: Central American and the Caribbean, South America, Western Europe, Central, Eastern and Southern Europe, East Asia, South Asia, the Middle East, and Africa.

The results are not surprising given Figure 2. The first column suggests that a child in a highly compliant PUMA after the passage of the proposition is more likely to speak English: the point-estimate suggests that going from the most compliant PUMA (which has a compliance value of 0.26) to the least (which has a value of -0.03) would increase the probability an immigrant student speaks English by $0.118 * 0.29 = 3.4$ percentage points, or 4.2 percent given a baseline probability of 0.815. The results also indicate that on average boys and Hispanics in the sample are less likely to speak English.

The second column shows that this result holds when instead of a dummy variable for whether the child reports speaking English, a categorical variable from zero to three indicating proficiency level is used.[28] My preferred specification is to use the dichotomous variable, but the results appear robust to either dependent variable.

One potential worry is that compositional changes across counties might be in part driving the result. In col. (3), I interact the *Hispanic* dummy variable as well as (logged) household income and age—three variables highly predictive of English proficiency—with the $Compliance$, $After$, and $Compliance \times After$ variables and include them, as well as the main effect of logged income, in the regression in col. (1).[29] The coefficient on $Compliance \times After$ remains positive and significant and actually grows slightly in magnitude. Overall, exposure to English immersion appears to increase the probability that a student reports being able to speak English.[30]

In cols. (4) and (5) I turn to whether compliance affected adults as well, and in particular the differential effect on adults living with children relative to adults living without children. The coefficient on the triple interaction term $Compliance \times Child\text{-}in\text{-}house \times After$

[28]The four categories are: does not speak English (0), speaks English but not well (1), speaks English well (2), speaks English very well (3).

[29]*Hispanic* and *Age* main effects were already included in the baseline specification.

[30]Note that, as discussed earlier in this section, the debate over bilingual education is much broader than which type of instruction best promotes *English language proficiency*. The debate includes whether the language gains represented by English emersion outweigh the potential losses associated with students being taught math and science in English before they understand the language. Evidence relevant to this debate is beyond the scope of this paper.

is negative but not significant. To conserve space, I do not include the continuous proficiency specification in the table, but the coefficient in that specification is also negative but not significant.

In cols. (6) through (8) I explore differences between adults living with children of the age where they could be useful language brokers and all other adults living with children. As discussed earlier, I assume that children between the ages of seven and fifteen would be most useful in this regard. In these specifications, the coefficient of interest is always negative and significant. The result holds when proficiency serves as the dependent variable in col. (7) or when interactions with *Hispanic*, *Income* and *Age* are included in col. (8).

The point estimates in cols. (1) - (3) and (6) - (8) suggest that the indirect effect of Proposition 227 on adults was in fact comparable to and perhaps even larger than the direct effects on children. Of course, the binary "speaks English" variable is a very imperfect measure of language skills, and when a more continuous measure is used, the effects are more similar in size. Moreover, the sizable standard errors for each estimate along with the possibility that adults and children answer the question differently suggests that comparing estimates across different samples should be done with caution. Nevertheless, the coefficient estimates suggest that the spillover effect on adults may indeed be economically significant.

4.6 Robustness checks and heterogeneity

Table 6 subjects the main "lean-on" result in col. (6) of Table 5 to several robustness checks. While I have so far relied on linear probability models in order to be parallel to the previous section, in col. (2) I report probit results (as marginal effects), and the coefficient of interest is if anything slightly larger in magnitude than in the original result, reproduced in col. (1).

Col. (3) shows that the result is not sensitive to defining children ages seven to fifteen as the ideal language brokers. The coefficient of interest when the ages six and sixteen are used is very similar to the original result. Though I do not report these results, the coefficient is essentially unchanged when living with children ages six to fifteen or seven to sixteen serves

as the treatment group.

The rest of the table explores heterogeneity across different groups. Cols. (4) and (5) show that the leaning effect is largely driven by Hispanics. Perhaps for Hispanics, the advantages of being the largest immigrant group in the state—with the large networks and rather Spanish-friendly environment that entails—mean that having an English-proficient child is enough to function, and thus there is little need for the household to develop further English skills.

The last two columns split the sample by whether respondents report having finished high school. Those without a high school education are far more likely to lean. In fact, those with a high school degree appear similar to the adults in the previous section—living with a school-age child in a compliant area seems to increase the likelihood they will speak English, though the effect is not statistically significant. The results are consistent with the cost of learning a new language decreasing in educational attainment, and thus those with limited education only learning the language if absolutely necessary (i.e., if there are no children around to translate).

4.7 Discussion

The evidence in this section suggests that adults are less likely to learn English when they can rely on the English skills of children, and that this effect may be economically significant. The increase in students' English proficiency between 1990 and 2000 was greatest in highly compliant PUMAs. In contrast, English proficiency of adults living with children who could serve as language brokers fell the most in the very areas where students gained the most. The heterogeneity in the response appears to support the idea of "leaning" being most prevalent when the need to learn English is most limited or the cost of learning is high, further supporting the model in Section 2.

5 Conclusion

In this paper I describe how children's acquisition of a given form of human capital can either encourage or discourage adult household members from acquiring it as well. On the one hand, children can teach the skill to adults, which, all else equal, will lower adults' marginal cost of learning the skill. I call this incentive the "learning effect." On the other hand, children's human capital can substitute for that of adults in household production, which will lower adults' marginal benefit of learning the skill. I call this incentive the "leaning effect."

Obviously, within a household, children's and adult's human capital levels can be correlated for reasons independent of my proposed mechanism. For example, parents can pass on their human capital to their children, which is after all the more traditional route of transmission; or common genetic or environmental factors might lead everyone in the household to have similar levels of human capital. As such, I identify two examples in which children receive sudden shocks to their human capital levels and estimate the effects on the adults in their household.

Black children in the South had virtually no access to formal education before the Civil War. Through the efforts of the Freedmen's Bureau and Northern philanthropic societies, hundreds of thousands of them attended classes in the five years after the war. Using 1870 Census data from states in the former Confederacy, I find that when black adults live in counties with high rates of black child literacy, they are more likely to be literate themselves. However, the effect is greater for those adults living with a child and greater still for those living with a school-age child. Thus, former slaves appear to *learn from* their literate children.

In the summer of 1998, Californians passed Proposition 227, with the aim of replacing bilingual education with English immersion in public schools. Indeed, during the 1997-1998 school year 29 percent of California students classified as "limited English proficient" were receiving core academic instruction in their native languages; by the fall of 1998 only eleven percent were. However, the implementation of Proposition 227 varied. I find that area compliance with Proposition 227 is associated with greater increases in children's English proficiency

between 1990 and 2000. But in the very areas where children's English skills improve the most, adults living with children (and especially adults living with school-age children) have lower levels of English proficiency compared to a control group of adults who do not have a child in their household. Thus, adults appear to *lean on* their English-speaking children.

Though this paper has not focused on why these two groups would have different reactions, one can speculate that children's human capital more effectively substitutes for that of adults in modern immigrant households than it did in the households of former slaves. As discussed earlier, past work has shown large labor-market returns to literacy for Southern blacks, and the ability to determine the terms of a contract (which may have been beyond the scope of even literate children to negotiate) could help protect scarce resources. Moreover, children's translations could not substitute for some of the goals expressed by former slaves in historical accounts—being able to read their favorite Bible passage themselves or learning to read as an expression of full citizenship.

In contrast, sociological and ethnographic accounts of immigrant families frequently describe adults' expectations that children, who can learn new languages more easily than adults, serve as translators and negotiators for their families. Given California's large supply of low-skilled jobs for adults that do not require English fluency and long established ethnic enclaves that provide goods and services in the native language, parents may have lost little by having their child specialize in English-intensive tasks.

As this paper illustrates, whether adults learn or lean depends on their specific circumstances, and future work might explore different settings, such as developing countries. As children in such countries often attain high education levels than their parents, children-to-adult spillovers might be especially important.

Regardless of the setting, future work might examine the effect on children's well-being of their parents' decision to either lean or learn. Being forced as a child to language- or literacy-broker might promote responsibility, maturity and independence, traits that might improve future labor market outcomes. However, some sociological studies suggest that par-

ents' inability to speak English may negatively affect their children's education and health. Weisskirch and Alva (2002) find that children list report cards and letters from school as the items they most often translate for their parents, highlighting the difficulty English-deficient parents face in monitoring their children's educational progress. A plurality of the 203 Hispanic parents interviewed by Flores *et al.* (1998) cites "language problems" as the single greatest barrier to obtaining health care for their children. Any negative effects of leaning might be especially important in developing countries, where children already face enormous challenges.

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Appendix

Proof of proposition stated in Section 2.

Proposition. *The effect of children's human capital on that of adults in the household,* $\frac{\partial k(e^*)}{\partial c}$*, can be positive or negative. It is a positive function of* $(-\lambda_{ec})$*. This term represents the extent to which learning from proficient children can lower the per-unit cost of adults' human capital investment (the "learning effect"). It is a negative function of* y_c*, the direct contribution of children's human capital to adults' consumption (the "leaning effect").*

Proof. First, note that adult's human capital $k = k(e)$ is a positive function of investment e alone, so it is sufficient to show the above result for optimal investment $e*$.

Recall the first-order condition which holds for optimal e^*: $\psi' y_k(k(e^*), c)k_e(e^*) = \lambda_e(e^*, c)$. Differentiating the first-order condition with respect to c yields:

$$\psi'[(y_{kk}k_e e_c^* + y_{kc})k_e + k_{ee}e_c^* y_k] + \psi''(y_k k_e e_c^* + y_c)y_k k_e = \lambda_{ee}e_c^* + \lambda_{ec}. \tag{6}$$

Gathering like terms gives an expression for e_c^*:

$$e_c^* = \frac{y_c y_k k_e \psi'' - \lambda_{ec} + y_{kc}k_e\psi'}{\lambda_{ee} - \psi' k_e^2 y_{kk} - k_{ee}y_k\psi' - \psi'' y_k^2 k_e^2}. \tag{7}$$

By the assumptions regarding functional forms described in Section 2, the denominator is always positive. Thus, the sign of e_c^* is equal to the sign of the numerator.

What is the effect of $-\lambda_{ec}$, the "learning effect?" It only enters the expression in the second term of the numerator, and as $-\lambda_{ec}$ increases the expression increases as well. Thus, the sign on the "learning effect" is positive.

What is the effect of y_c, the "leaning effect?" It only enters in the first term of the numerator, and is multiplied by ψ'', which by the concavity assumption is negative. Thus, the sign on the "leaning effect" is negative. ∎

Table 1: Summary statistics, 1870 Census data

	Children age 10 - 18	Adults age 25 - 60
Literate	0.192	0.103
	(0.394)	(0.304)
Attending school	0.0913	0.00121
	(0.288)	(0.0348)
Age	13.79	38.39
	(2.633)	(10.24)
Male	0.506	0.477
	(0.500)	(0.499)
Urban	0.0889	0.128
	(0.285)	(0.334)
Child in household		0.822
		(0.383)
School-age child in household		0.457
		(0.498)
Observations	11,417	17,388

Notes: Data from the 1870 IPUMS, weighted by IPUMS person-level sample weights. All observations in both columns are black, born in the South and living in the former Confederacy at the time of the Census. Only counties in which at least 100 observations can be sampled are included. The Census at the time did not collect literacy information for individuals younger than ten years old. A child is defined as "school-age" if he is between 10 and 14 years old, as school attendance peaks at these ages for children in the sample.

Table 2: The effect of black child literacy rates on black adult literacy

	Treatment: Child in household		Treatment: School-age child in household			
	(1)	(2)	(3)	(4)	(5)	(6)
Treatment x Black child literacy rate	0.187***	0.121**	0.144**	0.114**	-0.0141	0.114**
	[0.0591]	[0.0526]	[0.0564]	[0.0482]	[0.0687]	[0.0499]
Black child literacy rate	0.458***		0.562***			
	[0.0860]		[0.0878]			
Treatment	-0.0320***	-0.0223**	-0.0216**	-0.0187**	0.0227	-0.0172
	[0.0104]	[0.00899]	[0.00892]	[0.00790]	[0.0213]	[0.0217]
Treatment x White child literacy rate						-0.00204
						[0.0298]
Male	0.00572	0.00661	0.00271	0.00348	0.0634***	0.00337
	[0.00442]	[0.00435]	[0.00491]	[0.00483]	[0.0106]	[0.00485]
Urban	0.0263	0.0917***	0.0308*	0.0901***	0.0798***	0.0901***
	[0.0194]	[0.0191]	[0.0184]	[0.0181]	[0.0301]	[0.0181]
Sample	Black adults	Black adults	Black adults w child in HH	Black adults w child in HH	White adults w child in HH	Black adults w child in HH
County fixed-effects?	No	Yes	No	Yes	Yes	Yes
Observations	17,388	17,388	14,292	14,292	5,912	14,231

Notes: See Table 1 for sampling and variable definitions. County-level literacy rates are estimated by aggregating IPUMS data to the county level. All regressions include age-in-years fixed effects, are estimated with OLS, cluster standard errors at the county level, and use IPUMS sample weights. The sample size falls in col. (5) because the IPUMS sampling rule leads to over-sampling of counties with large black populations. $^{*}p < 0.1,^{**} p < 0.05,^{***} p < 0.01$.

Table 3: The effect of county-level child literacy rates on black adult literacy, robustness checks

	Dependent Variable: Respondent is...				
	(1) Literate	(2) Literate	(3) Literate	(4) In school	(5) Literate
School-age child in HH x Bl child lit rate	0.114**	0.121**	0.151**	-0.00125	0.128***
	[0.0482]	[0.0564]	[0.0596]	[0.00251]	[0.0415]
School-age child in household	-0.0187**	-0.0236***	-0.0266***	0.000956	-0.0224***
	[0.00790]	[0.00895]	[0.00996]	[0.000954]	[0.00778]
Male	0.00348	0.00807	0.00254	0.000203	0.0161***
	[0.00483]	[0.0100]	[0.00550]	[0.000460]	[0.00480]
Urban	0.0901***	0.0604***	0.113***	0.00130	0.126***
	[0.0181]	[0.0209]	[0.0281]	[0.00237]	[0.0195]
Sample	Full sample	Excl. potential CW veterans	Excl. NC, LA, VA	Full sample	Only ages 20 - 40
Observations	14,292	9,410	11,074	14,299	14,865

Notes: See Tables 1 and 2 for variable definitions and sampling rules. Col. (1) merely replicates col. (4) of Table 2. All regressions include fixed effects for county and age in years and sample only blacks living with at least one child in their household. The non-veteran sample comprise all women but excludes men between the ages of 24 and 45 as they would have been most likely to have served in the Union Army. $^{*}p < 0.1,^{**}p < 0.05,^{***}p < 0.01$

Table 4: Summary statistics, 1990 and 2000 Census data

	Children age 5 - 18	Adults age 25 - 60
Speaks English	0.815	0.741
	(0.388)	(0.438)
Male	0.537	0.494
	(0.499)	(0.500)
Hispanic	0.648	0.475
	(0.478)	(0.499)
Age	12.14	35.42
	(4.375)	(9.229)
After Prop. 227	0.471	0.508
	(0.499)	(0.500)
Child in household		0.646
		(0.478)
Child age 7-15 in household		0.368
		(0.482)
Observations	27,767	44,110

Notes: All data taken from the 1990 and 2000 IPUMS, weighted by IPUMS person-level sample weights. To be included in the sample, respondents must be born in a non-English-speaking country, be living in California at the time they were observed in the Census, and have arrived in the US no earlier than three years before the time of the Census. In addition, adults must not be currently enrolled in school.

Table 5: The effect of Proposition 227 on children's and adults' English proficiency

	Children			Treatment group: Adults living w children		Treatment group: Adults living w children 7-15		
	(1) Speaks Eng.	(2) Proficiency	(3) Speaks Eng.	(4) Speaks Eng.	(5) Speaks Eng.	(6) Speaks Eng.	(7) Proficiency	(8) Speaks Eng.
PUMA compliance rate x After	0.118**	0.358*	0.122**	0.116	0.140*	0.196*	0.143	0.259***
	[0.0512]	[0.180]	[0.0528]	[0.0862]	[0.0800]	[0.0978]	[0.287]	[0.0864]
Treatment x Comp. rate x After				-0.0685	-0.0425	-0.244**	-0.428*	-0.252**
				[0.0890]	[0.0814]	[0.110]	[0.234]	[0.111]
Male	-0.0164***	-0.0634***	-0.0166***	0.0507***	0.0504***	0.0700***	0.130***	0.0694***
	[0.00573]	[0.0150]	[0.00563]	[0.00393]	[0.00389]	[0.00462]	[0.0170]	[0.00458]
Hispanic	-0.0990***	-0.527***	-0.0893***	-0.156***	-0.114***	-0.176***	-0.552***	-0.138***
	[0.0123]	[0.0451]	[0.0171]	[0.0171]	[0.0212]	[0.0197]	[0.0576]	[0.0239]
Covariates	Standard	Standard	Additional	Standard	Additional	Standard	Standard	Additional
Control group	N/A	N/A	N/A	Other adults	Other adults	Other adults with kids	Other adults with kids	Other adults with kids
Observations	27,760	27,760	27,741	37,138	37,111	24,905	24,905	24,882

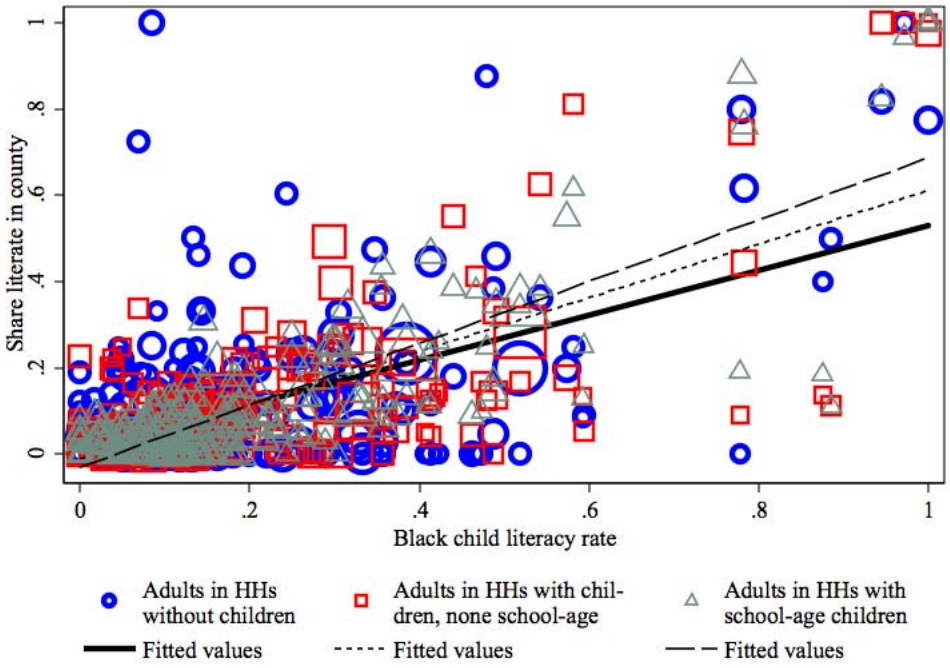
Notes: See Table 4 All regressions are estimated via OLS, cluster standard errors at the PUMA level, and use sample weights. "Standard" covariates include fixed effects for PUMA, all lower-order terms of $Compliance\,rate \times After$ in cols. (1) through (3) and $Treatment \times Compliance\,rate \times After$ in cols (4) through (8), region of home country (defined by the eleven categories in the Census), and age in years. "Additional" covariates include all of the standard covariates, as well as interactions between the Hispanic indicator variable and $After$, $Compliance\,rate$ and $Compliance\,rate \times After$, as well as interactions between household income and $After$, $Compliance\,rate$ and $Compliance\,rate \times After$ and interactions between age and $After$, $Compliance\,rate$ and $Compliance\,rate \times After$. $^{*}p < 0.1$,$^{**}p < 0.05$,$^{***}p < 0.01$

Table 6: The effect of Proposition 227 on adults' English proficiency, robustness checks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Treatment x	-0.244**	-0.283**	-0.251***	-0.315**	-0.0532	-0.690***	0.191
Comp. rate x After	[0.110]	[0.138]	[0.0900]	[0.122]	[0.136]	[0.245]	[0.197]
Male	0.0700***	0.0783***	0.0701***	0.0817***	0.0586***	0.0883***	0.0421***
	[0.00462]	[0.00590]	[0.00465]	[0.00835]	[0.00715]	[0.0107]	[0.00528]
Hispanic	-0.176***	-0.203***	-0.177***			-0.103**	-0.156***
	[0.0197]	[0.0237]	[0.0198]			[0.0438]	[0.0164]
Sample	All	All	All	Hispanic	Non-Hisp.	No HS deg	HS deg
Specification	OLS	Probit	OLS	OLS	OLS	OLS	OLS
Treatment: Living w children age	7-15	7-15	6-16	7-15	7-15	7-15	7-15
Observations	24,905	24,829	24,905	14,198	10,707	11,800	13,105

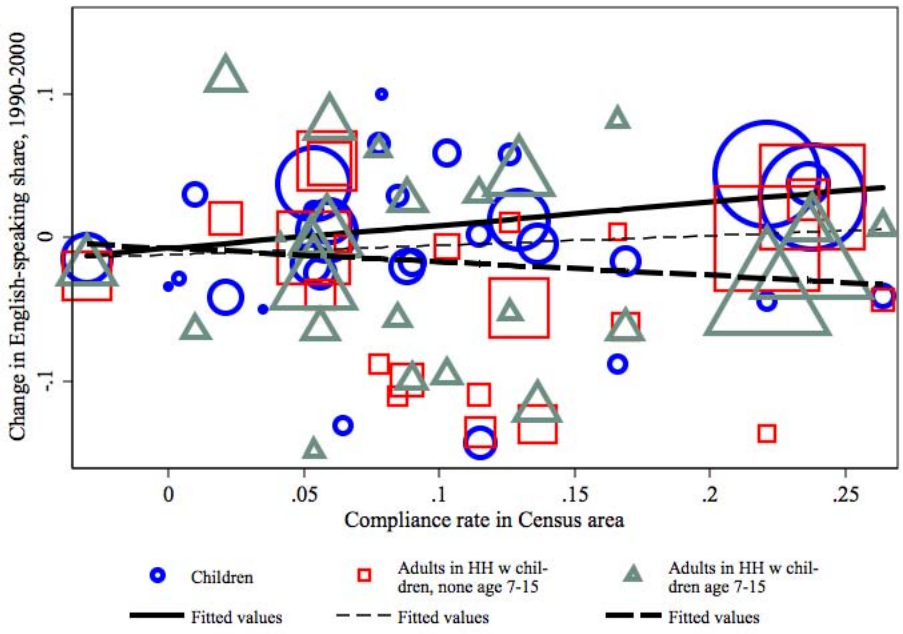
Notes: See Table 5 for sampling rules and variable definitions. All regressions include the "standard" set of covariates described in Table 5. Col. (1) merely replicates col. (6) of Table 5. All regressions include only those adults living with children, as in cols. (6)-(8) of Table 5. In col. (2) the probit results are reported as marginal effects. $^{*}p < 0.1$,$^{**}p < 0.05$,$^{***}p < 0.01$

Figure 1: Relationship between adult and child literacy among former slaves in 1870



Souce: IPUMS data, 1870. The universe of respondents used to generate this figure are black residents born in the South and residing in the former Confederacy at the time of the Census. I plot county-level literacy rates for black children age 10-18 on the x-axis. The same statistic is calculated separately for the three groups of adults and plotted on the y-axis.

Figure 2: Percentage-point change in English-speaking share of California children and adults, 1990-2000



Source: IPUMS data, 1990 and 2000, and school-level California Department of Education data. A school's compliance rate is defined as the percent-point decrease in the share of English learners receiving core academic instruction in their primary language. This measure is weighted by total English-learner enrollment and averaged for all schools in a PUMA. In order to avoid having the area where the majority of the data lie from being overly compressed, the scatter plot drops outliers (those observations with y-axis variables greater than 0.2 or less than -0.2). These outliers represent 0.4 percent of the observations in the children sample and 2.8 percent of the observations in the adult sample. The fitted lines, however, include these outliers.