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Evidence from the Mexican Family Life Survey

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Abstract[1]

This paper uses data from the Mexican Family Life Survey to estimate the impact of a household member's migration to the United States on the cognitive development of children remaining in Mexico. While there is no developmental effect of a child's sibling migrating to the United States, there is an adverse effect when another household member—typically the child's parent—migrates. This is particularly true for pre-school to early-school-age children with older siblings, for whom the effect of parental migration is comparable to speaking an indigenous language at home or having a mother with very low educational attainment. Additionally, household-member migration to the United States affects how children spend their time in ways that may influence and/or be influenced by cognitive development.

JEL Classification: I12, I38, J11, J61, O15
Keywords: Mexico, Migration, Early child development, Cognitive development

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1. Introduction

Migration is a critical option for enhancing income for many families in Latin America and the Caribbean (LAC). The World Bank reports that LAC is the top remittance-receiving region in the world, with remittances topping $48.3 billion in 2005. In 2004, remittances representedover 50 percent of Haiti's GDP, while remittances to Jamaica, Honduras, El Salvador, Guatemala, Nicaragua, and the Dominican Republic all surpassed 10 percent of GDP (Fajnzylber and López, 2007).

Of all countries in the LAC region, Mexico is the absolute leader in remittance volume, with a total of $21.8 billion received in 2005 (Fajnzylber and López, 2007).[2] Remittances are an important income source for the Mexican economy, and migration for economic opportunity is pervasive. According to Hanson and Woodruff (2003), the Mexican immigrant population in the United States equaled nearly 8 percent of the total population of Mexico in 2000. Thus, many Mexican households are directly and indirectly affected by migration to the United States. Migration for economic opportunity may be permanent or circular (also termed "recurrent"). The composition of migration has changed markedly since the mid-1990s, with circular migration sharply down by the era of this study: In 2005 the number of trips per migrant between the United States and Mexico was 1.6, down from 4.4 in 1996, and the average duration of each trip was 71.9 months in 2007, up from 38 months in 1999 (Mendoza, 2008, and Reyes, 2004, document these trends and present evidence that restrictive United States migration policies have contributed to increased trip duration).

Economic migration may affect child development through several mechanisms. By increasing household income, remittances increase consumption in ways that may benefit child development, including consumption of costly education services.[3] A change in household membership changes the overall household workload of both home production and market work and its allocation among the remaining members. While some changes may entail new responsibilities for children, others may reduce the overall home production work load, possibly

[2] Remittances from the United States are believed to have fallen precipitously with the recent global economic crisis.
[3] For Latin America, compelling evidence drawn from the randomized introductions of conditional cash transfer programs in Latin America suggests increased income improves cognition, health, and physical development (e.g., Paxson and Schady, 2008). A lively debate persists in the literature as to whether income per se improves child development in the United States. Guo and Harris (2000) argue that a strong association between poverty and a lack of cognitive stimulation drives the correlation between poverty and child development, where the lack of stimulation is the causal factor in development.

increasing the amount of time children allocate to development-enhancing activities. Increased income from migration opportunities allows family members to specialize more in child investment activities, possibly enhancing child development.[4] When an adult leaves the household, it is possible that the identity of the *de facto* household decision maker changes in ways that potentially benefit children.

Children may also be influenced by the absence of the migrant in other, potentially complex ways. For example, the absence of a male role model might have a detrimental effect on boys, while the demonstration effect of migration might cause some children to reduce their effort in school, because they anticipate migrating for low-skilled work in the future. Even changes in the internal household pecking order (e.g., a child becomes the oldest boy when a sibling leaves) could plausibly influence development. The mere absence of the household member may have immediate spillover effects, e.g., through changes in room-sharing and shared television watching. Migration to the United States may expose households to new knowledge of child development or parenting styles, through so-called "social remittances."[5] Finally, migration may be psychologically stressful for family members, including children and their caregivers who are left behind, in turn influencing cognitive development.

Despite the widespread phenomenon of recurrent/circular migration in the LAC region and the growing body of literature on child development in the region, little is known about the effects of international migration, particularly temporary international migration for labor opportunities, on child development. Understanding the extent to which families and children are resilient in the face of major life changes such as migration is important for better understanding child development and for crafting migration and family support policies. Information enabling policies to be better tailored to the fact of temporary economic migration is of immediate value.

This project examines the impact of migration for economic opportunity to the United States on the cognitive development of Mexican children. Data from the Mexican Family Life Survey (MxFLS) are used to estimate the effect of sending a household member to the United States on the cognitive development of children aged 5-12 who remain behind in Mexico.

[4] Hanson (2005) finds that between 1990 and 2000, women from high-migration Mexican states became less likely to work outside the home relative to women from low-migration states, consistent with greater intra-household specialization. This suggests that women in migrant families might be able to hold steady or even increase total parental time investment in children.

[5] Creighton, Goldman, Teruel, and Rubalcava (2010) present evidence that children residing in Mexican households in U.S. migration networks are more likely to become obese.

An immediate challenge to any analysis of this issue is that migration and child investment decisions are jointly made. Endogeneity or simultaneity of the migration and investment decisions, including the fact that migrant households and members self-select into this status on the basis of both observed and unobserved characteristics, complicates identification of the causal effect of migration on child development. The empirical strategy here exploits both the unusually rich set of variables provided by the MxFLS and its longitudinal structure. An instrumental variables strategy based on historical migration patterns is also explored. Specifically, the inclusion of parent cognitive scores as controls for child development ameliorates potentially important biases due to the likely correlation between migration and unobserved abilities at the family level, while the instrumental variables strategy attempts to address unobserved child-specific heterogeneity, endogeneity, and simultaneity problems.

The empirical approach is as follows. A basic value-added model (Todd and Wolpin, 2003) is employed which models a child's current (wave 2) cognitive score as a function of her prior (wave 1) score, other "family background" variables (including parent cognitive scores), and interim shocks and changes hypothesized to affect child development. The latter include the incidence of household members' migration to the United States. Inclusion of child and parent cognitive scores as explanators in the specification controls for spurious correlations of the child's subsequent cognitive ability with household migration status due to selective migration. In addition, an instrumental variables strategy based on historical migration patterns attempts to further identify the causal effect of migration on cognitive ability. Ideally, the IV strategy eliminates bias from residual influences of unobservables (i.e., "residual" once child and parent cognitive scores are controlled) and identifies variation in migration that is exogenous with respect to cognitive development.[6]

The focus of this work is on estimating the net impact of migration on cognitive development, rather than investigating some or all of the many possible specific channels through which migration could affect development that are described above. In the case of perhaps the most discussed channel, remittances, data on remittances from recurrent United

[6] If there is random measurement error affecting the probability of migration, applying instrumental variables in the linear probability model also alleviates this problem. The MxFLS team attained a wave 2 re-contact rate of out-migrants to the Unites States of over 91 percent, suggesting that information provided on family members abroad is quite accurate (Rubalcava and Teruel, 2007).

States migrants to their families in Mexico are not collected in the MxFLS.[7] The MxFLS does, however, provide some information on other behaviors that may be influential for, or even influenced by, child cognitive development and which may also be affected by migration. Because theory suggests that changes in time investments of household members may play a major role in early childhood development (ECD), I also report findings on the net impact of migration on children's time use.

To preview the findings, single-equation estimates indicate that migration often has a significant effect on child development, with the strongest and most robust effects on the cognitive development of children who are younger and not the family's first-born. Importantly, the effect of migration on children depends critically on the migrant's identity. The findings indicate that, in general, younger children in households sending a migrant to the United States between waves 1 and 2 of the MxFLS fall significantly behind their peers in cognitive attainment-for-age. However, when the migrant is a sibling, there is no detrimental effect on the cognitive development of the brothers and sisters left behind. In an attempt to further address biases caused by unobserved heterogeneity and endogenous migration, the model is also estimated using instrumental variables. The IV estimates are qualitatively similar to the single-equation findings, but their significance is quite sensitive with respect to whether errors are clustered at the household level.

The paper proceeds as follows. The next section describes the present state of knowledge about migration and child development. A subsequent theoretical discussion outlines a simple model in which families make decisions about investments of adult time and purchased goods in children—resulting in specific developmental attainments of children—and the economic migration of adults, and the key insights for empirical work are discussed. Next, a discussion of the data source and a preliminary descriptive analysis are presented. A discussion of the methodological approach and empirical implementation is followed by a presentation of single equation and instrumental variables estimates of both children's cognitive development and time use. The final section discusses the findings, their implications for policy, and draws conclusions.

[7] Hanson and Woodruff (2003) maintain that remittance information, in data sets where it is collected, is likely to be inaccurately reported.

2. Prior Literature on Migration and Child Development

The study with aims most similar to this one is by Macours and Vakis (2007), who examine the impact of recurrent migration in Nicaragua, where seasonal agricultural migration to other Central American countries is common, on the TVIP (a Spanish-language picture vocabulary test) scores of children ages 3-7. They find that for seasonal migration undertaken over the prior 12 months, the duration of maternal migration is associated with significantly higher cognitive scores, the duration of paternal migration has a negative effect on scores, and migration undertaken by another household member has no effect. They do not specify the other controls included in their regressions, nor do they specify whether the migrant has returned to the household by the time of the interview. The positive effect of maternal migration is supported by estimates that use wage, illness, price, and agricultural plague shocks as instrumental variables. The analysis, while intriguing, has some shortcomings. Instruments of this type are typically believed to be invalid in this context, because of their potential direct influence on child development (e.g., Hildebrandt and McKenzie, 2005). In addition, very low reported F-tests in the first stage indicate that the instruments are extremely weak. Interesting features of the analysis are the focus on the family role of the migrant, the ability to identify temporary migration events in the data, and information on the duration of migration at high frequency.

With the exception of Macours and Vakis (2007) and one other study noted below, none of the studies discussed in this section treat migration and child development as endogenous. Relatively little research exists on the topic of migration and child development in general. Fajnzylber and López (2007) review the literature and present their original work on several topics. They find that remittances improve anthropomorphic outcomes for Nicaraguan children and provide some cross-country LAC evidence of increased school enrollment of 10-15-year olds in households receiving remittances. Yang and Martínez (2006) find that greater remittances in the Philippines increase school attendance and reduce child labor. Some research for Ghana (Guzmán, Morrison, and Sjöblom, 2007) suggests that migration affects child consumption patterns in ways that may be beneficial for child development.

Bryant (2005) draws several conclusions from a survey of evidence from the Philippines, Indonesia, and Thailand. First, parents' migration has a positive effect on the material conditions of children remaining in their home country; this improvement in material conditions appears likely to affect children's health and schooling as well. Second, while parents' migration entails some social costs, the involvement of the extended family largely mitigates them. Moreover, governmental and non-governmental organizations in the Philippines offer a variety of services for the children of migrants and migrants themselves; such services are less abundant in Indonesia and Thailand.

Bryant (2005) additionally notes that a handful of studies provide evidence that children of migrants have better physical abilities, no worse or better mental health, and are no more likely to engage in risky behavior as older teenagers. More recently, however, Deb and Seck (2009), using the MxFLS, find that although internal (i.e., within-Mexico) migration increases household consumption, it adversely affects the emotional wellbeing of household adults (including the migrant) and increases children's time spent on household chores. Even though emotional effects on children were not studied, it is plausible that adverse emotional effects on adults have negative implications for child-rearing. The findings are driven largely by migration to a distant location, which may make their findings relevant for Mexico-United States (”external”) migration.

Evidence on the school attainment of migrants' children is mixed. While children of migrants are more likely to attend private school, they are equally likely to be out of school, and there is little effect of migration on achievement as measured by grades (Bryant, 2005). Other studies find positive effects of remittances on schooling in Ecuador and Pakistan (see Macours and Vakis, 2007). Hanson and Woodruff (2005), using interactions between historical state migration patterns and household characteristics as instrumental variables for migration, estimate the effect of having any household-member migrant to the United States on years of completed schooling of Mexican children ages 10-15. Children (particularly girls) in migrant households where parents have low education levels complete significantly more years of schooling, but the effects are not estimated to be significant for other households. The authors argue "the results are consistent with emigration helping relax household credit constraints on the financing of education."

Hildebrandt and McKenzie (2005) study the impact of household members' migration to the United States from Mexico on children's health, using a 1997 sample of rural households. They estimate the impact of migration of household members to the United States prior to January 1, 1994, on subsequent birth outcomes (infant mortality, birth weight, and low birth weight incidence), for births occurring during 1994-1997. They use the "historical migration" approach, as in this paper, employing the 1950s migration rates of Mexican states as instrumental variables for migration. Their IV estimates suggest that migration to the United States improves subsequent birth outcomes. Hildebrandt and McKenzie (2005) also study mechanisms by which migration experiences might affect infant health, including maternal health knowledge. While their IV estimates indicate that migration increases maternal health knowledge, puzzlingly, the children of these women are less likely to be breastfed and to receive vaccinations and other preventive care in the first year of life.

There is some evidence that the extended family steps up its caregiving in response to migration. Changes in caregiving and household arrangements have been documented in a number of studies (see the citations in Bryant, 2005). Bryant (2005) finds that “children of migrants are more likely to have relatives from outside the nuclear family (i.e., cousin, aunt, uncle, or grandparent) living in the same household, especially if both parents are overseas.”

There is little direct research on how migrants’ family roles moderate the effects of migration on children. In a 2002 interview of children in the Philippines, respondents with a migrant parent were more likely to report being sad or worried about their family when the mother was absent, and children stated that they would miss their mother the most if they had to choose a parent to migrate (Bryant, 2005). Bryant concludes that “the extended family has more difficulty substituting for absent mothers than for absent fathers.”[8]

3. Theoretical Model and Hypotheses

The centerpiece of the basic model of human capital development is a human capital production function that specifies the relationships of inputs to outputs (e.g., Behrman, Pollack, and Taubman, 1982). Families optimize with respect to consumption investments and human capital investments in their child or children. The issue of migration can be analyzed in a straightforward way by permitting adults to work outside the home. For simplicity’s sake, adult earnings are assumed to be the sole income source, and household production, including children’s role in it, is not modeled. To avoid complicating the analysis, the migration decision is

[8] Some studies of the effect of parental absence (largely due to divorce and separation) on child development have been conducted. For the United States, Lang and Zagorsky (2000) find some evidence that paternal absence reduces cognitive ability, while maternal absence adversely affects the cognitive ability of daughters. Using parental death as a “natural experiment,” they find no significant impacts of parental absence on cognitive ability. This study aims to estimate the net effect of migration and cannot identify the role of a family member’s absence per se in the findings. Arends-Kuenning and Duryea (2006) report small reductions in school attendance and attainment of adolescents in single-parent families in Brazil, Ecuador, Nicaragua, and Panama.

not modeled discretely, nor are the financial and psychic costs of migration to the adults made explicit. The possibility that migration itself affects the allocation of consumption to the child (e.g., through intra-family bargaining) is not modeled.

Behrman (1998) lays out the human capital investment problem in the case of multiple children with heterogeneous characteristics. Without loss of generality, suppose there are k=1,2 children and j=1,2 adults in the family. The family maximizes a welfare function, $W(c, H_1, H_2)$, whose arguments are adult consumption (c) and the human capital attainment of the children (H_k). For simplicity, there is no utility from leisure. A human capital production function for each child is specified $H_k=h(t_1^k, t_2^k, c_k, a_k)$. The number of units of time investment of adult j in child k is denoted t_j^k and c_k is consumption of child k. The parameter vector a_k summarizes key characteristics of the child that affect human capital production, including observed (e.g., age, sex) and unobserved ("teachability") characteristics, as well as important characteristics of the two adults (again, both observed and unobserved) that moderate the transformation of time and consumption inputs into the realized human capital of child k. The time constraint for each adult is $t_j^1+ t_j^2 + l_j<=16$, j=1,2, and the household budget constraint is $c+c_1+c_2<=l_1w_1+l_2w_2$, where l_j is hours worked by person j at wage w_j.

For simplicity, the family utility function is assumed to be separable in consumption. The problem is to maximize $V(H_1, H_2)$ subject to the technological, time, and budget constraints. The first-order conditions from this optimization problem can be manipulated to reveal the relationship, for each child k, between the substitutability of adult time in the production function and relative wages, or

$$\frac{\frac{\partial V}{\partial H_k}\frac{\partial h(a_k)}{\partial t_1^k}}{\frac{\partial V}{\partial H_k}\frac{\partial h(a_k)}{\partial t_2^k}}=\frac{w_1}{w_2}.$$

For each child k, the optimal time investment contributions of heterogeneous adults are governed by the substitutability of adult 1 and 2's time investment in the human capital production function (valued in utility terms), balanced against their relative wages. In the special case where time contributions from adults 1 and 2 are perfect substitutes in the human capital production function, the optimum requires specialization; the higher-wage adult makes no time investment while the other adult provides all the time investment. In the special case where the time investments of two adults are perfect complements, both adults contribute time investment, regardless of their relative earning power. Therefore, adult 1 is more likely to migrate to the extent that he or she earns a sufficiently high wage abroad and/or to the extent that the time investment of adult 2 is sufficiently substitutable for adult 1's time investment.

For each parent, the distribution of his or her total time investment across the two children is governed by

$$\frac{\partial V}{\partial H_1}\frac{\partial h(a_1)}{\partial t_j^1} = \frac{\partial V}{\partial H_2}\frac{\partial h(a_2)}{\partial t_j^2}.$$

If the children are homogenous and parental preferences display equal concern (i.e., parental preferences are symmetrical across the children), then each parent divides his investment contribution equally among the children. In general, this will not be the case. Parents allocate their total contribution across heterogeneous children so as to equalize the marginal benefit of an additional hour spent with the child. Heterogeneous child and adult characteristics imply that an adult's time investment is more productive for some children than others. Thus, there could well be differential investment across the family's children by the same adult. Similarly, the relative value of time versus consumption investments in children may vary, so that the consumption allocation is unequal across children.[9]

In this simple model, the child development impacts of migration depend on the family role of the migrant and the relative potential wages of household members, inclusive of migration opportunities. Child and adult characteristics determine the household member optimally selected to migrate for economic opportunity. Migration may have little effect on child development if families can undertake compensatory adjustments, either by sending someone whose role is not critical for child development (e.g., an extended family member who does not normally reside with the children) or if there exist continuing household members who are good substitutes for the migrant in the human capital production functions. Therefore families with children that lack a rich household roster of adults are predicted to be less likely to choose economic migration, *ceteris paribus*. However, there are plausible circumstances when families with sparse household rosters may also find it optimal to send an economic migrant and reduce time investment. For instance, in very poor families with extremely low consumption, the

[9] The relevant first-order condition is $\frac{\partial V}{\partial H_1}\frac{\partial h(a_1)}{\partial c_1} = \frac{\partial V}{\partial H_2}\frac{\partial h(a_2)}{\partial c_2}$.

marginal value of an additional unit of consumption investment may outweigh the developmental loss from reduced time investment in the child.

An obvious and important extension of this model is to multiple periods, as in Cunha and Heckman (2007). In a dynamic model, human capital investment may be complementary over time and “self-productive” in the sense that increases in one period make investment more productive in the next, giving rise to what Cunha and Heckman (2007) term “critical” and “sensitive” periods of child development. An obvious implication of this extension is that the timing and length of migration relative to the child’s developmental stage potentially influences child development. In addition, in a dynamic model the relative substitutability of adults with respect to a given child could vary over time. However, the basic notion that having “substitute” adults on the household roster mitigates detrimental effects of economic migration on child development, although made more complex by consideration of the temporal dimension, continues to be a key hypothesis.

4. Data and Descriptive Analysis

Data from the first two waves of the Mexican Family Life Surveys (MxFLS) are used to evaluate the impact of migration on child development. The MxFLS is an ongoing, longitudinal, nationally representative and comprehensive survey of Mexican households. The first wave consists of 8,440 households (or over 35,000 individuals) in 150 communities surveyed in 2002. Follow-up interviews were conducted in 2006, with a third wave of surveying in progress as of this writing. The MxFLS contains detailed data on individuals and households, including measures of cognitive development and migration activity.

The MxFLS is an excellent resource for this study for several reasons. Flows of migration between Mexico and the United States are very large, so a substantial number of households with workers abroad appear in the survey. The MxFLS has an excellent measure of cognitive development: Raven’s figure test. The identities of wave 1 household members who reside in the United States in wave 2 are provided, as is complete information on family relationships that can be used to infer the wave 1 household role of the migrant.

In this section, the construction of the sample is explained and descriptive information is presented on cognitive scores and sample characteristics according to migration activity.

4.1 Identifying Children with Migrating Household Members

The sample consists of children interviewed in wave 1 of the MxFLS who remain at home in wave 2 and who have a wave 1 household member who resides in the United States in wave 2. A wave 2 follow-up module tracks the 854 wave 1 household members, originating from 510 households, who reside in the United States at wave 2. A disadvantage of using this approach to identify United States migrants is that families may benefit from non-household members' migration. This sample selection likely leads to understated estimates of the overall benefits of migration to children in Mexico. On the other hand, since household-member migration is likely to have the greatest impact on a household's children, this type of migration is of greater policy interest.

There are some other limitations of the *Migrants U.S.* module of the MxFLS which is used to identify children affected by United States migration. Remittance information is not provided for the individuals identified as "movers" in this module. In the absence of a third wave of the MxFLS, it is not possible to distinguish whether these moves are permanent or circular. Finally, the date at which the United States migrant left the household is not asked.

This approach identifies 2,018 individuals in the wave 1 sample (out of 34,674 total individuals) who are "left behind" in Mexico by a wave 1 household member who has migrated to the United States by wave 2. Of 474 children with reported wave 1 cognitive (Raven's test) scores left behind by a United States-migrating household member, in 35 percent of cases the migrating family member is their parent (nearly always the father), their sibling in 67 percent of cases (75 percent of these migrant siblings are brothers), and another household member in just 3 percent of cases. Eleven percent of these children experience migration by more than one type of household member.

4.2 Raven's Test Scores

The indicator of cognitive progress in children age 5-12 used in this study is the Raven's colored progressive matrices instrument (Raven, Raven, and Court, 1998). The test consists of a series of color figures that measure visual reasoning ability. Color makes the test easier, improving the ability to discern ability at the lower end (Raven, 2000). A total of 18 color matrices are shown to the child. Respondents older than age 12 take a "standard progressive matrices" (black and white figure) test with 12 matrices.

A chief advantage of the instrument is that it is designed to be "culture free." For example, it is possible to conduct the test even when the respondent does not have knowledge of a particular language or formal schooling. As such, the test is intended to measure "ability" rather than "achievement" (i.e., knowledge attained through schooling or other experiences) although there may be spillovers between ability and achievement in both directions. Although often interpreted in the literature as a measure of "innate" reasoning ability, Behrman et al. (2008) find that Raven's test scores appear mutable even at "schooling" (ages 7-14) and "post-schooling" (ages 15 and older) stages of childhood and young adulthood, respectively.

It is possible to track between-wave progress for the same children. In the first wave, 6,325 children are tested, along with over 19,498 adults. In the second wave, over 5,541 children are tested, along with over 14,741 adults. Thus, it is also possible to control for parents' cognitive abilities when predicting children's development. Of the 474 sample children ages 5-12 in the "left behind" group with reported wave 1 Raven's test scores, 246 are administered the colored matrices ("child" test) version in wave 2, while an additional 205 are re-tested with the adult version (23 are not re-tested).

4.3 Potential Non-response Bias

Before proceeding to a preliminary analysis of the Raven's test score data, a study of non-response bias was conducted. Twenty-one percent of all children in wave 1 households did not have a wave 2 Raven's score. This was almost entirely due to wave 2 non-interview status. Regression analyses confirmed that the determinants of non-interview status and not having a Raven's test score were the same. Significant predictors of wave 2 non-interview status were rural location and being an older child in the family in wave 1. The former may indicate selective attrition of rural households, while the latter likely indicates that these older children left the household for life-cycle reasons. Both missing wave 1 cognitive scores for mothers and fathers significantly raised the probability of a wave 2 non-response for the child's Raven's test score. A specification with a wide variety of wave 1 variables explained less than 3 percent of the variation in non-response.[10]

Only 5.3 percent of children interviewed in both waves 1 and 2 were missing their wave 2 Raven's score. The major factor influencing non-reporting for this group was, in fact, whether

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[10] It is plausible that households with migrant members are disproportionately wave 2 non-respondents, but this cannot be captured in the regression.

the child migrated to the United States (99 percent of children who leave for the United States do not have a wave 2 Raven's test score). Within the sample of children remaining in Mexico, a comprehensive specification explained only 2 percent of the variation in non-reporting. A longer period between wave 1 interview and wave 2 follow-up (suggestive of more difficulty obtaining a response) and rural location were associated with a higher probability of non-response, while children with more educated fathers were more likely to have a Raven's score. Finally, there were few systematic differences within the sample of households with United States migrants according to missing test score status. Within this group, children in rural and indigenous households were more likely to report a Raven's score, while those with more educated fathers were less likely to have a Raven's score. Overall, however, it was difficult to explain non-reporting within this group (the adjusted R-squared was under 3 percent).

4.4 Descriptive Analysis

Figure 1 shows that children's Raven's test scores (computed as the percent of correct answers in the total on the colored progressive matrices test) rise steadily with age, from a low of 49 percent correct answers at the age-5 sample mean to 71 percent correct at age 12 (see the y-axis scale on the right). The figure also shows (see the y-axis scale on the left) that the inter-wave correlation of scores is increasing in age—roughly tripling by age 9—consistent with cognitive ability plateauing and coalescing at older ages. Raven's tests score distributions for boys and girls are similar, and a Kolmogorov-Smirnov test fails to reject the hypothesis that the two distributions are the same with corrected p-value 0.155. Likewise, there are no obvious sex differences in the age pattern of inter-wave correlations (not shown).

To remove the strong age trend in raw scores, each individual's score is benchmarked against the sample average score for the corresponding year of age and survey wave. In particular, each observed Raven's test score is transformed by dividing through by the age-specific sample mean for the appropriate in-sample calendar year of age, by survey wave. These transformed relative scores can be interpreted as cognitive ability for age. Scores in excess of one indicate above-average achievement for an age-wave cohort.

Figures 2 and 3 present kernel density function plots of wave 2 Raven's test scores. Figure 2 presents relative Raven's test score distributions according to household migration status. The top panel shows the distribution for children ages 5-12 in wave 2, while the bottom panel provides comparable estimates for the sample of adults from the same households in this wave. The distribution of scores in the children's samples is shifted to the left for migrant-sending households, indicating lower overall cognitive ability of children in households with a migrant. A Kolmogorov-Smirnov test indicates that the two distributions pictured in Figure 2a differ with corrected p-value 0.022. The pattern for adults (Figure 2b) is similar (the two adult distributions pictured in Figure 2b differ with corrected p-value 0.000).[11] If adult's cognitive development is not greatly affected by short-term migration, Figure 2 suggests that the pattern for children may simply be a product of adult self-selection for migration and heritability.[12]

Figure 3 presents more kernel density estimates, using further detail on the identity of the migrant from the wave 1 household. The top panel contrasts the distributions for children in migrant households whose sibling or parent migrates. Except at the extremes of the distribution, the distribution of Raven's test scores for children appears less favorable when a parent migrates. However, a Kolmogorov-Smirnov test with corrected p-value 0.838 fails to reject the hypothesis that the two distributions are the same. In the case of adults (see bottom panel), the "parent migrant" group exhibits less density in the lower range of scores, and the Kolmogorov-Smirnoff corrected p-value is marginally significant, at 0.105. In contrast to Figure 2, the densities for children are not very similar to the adults'.

4.5 Sample Characteristics by Migration Activity

Table 1 presents characteristics of migrants and non-migrants from wave 1 households with children. Recall that (United States) 'migrant' is defined as a wave 1-household-member who resides in the United States in wave 2. Migrants tend to be much younger (by over 12 years on average), more often male, and most often the child of the wave 1 household head, rather than the head themselves. They are very unlikely to be the spouse of the head and less likely to be married. Migrants are less likely than non-migrants to have no formal education, and the proportion of those with just an elementary education is similar (the difference is not statistically

[11] There is a debate in the literature over whether Mexican migrants to the United States are positively or negatively selected on education and ability with respect to the Mexican population (e.g., see discussions in Hildebrandt and McKenzie, 2005 and McKenzie and Rapoport, 2007). The findings in Figure 2b indicate negative selection on visual reasoning ability.

[12] The findings from Behrman et al. (2008) suggest that adult scores could also be affected by migration. If the adults represented in the figure work less because someone in the household has migrated, it is possible that their cognitive development is adversely affected. In the regression analysis below, adult Raven's test scores from wave 1 are included as controls.

significant). Migrants are more likely to have obtained just a secondary education, but less likely to have completed their high school education (they are also less likely to be college graduates). While migrants more often report working in the past 12 months, they are no more likely to have received earnings during that period. Non-migrants' Raven's test scores equal the average attainment of their age-wave cohorts, but migrants' cognitive ability is significantly below attainment-for-age.

Table 2 presents select characteristics of the households in which the sample children reside, according to the household's migration status. The categories examined are "household has no migrant," "household has any migrant," and the subcategories of the latter group, "household sends parent" and "household sends sibling." The latter three groups are not mutually exclusive, as households may have multiple migrants.

Comparing the first two columns, households that send a migrant to the United States start large and grow rapidly over the waves. Households with a migrant are larger by around 1.4 members. Migrant households also tend to be well supplied with adults.[13] Over 70 percent of migrant-sending households have more than two adults in the household in wave 1 (substantially more than the proportion in non-migrant households). While the total change in household size for migrants and non-migrants is similar, migrant households also gain significantly more adults (defined as members age 15 or older) than non-migrant households, despite the loss of an entire adult to migration. Thus, migration does not lead to an obvious shortage of adult household members, on average. Households with migrants are also relatively "rich" in male family members, which is expected given the greater propensity of males to migrate. The ratio of male to female adults in wave 1 is 0.84 for households with a migrant versus 0.64 for those without.[14] Finally, migrant households live in states with historically high migration rates. The state-average 1950s migration rate for households sending a migrant is 2.22 percent, in contrast with a rate of just 1.56 percent for households without migrants.

Table 2 displays several significant differences in characteristics by type of migration (parent or sibling). Households that send a parent to migrate have significantly fewer adults in the household to begin with than those that send a sibling, while those who send a parent gain fewer adults and have a lower ratio of male to female adult members, initially.

[13] Throughout the paper, the term "adult" refers to individuals age 15 or older.
[14] The ratio of males to females holds steady into wave 2 for households with a migrant.

5. Methodological Approach

Todd and Wolpin (2003) argue that the value-added model is a reasonable approach to estimating child development when choosing among imperfect alternatives. The empirical strategy is to implement a ‘value-added’ specification of child development, augmenting this approach with parents’ Raven’s test scores and instrumental variables in order to correct for estimation biases due to unobserved selection on migration and the simultaneous determination of migration and child development investment choices.

The basic specification is

$$RK_{it} = \{X_{i,t-\tau+j}\}_{j=1}^{\tau}\gamma + \beta RK_{i,t-\tau} + \{a_{i,t-\tau+j}\}_{j=1}^{\tau} + \{h_{i,t-\tau+j}\}_{j=1}^{\tau} + \varepsilon_{it}$$

Child *i*’s wave 2 relative Raven score (RK_{it}) is modeled as a function of the wave 1 score ($RK_{i,t-\tau}$) and other observed factors (reduced forms for investment and changes/shocks/events, denoted $X_{i,t-\tau}$) that influence the child’s development in the intervening period between ability observations. Migration of a household member in the intervening period is included as one of these factors. In addition, intervening unobserved influences at the child (*a*) and household (*h*) level may influence development.[15]

An advantage of the value-added specification is that the impact of any systematic unobserved differences between children in migrant and non-migrant households that occur through period t-τ (including any time-invariant, permanent, household, or child heterogeneity) are subsumed in $RK_{t-\tau}$. Remaining concerns about unobservables are thus limited to non-permanent “shocks” that occur between waves (typically a 3 to 3.5 year period).

The value-added specification directly addresses concerns about estimation bias due to selection of migrant households with regard to child cognitive ability. However, other biases are legitimately concerning, and these problems and potential solutions are now discussed.

A practical concern with implementation of the value-added model is that children’s Raven’s test scores may be quite noisy. In particular, the earliest observed score, which plays the crucial role in controlling for selection, may be a noisy indicator of true visual reasoning ability. Therefore, the initial distribution of child cognitive ability with respect to migration status may not be well characterized; this problem presumably worsens when examining younger

[15] Note that *h* might include shocks simultaneously affecting child health and migration, such as rainfall.

subsamples. Since maternal Raven's test scores have been shown to better predict children's later cognitive attainment than a child's own early scores, a straightforward remedy is to include parent Raven's test scores as "state" variables in addition to $RK_{t-\tau}$.[16]

Many variables that should plausibly be included in *X*, such as family structure changes, are endogenously determined with migration, leading to potentially inconsistent estimates of all the parameters. Other potential *X*s, such as health measures, which have been found to be highly correlated with cognitive skills (see Behrman et al., 2008, for a review of the many studies emphasizing the importance of nutrition for cognitive development), are simultaneously inputs and outputs of the child development production function. Other standard "inputs" to cognitive development, such as schooling, are also likely endogenous. Instruments for migration that are exogenous with respect to the right-hand-side variables and that do not directly influence child development but directly influence migration, afford a consistent coefficient estimate for migration. An appropriate IV strategy also addresses the problem of unobserved transitory influences (*a* and *h*) on child development.

Treating migration as an "X" ("interim") variable is an *ad hoc* extension of the value-added model because, as the theoretical discussion indicates, migration, child investments, and child development are all jointly determined. The theoretical model indicates that factors directly influencing child development also influence migration. It may therefore be difficult to identify the entire effect of migration on cognitive development when these aforementioned factors are also included as explanators in the child development specification. An IV strategy addresses the potential identification problem that arises from extending the value-added model to encompass migration, in that an exogenous shifter of migration aids the identification of its coefficient.[17]

A potentially important problem remains. Migration may be correlated over time, so that families experiencing migration in the past are more likely to have migrant members in the present. If so, causality may run from the "current" United States migration variable to the baseline child cognitive score. Such a relationship makes it difficult to identify the separate

[16] According to Cunha, Lochner, and Masterov (2005), measures like the Raven's test score, characterized by them as "pure cognitive ability," do not predict adult IQ well (although Ghuman, Behrman, Borja, Gultiano, & King, 2005, suggest that early-life cognitive skills are strongly associated with completed schooling, earnings, and employment outcomes later in life). They argue that prior to age 5, maternal IQ is a better predictor of age-15 IQ than any available test score and that after age 10, "IQ becomes stable within the constraints of psychometric measurement error." The scores of the younger children (5-10) taking Raven's test in this sample could be subject to this problem.

[17] Just as an exogenous shifter of demand identifies the supply curve, in the famous case.

influences of initial cognitive ability and intervening household migration status on current cognitive development. It is not evident that the particular IV strategy taken in this paper can successfully address this problem. Because the instruments are based on historical migration patterns, the instrumented migration variable may well be correlated with baseline child development if baseline child development was influenced by past migration. Under the strong assumption that migration during the child's lifetime does not affect adults' cognitive development, an alternative approach is to replace the child's initial Raven's test score with those of his parents.

Variables included as additional explanators are believed to be either closely correlated with inputs or with factors governing the transformation of inputs to child human capital (output). Child characteristics may drive the demand for certain inputs according to the stage of life, govern the transformation of inputs to developmental progress, and influence the substitutability of consumption with time as well as the substitutability of time inputs from various family members. Parental characteristics reflect available inputs and the ability to transform inputs into child development. The major insight of the simple theoretical model is that the household roster is a major determinant of migration decisions in the presence of children, as well as of migration's potential impact on child development. *Ceteris paribus*, the presence of close-substitute caregivers on the household roster increases both specialization in human capital investment among the adult household members and the likelihood of migration of adult roster members with the best overseas earning potential. Thus, it is important to characterize the household roster of potential caregivers and workers in empirical work. Ideally this characterization extends beyond the current household membership to include those whose time investments and earnings contributions are *potentially* available to the household, rather than simply observed, but this is impractical given typical data limitations. Family structure variables characterize the roster of potentially available adults (observed pre-migration) to contribute to the household through time investments in children and/or work. Geographic variables reflect regional variation in resources and cultures that may influence the production of child development.

Finally, dwelling characteristics are included in the empirical implementation. These variables are believed to be reasonable proxies for household wealth. In theory, wealth ought to be redundant with the "state" variable of initial child Raven's score. This is unlikely to be the case in practice for several reasons. First, as noted above, a child's lagged Raven's score may only measure her actual ability with error. Second, the model might be mis-specified. Third, these state variables may be correlated with the omitted terms ($a_{i,t-\tau+j}$, $h_{i,t-\tau+j}$) in some specifications. Fourth, the state variables may be collinear with the right-hand-side variables that reflect "investment."

5.1 Instrumental Variables Strategy

This paper follows the IV strategy developed in Woodruff and Zenteno (2001) and also implemented in Gitter, Gitter, and Southgate (2008). Historical migration rates for each *edo* (state) from the 1950s serve as instruments for current migration. Following Gitter, Gitter, and Southgate (2008), the migration rates are also interacted with the region of Mexico (region dummies also appear in the child development specification). Arguments for the validity of these instruments are that early migration patterns were established by geographic barriers, transportation advances established and located prior to the phenomenon of widespread migration (chiefly railroads), and the Federal *Bracero* program that brought large numbers of Mexican migrants to the United States during and after World War II. Migration networks (knowledge about and practical help with migration at the origin, as well as help obtaining employment at the destination) were strongly established for communities that were initially advantaged in travel.[18] In turn, these established origin and destination migration networks reinforced historical migration patterns. As a result, contemporary patterns of migration still strongly mimic earlier historical patterns, despite subsequent substantial changes in the relative ease of travel to the United States.[19]

6. Single-Equation Estimates of the Effect of United States Migration of Household Members on Children's Cognitive Development

Single-equation estimates of the value-added specification for children's Raven scores (i.e., percent correct answers, normed by the average percent correct by calendar year of age and survey wave) are presented in Tables 3 through 6. Tables 3 and 4 show how the key coefficients

[18] Munshi (2003) finds that destination networks are highly effective in obtaining superior U.S. labor market outcomes for recurrent migrants, as measured by both employment and earnings, while Davis, Stecklov, and Winters (2002) find that both origin and destination networks are important influences in migration.

[19] The other major instrument for selection on migration in the literature is rainfall shocks. The validity of a rainfall shocks variable is questionable when the dependent variable is a child outcome, since important factors such as family wealth and consumption may be affected.

evolve as sets of explanators are added sequentially to the specification. Table 5 presents findings from alternative specifications and sample restrictions.

6.1 Findings for the Entire Sample of Children

Table 3 presents estimates for the entire sample of children (defined as individuals in wave 1 with non-missing Raven's colored progressive matrices test scores, largely falling between ages 5-12). Note that the wave 2 test score for older children in this sample may be from the black and white test instrument. All specifications include two dummy variables indicating migration status—whether there is any migrant from the household ("sending household") and whether the migrant from the household is a sibling. Coefficients associated with the visual reasoning ability scores are also reported for the child and the child's mother.

Column 1 presents the findings from the value-added specification of cognitive ability where the child's wave 1 Raven score is the only additional explanatory variable. The effect of migration is negative at a confidence level exceeding 95 percent, and the estimated effect of sibling migration on cognitive development is insignificant. As additional explanators are added to the model, the effect of having a migrant from the household diminishes and becomes insignificant. The effect of a sibling migrant is estimated to be insignificantly different from zero at standard confidence levels for every specification. The child's wave 1 Raven's test score is always highly significant, but the magnitude of its effect declines as additional explanators are introduced, dropping by one-third from the least to most "saturated" specifications. The influence of maternal Raven's test score is fairly similar across specifications. The (unadjusted) R-squared doubles across specifications. The only groups of explanators that are not estimated to be jointly insignificantly different from zero at standard levels of confidence are detailed family structure variables, geographic information, and interim shock and change variables (i.e., variables in *X*).

The specific variables are as follows. "Dwelling characteristics" originally included indicators of an indoor toilet, tap water access, and whether the home was paid for. Tap water access and whether the home was paid for were found to be redundant with the presence of an indoor toilet, so only the latter is included as a dwelling characteristic. The effect of an indoor toilet on child development is positive.[20] This finding may reflect the influence of household wealth on children's cognitive development that is not captured by the lagged Raven score, the impact of the physical environment on other important factors influencing development (chiefly health), or the influence of the physical environment on the production of cognitive development.

The set of child characteristics includes whether an indigenous language is spoken at home, current school grade, the birth order of the child (expressed as dummy variables indicating first born, second born, etc., up to fifth or later-born), twin status, only-child status, dummy variables indicating the presence of none, one, or two or more younger siblings, whether the mother is reported to be the caregiver, sex, and a full set of dummies for child age.[21] Cognitive development is significantly slower for children who speak an indigenous language, those with a greater number of older siblings, and those with a greater number of younger siblings. Children who speak an indigenous language at home could be disadvantaged in school, and parenting styles, preferences, and efficiency in producing cognitive gains might differ across demographic groups of the population. Children with fewer older siblings may benefit from a higher average intellectual environment and less competition for parental attention and other resources in early childhood. While older children might also benefit in their own development from teaching younger children, advantages to seniority in a sibship are offset by a greater number of younger siblings, suggesting that eventually younger siblings "crowd out" developmental investment in older children, or that younger siblings are a "public bad" within the family, in the sense of Becker. The findings suggest a declining effect of age on measured ability, although several individual age dummies have large standard errors. Since the Raven's scores are age-normed, this finding is consistent with a declining likelihood of improving cognition-for-age in age, consistent with cognitive ability coalescing in later childhood.

Maternal and paternal characteristics consist of age, education, and work status variables, and parent's Raven's test scores. Parental factors that significantly increase child development are parental Raven's test scores and higher maternal and paternal educational attainment. These factors are associated with heritability of intelligence, increased efficiency in the production of child cognitive development, and/or higher-quality parental inputs to the production process.

[20] Throughout this discussion findings are reported from the 'saturated' specification in column (7), which excludes only potentially endogenous 'interim' variables.

[21] The variable 'mother is caregiver' appears to capture whether the father is involved with the family.

Parental factors associated with diminished child development are older maternal age and whether the father worked in the past year. In addition, the literature indicates that Mexican immigrants in the United States are concentrated in the middle of the Mexican wage distribution, suggesting that relative education may be an important factor determining the rewards from migration (Chiquiar and Hanson, 2005). Thus, this variable is also included as a control for observed selection on migration.

Family structure variables consist of the ratio of males to females, the number of individuals in the household, the number of adults in the household, and a dummy variable indicating the presence of three or more adults, all measured at wave 1. The major insight of the simple theoretical model is that the household roster is a major determinant of migration decisions in the presence of children, as well as of migration's potential impact on child development. *Ceteris paribus*, the presence of close-substitute caregivers on the household roster increases both specialization in human capital investment among the adult household members and the likelihood of migration of adult roster members with the best overseas earning potential. Thus, it is important to characterize the household roster of potential caregivers and workers in empirical work. Ideally this characterization extends beyond the current household membership to include those whose time investments and earnings contributions are *potentially* available to the household, rather than simply observed, but this is impractical given typical data limitations. These variables may govern the child development process and are also strongly correlated with migration. None of the aforementioned variables are estimated to have significant effects, and the variables are insignificant as a group.

Geographic information includes the region of the country and the size of the municipality. Central location has a negative effect on child development, but these variables are also insignificant as a group.

6.2 Findings for Younger Children

One might expect a greater impact of migration on children at younger ages for a couple of reasons. A migration episode of a given duration comprises a larger share of the child's lifetime, the younger the child. Very young children also grow rapidly, so their brain development might be more sensitive to such experiences at younger ages. Cunha and Heckman (2008), looking at two-year periods of child development in United States data, identify the age periods from 6-9 through 8-11 as sensitive periods for cognitive skills; their findings indicate a sensitive period for cognitive skills from ages 6-7 to 8-9 that is especially robust.

In the case of the MxFLS, there is also a practical reason to prefer estimates from younger samples. For older wave 1 children in the sample, the inter-wave change in Raven's test score does not reflect cognitive development alone; it also encompasses a change in the format of the Raven's test from the colored progressive matrices and large number of questions to the black and white test with fewer questions. In particular, mixing adult and child test versions aggregates and thereby obscures changes in ability at the lower end of the distribution, to which the color test is geared. Only the visual reasoning ability of younger wave 1 sample members (roughly those aged 5-8) is measured on a consistent basis across waves.

Table 4 presents the results of repeating the specifications described above, restricting the sample to children who have taken the children's version of Raven's test in both interview waves. This roughly captures the transition of children from preschool and early-school ages into early-school age.[22] In contrast to the first set of regression findings reported in Table 3, the effect of sending a migrant is typically negative, while the effect of sending a sibling as the United States migrant is typically positive. The findings consistently indicate that non-sibling migration (which is almost exclusively parental in this sample) has a negative effect on child development, while an offsetting beneficial effect of sibling migration results in no net effect of migration on visual reasoning ability when the sibling is the migrant. The effect of the wave 1 Raven's test score on the wave 2 Raven's test score is substantially smaller for the younger sample (compare with Table 3); as expected, the scores of younger children have less predictive value. The coefficient of Raven's test score for young children declines by about 40 percent from the first to last specifications, while the effect of maternal score declines by roughly one-quarter. As expected, the maternal Raven's score is slightly more influential for the younger group of children, while the child's own initial score is much less influential in the younger sample. Once child and other characteristics are introduced into the specification, the model actually explains more of the variation in younger children's scores than it does for all children. This is consistent with the inter-wave change in scores being more finely gradated for the younger sample, as discussed. The effects of other variables are as described previously for the unrestricted sample.

[22] Behrman, et al. (2008), define "preschool", "early schooling", "late schooling", and adult periods. These periods correspond to wave 1 ages of 5-6, 7-10, and 11-12, respectively, in this sample.

To place the magnitude of these changes in perspective, the mean inter-wave change in relative Raven's test scores for the young child sample is 0.022 with a standard deviation of 0.41.[23] According to the preferred specification (column 7), sending a parent to migrate reduces the wave 2 relative Raven's test score by 0.052. While this effect amounts to less than 15 percent of one standard deviation in visual reasoning ability, it is comparable in magnitude to several other significant explanators. For instance, the effect of parental migration is not estimated to be significantly different from the effect of speaking an indigenous language at home, or low maternal education (having no formal education versus an elementary or secondary education).

6.3 Robustness of the Findings to Sample and Specification Changes

Table 5 presents single-equation findings for interacted specifications and additional subsamples. Columns (1) and (2) in Panel A repeat the findings in column 7 of both Tables 3 and 4 for reference purposes. Aside from age, another characteristic of children that may plausibly influence the impact of migration is birth order. There is evidence from the United States that first-born children receive substantially more parental time investment (Price, 2008). Whatever mechanism produces this outcome may also be protective against the adverse consequences of migration for first-borns. In the third column, the preferred specification is estimated for the subsample of children with older siblings. Without further sample age restrictions, the effects of migration have large estimated standard errors and are insignificant. However, when the sample is restricted further to young children taking the colored matrices test in both waves and who are not first born, migration by family members other than the sibling reduces cognitive development (column 4), but there are no adverse effects if a sibling is the United States migrant.

Panels B through D present the key migration findings for various changes in the specification. Panel B omits the child's wave 1 (baseline) test score from the specification.[24] Findings are fairly robust with respect to this modification, although the effect of sending a migrant is not estimated to be significant at even the 90 percent level for the sample of younger children with older siblings. In Panel C, the basic specification is augmented with additional information about past migration activities, specifically: whether a household member permanently migrated to the United States since 2001 or since the age of 12, whether a

[23] The positive inter-wave change in Raven's scores indicates that the young child group is positively selected for above-average cognitive growth. There is not an obvious explanation for this.

[24] Cunha, Lochner, and Masterov (2005) summarize prior research as suggesting that prior to age 5, IQ scores of children are unstable and lack predictive value. This argument might also apply to children somewhat older than 5.

household member migrated anywhere during the past two years for a trip of less than one year, and temporary (duration less than one year) migration to the United States by any household member, all measured as of wave 1. Across all samples, the findings for the key migration variables are quite robust with respect to these additions. This suggests that the problem discussed above of identifying the effect of the "present" United States migration episode from past episodes, due to autocorrelation in migration, may not be that serious.

Finally, Panel D introduces additional control groups, effectively comparing household member migration to the United States with moves out of the household for all other reasons (the latter would include internal migration and household moves for life-cycle reasons). So far, children in households with United States migrants have been compared to children in all other households. Although it would be interesting to compare the effects of internal (within-Mexico) and United States migration, it is not possible to construct internal migration variables that are comparable to the United States migration variables. Since information on internal migration is collected retrospectively, migration history is only known for individuals who have returned to the household by the wave 2 interview. This specification aids identification of effects of migration on cognitive development above and beyond the fact that migration to the United States causes the former household member to exit the household.[25]

Across all samples, moves of parents from the household for all reasons have no effect on cognitive development, while departures of siblings (for any reason) adversely affect young children. It continues to be the case that the net effect of parental migration (computed as the sum of the "sending household" and "parent absent" coefficients) tends to be marginally negative, while the net effect of sibling migration (computed as the sum of the "sending household", "sibling migrant", and "sibling depart" coefficients) continues to be positive.

6.4 Differences in Findings by Sex

Because there are 108 parent migrants in the unrestricted regressions sample, of which only 14 are the mother of the sample child, inferences about parental roles and child development from this sample are unreliable. However, since the sex of the child varies, there are many cases of both same-sex and opposite-sex migrant-child pairings, and the question of whether it matters if the parent is the same or opposite sex of the child can be explored. In contrast, there is ample

[25] One obvious potential cause of a special "U.S. migration" effect is increased resources due to remittances, in contrast to the relative increase in resources when a household member departs for other reasons.

variation in the sex composition of sibling migrants. There are 1,130 children whose brother migrates and 772 children whose sister migrates (since only 1,495 children have a sibling migrant, this implies that 407 children have at least one brother and one sister who are United States migrants).

Regressions (not reported) interacting the migration variables with the sex of both the migrant and the child uncovered few instances of significant differences according to either same or opposite sex pairings or specific male-female, female-male, male-male, and female-female migrant-child pairings. In the case of a specification which examined boy-girl differentials in the effect of migration (differentiating by the identity of the migrant), girls' cognitive development was adversely affected by a parent migrant, while boys' was not. In a specification capturing whether a sibling migrant was a brother or sister, there was a marginally positive effect when a sister was the migrant (regardless of the child's sex). Finally, in a detailed specification for sibling migrants (indicating whether migrants are brothers or sisters of a boy or girl child), girls were positively affected by United States migration of sisters. However, all of these findings were for the sample of all children. There were no significant findings in the case of younger or younger and later-born child subsamples. Overall, then, there is little evidence of sex differences in the effects of United States migration.

7. Single-Equation Estimates of the Effect of United States Migration of Household Members on Children's Time Use

Theory suggests that changes in time investments of household members, both adults and children, may play a major role in child development. In this section, I report findings from an analysis of the net impact of migration on children's time use, providing some insight into the ways in which migration changes behavior, responsibilities, and daily routines within the family. Information about time use is available for children under age 12 in each wave. The dependent variables analyzed are hours during the past week spent doing chores, watching TV, playing, reading, and sleeping. All variables are estimated using a Tobit specification. Household chores is an aggregated measure, following Deb & Seck (2009). Many observations are lost due to varying age universes of some of the underlying questions.

The specification parallels the value-added specification for cognitive development, with each time use variable taking the place of the waves 1 and 2 cognitive scores. In parallel to the value-added specification of cognitive development, the number of wave 1 hours spent on the activity, plus a dummy variable indicating if no hours were spent on the activity in wave 1, constitute "baseline" controls. Wave 1 child Raven's test scores also appear as controls, and all other controls from the preferred migration specification are maintained. Table 6 presents the main findings for samples of all children and subsamples of young children and young children with older siblings. Sample statistics for the dependent variables are provided in Table 6a.

There are few significant migration coefficient estimates for the entire sample of children (column 1). Time spent reading is significantly increased when a parent migrates, while the effect of a sibling leaving is not estimated to be significantly different from zero.

Since the strongest findings for migration and measured cognitive development are those for younger and younger, later-born children, I also focus on these restricted samples for the time-use models. In the cases of time spent doing household chores, playing, and sleeping, there are no significantly estimated effects of migration. However, young children's television viewing is estimated to rise by 20 to 30 percent above an average of 13.5 to 13.3 hours per week when a parent migrates. When a sibling migrates, there is no net effect on television viewing. The increase in television viewing amounts to about 0.40 of a standard deviation, regardless of the subsample.

An analysis of reading time also yields significant coefficient estimates. When a parent migrates to the United States, reading time is estimated to double, while there is no effect on reading time if a sibling leaves for the United States. The huge effect of parental migration on estimated reading hours may be an artifact of the fact that there are many zero hours reports for reading (as opposed to all the other activities). Even so, the estimated change in reading amounts to an increase of 0.52-0.81 of a standard deviation, which is large.

8. IV Estimates of Child Cognitive Development and Time Use

Appendix Table 2 presents first-stage regression coefficient estimates for the instrumental variables in the model of visual reasoning ability, along with F-tests for the joint exclusion of the instruments from the first-stage specification. All the other model variables are also included in these specification (i.e., dwelling characteristics, child and parent characteristics, detailed family structure, and geographic information), but their coefficients are not reported. For the entire sample of children, variables that increase the chance that a household sends any migrant to the

United States are a toilet in the house, higher birth order, maternal age, the ratio of adult males to females, and living in a non-rural area. Factors that reduce the probability of sending any migrant are maternal caregiver, mother worked in the past year, and father's age. Neither cognitive scores for children nor parents are significant predictors of migration from the household, nor is parents' education.

The findings reported in Appendix Table 2 indicate that the strength of the instrument set varies widely across subsamples. The instruments are strongest (as indicated by an F-test for their joint significant in the first stage) for the entire sample of children and for the sample of later-born children. The instruments' predictive power is substantially weaker when the sample is restricted by age. Although the bias of weak instruments is well understood in the case of a single endogenous instrument, exact test statistics are not available in the case of more than one endogenous variable, as here. Nevertheless, intuition suggests that explanatory strength of instruments is still a desirable characteristic.

Table 7 presents the IV coefficient estimates of the effect of United States migration on cognitive development and children's time use. The scale of the coefficient is altered because the instrumental variables model is estimated as a linear probability model in the first stage: the right-hand-side migration variables explaining child development are migration probabilities, not binary outcomes. The focus is on samples of younger children whose Raven's scores are collected on a consistent basis in both waves.

The first row of the table presents the key coefficient estimates from the model of cognitive development. Immediately beneath the coefficient estimate is the standard error, while the third entry in each cell is the standard error after adjustment for potential intra-family correlation in the error term ("clustered" errors). When standard errors are not clustered, the findings are qualitatively similar to the single- equation findings, with a negative effect of any migration to the United States from the household (typically by the parent) and an offsetting effect of sibling migration, resulting in a zero effect of sibling migration. However, when errors are clustered, the findings are quite imprecise.

The next two rows present the findings when (B) the child's initial Raven's test score is excluded from the specification and (C) when the complete specification is augmented with interim change and shock variables (indicators for death of a household member, serious illness of a household member, unemployment of a household member, experience of a natural disaster or crop failure, an increase in the number of younger siblings, the change in total household size, the change in the number of household adults, and a decrease in the number of older siblings in residence). Recall that these variables are likely determined endogenously with migration; the IV approach presumably yields consistent estimates of the migration coefficients. The IV estimates are robust with respect to excluding the child's baseline test score. The migration coefficient estimates are substantially larger in absolute magnitude when interim change and shock variables are controlled. This finding suggests that interim changes and shocks may be correlated with migration and also mask adverse effects of parental migration (e.g., compensatory changes in household membership).

Household chores may also be endogenous with migration if the household workload is endogenously determined. For example, families where chores are readily reallocated to children may also be more likely to send a migrant abroad. The remaining rows of Table 7 present instrumental variables estimates of household chores from a two-step Tobit IV procedure.[26] In the case of television viewing, reading, and sleeping, the Tobit IV estimates are qualitatively similar to the single-equation estimates. Migration of a parent to the United States is estimated to increase time spent on these activities, while there is no net increase if a sibling migrates. As is the case with single-equation estimates, children's sleep is not affected by migration. In contrast to single-equation findings, IV estimates suggest that children's time spent on household chores and playing rises when a parent leaves, with no effect if siblings migrate to the United States At face value, this suggests that the endogeneity of migration masks these effects in single-equation specifications.[27]

9. Conclusions

A simple theoretical model indicates that migration and child development are jointly determined. Optimizing families with children are generally predicted to send household members to the United States who have relatively better earnings opportunities abroad and who are either not influential for child development or for whom there are good substitutes in the household roster vis-a-vis the child development production function. Data from the MxFLS are

[26] Maximum likelihood estimates frequently failed to converge.

[27] For example, families with a migrant parent may be less likely to shift household chores onto children for unobserved reasons.

used to estimate the net impact of migration of household member(s) to the United States on the cognitive development (specifically, visual reasoning ability) of children remaining in Mexico.

Single-equation estimates of children's cognitive development, as indicated by visual reasoning ability, indicate that the identity of the migrant is influential for cognitive development, as are the characteristics of the child and parents and dwelling conditions. Children experiencing parental migration from the household have significantly lower cognitive gains over the inter-wave period. When the migrant is a sibling, migration typically has neither an adverse nor beneficial effect on cognitive development. In the basic specification, the reduction in growth in visual reasoning ability is comparable to that predicted by speaking an indigenous language at home, or having a mother with little or no formal education, versus elementary or secondary school experience. Adverse effects of non-sibling migration are largest for younger and higher-birth-order children. Further analysis produces little evidence of differences in the effect of migration according to the sex of the child or whether the child and sibling migrant are of the same sex.

The value-added specification controls for the distribution of child development in a way that arguably addresses the issue of selective migration based on "permanent" child and household characteristics that also influence child development. Inclusion of parental Raven's test scores also controls for the unreliability of very young children's scores and further controls for selective migration, since parent cognitive ability is presumably determined prior to migration from the household. However, potentially important problems of selection on intervening characteristics, reverse causality from child development to migration, endogeneity with intervening observed variables with migration, and potential endogeneity of the initial measure of child development with migration remain.

To that end, an instrumental variables strategy that uses regionally interacted historical migration patterns is applied. The IVs are strong predictors of migration from the household so long as the sample is not restricted to the youngest children (ages 5-8 in wave 1). The IV findings are qualitatively similar to the single-equation findings, in that the estimated coefficient of "any migrant" has a negative sign, and the effect of a sibling migrant is of opposite sign and of roughly the same absolute magnitude. However, the significance levels of the IV estimates are sensitive with respect to clustering of errors at the household level.

An analysis of migration effects of children's time-use was also presented. For younger children, quite large increases in both reading and television viewing were estimated when a parent was the migrant. It is possible that large increases in television viewing could slow the development of visual reasoning ability. It is also possible that verbal ability improves at the expense of other abilities due to increased reading. Instrumental variables estimates also suggested that time spent on household chores and playing increase when a parent is the migrant.

9.1 Comparisons with Prior Literature

I find some evidence that parental migration to the United States reduces growth in visual reasoning ability of younger children. Macours and Vakis (2007) conclude that parental migration improves verbal ability. Setting aside differences in the countries studied, because separate aspects of cognitive development may be differentially affected by migration, the findings on visual reasoning ability and verbal knowledge are not necessarily at odds. Deb and Seck (2009), who also use the MxFLS, find evidence of adverse effects of household migration on the emotional wellbeing of household adults, which could affect child-rearing. Like Deb and Seck (2009), this study finds some evidence (from IV estimates) of increases in children's household chores due to migration. The findings with respect to television viewing also provide other potential explanations for the link between Mexican-United States migration and obesity uncovered by Creighton, Goldman, Teruel, and Rubalcava (2010).

9.2 Directions for Future Research

The findings in this paper suggest several directions for additional research. First, there are several avenues for fuller development of findings. It is not known whether the observed migration event is part of a pattern of circular or recurrent migration, although it is intuitively less likely that parental migration is permanent. To the extent that the nature of migration matters for child development, it is desirable to piece together a more complete picture of the migration episode and its context.

The analysis can also be extended to consider other child development indicators that are "outputs" of the human capital production function, such as school progress and physical health. The analysis presented here can be readily extended to provide evidence on the impact of migration on other potential child development measures and potential inputs to child development such as household income and consumption, "quality" time spent with children, and child care arrangements.

A key question is whether the adverse effects detected in this study represent permanent or transitory losses in visual reasoning ability. This is a critical issue for policy; if short-run losses are readily recouped, the urgency to intervene is diminished. With the third release of the MxFLS, it may be possible to examine the longer-term effects of migration on cognitive development.

Further investigation of the exact mechanisms by which migration may affect child development (e.g., remittances, time use, consumption allocated to children) appears merited based on the evidence presented here. In addition, it is possible to analyze the impact of migration on problem behaviors of children, depression in adults, and time use of adult household members who are present in both waves.

Release of the third wave of MxFLS will allow estimation that removes family effects. Estimates of lagged dependent variable models are inconsistent in the presence of fixed effects, but a first-difference version can be consistently estimated, albeit with "severe efficiency loss" (Bernal and Keane, 2010). Differential migration experiences between waves 1 and 2 and waves 2 and 3 could identify migration's effect; however, the potential non-representativeness of this restricted sample is invariably the "cost" of this type of analysis, as noted by Todd and Wolpin (2006).

9.3 Considerations for Policy Formulation

Bryant (2005), surveying the literature at the time, argued that there was a lack of evidence that the costs of migration were important enough to justify expensive policy interventions for families with children sending household migrants far away. The findings from this study, however, indicate a significant loss in visual reasoning ability due to parental migration, the magnitude of which is similar to other factors that might be interpreted as indicators of disadvantage, such as speaking an indigenous language at home or having a mother with very low educational attainment. While the effect of migration out of the household to the United States on children's cognitive development does not appear to be a policy problem in general, in the specific case in which a parent migrates, there may be development losses consequential enough to consider policy interventions.

Bryant (2005) argues that in the Philippines, the government, a well-developed non-governmental organization sector, and religious groups provide a wide range of relatively inexpensive services to assist migrants and their families. By facilitating migration, providing counseling and other resources for the "left behind" family members, and offering reintegration services for returning migrants, it is possible that the emotional stresses associated with migration are ameliorated. However, it is not yet clear whether these emotional stresses are responsible for the adverse effects on cognitive development identified here.

Another potentially important policy area, given that parents may still continue to migrate, is child care. It may be desirable to target families with migrant parents for early childhood education intervention, along the lines of the Head Start program in the United States However, while the findings on increased television viewing and reading are consistent with a potential decline in children's time spent interacting with adults, which might be remedied by engaging adults from outside the household, the substitutability of child care or education for parental care is questionable. There is some evidence from the United States that child care is not a good substitute for maternal care (Bernal and Keane, 2010). Raven (2000) argues that parenting styles play a critical role in determining visual reasoning ability and that parents undertake a cycle of learning their children's level of competence. As children demonstrate competence at one level, parents place them in situations at a higher level in which learning and practice can occur. A formal setting with multiple children and fewer adults would be unlikely to produce equally positive results.

One policy approach is to reduce migration of *parents* to the United States in the first place. While some countries have considered bans on parental migration (usually targeting mothers), conditional cash transfer (CCT) programs, already well-established in Mexico, appear to play an important role in reducing out-migration to the United States from Mexico. Stecklov, Winters, and Stampini (2005) provide evidence that CCT programs are particularly effective at discouraging out-migration from rural areas, as well as areas with well-established migration networks. In this case, an additional argument for strong CCT programs is the benefit to young children from reducing parental migration. Given this additional goal for these programs, policymakers should explicitly consider the incentives and disincentives to migrate that such programs create, paying particular attention to any potential unintended consequences of program features for parental migration.

Appendix Table 1. Descriptive Statistics Accompanying Regressions

	(1) All children	(2) Young children	(3) Higher birth-order children	(4) Young, Higher birth-order children
Relative Raven's score, wave 2	1.00 (0.319)	1.01 (0.269)	0.991 (0.322)	1.00 (0.271)
Household sends migrant to United States	0.083 (0.277)	0.078 (0.270)	0.104 (0.307)	0.094 (0.291)
Household sends sibling migrant to United States	0.058 (0 .234)	0.050 (0.216)	0.080 (0.271)	0.066 (0.248)
Relative Raven's score, wave 1	0.996 (0 .336)	0.988 (0.371)	0.982 (0.342)	0.975 (0.373)
Months elapsed between interviews	39.48 (4.15)	39.45 (4.21)	39.43 (4.13)	39.41 (4.25)
Missing interview date	0.0015 (0.039)	0.002 (0.044)	0.002 (0.040)	0.002 (0.047)
Indoor toilet	0.628 (0.483)	0.628 (0.483)	0.605 (0.489)	0.602 (0.490)
Speaks indigenous language	0.114 (0.317)	0.120 (0.324)	0.130 (0.332)	0.137 (0.343)
Enrolled in school	1.94 (1.84)	0.823 (1.03)	1.85 (1.81)	0.800 (1.01)
Born second	0.294 (0.456)	0.283 (0.451)	0.416 (0.493)	0.389 (0.488)
Born third	0.208 (0.405)	0.211 (0.408)	0.292 (0.455)	0.290 (0.454)
Born fourth	0.105 (0.306)	0.111 (0.313)	0.148 (0.356)	0.152 (0.359)
Born fifth	0.101 (0.301	0.123 (0.328)	0.143 (0.350)	0.169 (0.375)
Only child	0.055 (0.234)	0.067 (0.255)	0	0

Appendix Table 1. (continued)

Twin	0.014	0.015	0.018	0.018
	(0.121)	(0.127)	(0.132)	(0.132)
Has one younger sibling	0.356	0.376	0.327	0.335
	(0.478)	(0.483)	(0.469)	(0.472)
Has two or more younger siblings	0.272	0.195	0.224	0.166
	(0.444)	(0.395)	(0.417)	(0.372)
Mother primary caregiver	0.851	0.865	0.835	0.860
	(0.363	(0.348)	(0.371)	(0.347)
Male	0.491	0.497	0.485	0.491
	(0.500	(0.500)	(0.500)	(0.500)
Age is 6	0.119	0.203	0.129	0.213
	(0.324)	(0.403)	(0.335)	(0.409)
Age is 7	0.120	0.204	0.121	0.200
	(0.324)	(0.402)	(0.326)	(0.400)
Age is 8	0 .135	0.225	0.136	0.220
	(0.343)	(0.418)	(0.343)	(0.415)
Age is 9	0 .130	0.159	0.131	0.158
	0.336)	(0.365)	(0.337)	(0.365)
Age is 10	0.137	0.018	0.137	0.019
	(0.345)	(0.133)	(0.344)	(0.135)
Age is 11	0.123	0.001	0.118	0.001
	(0.329)	(0.031)	(0.323)	(0.036)
Age is 12	0.123	0.003	0.115	0.000
	(0.328)	(0.0180)	(0.319)	(0.021)
Mother’s wave 1 Raven’s score	0.408	0.407	0.384	0.383
	(0.259)	(0.258)	(0.256)	(0.254)
Mother’s wave 1 age	33.59	32.13	34.77	33.36
	(10.14)	(9.89)	(10.39)	(10.06)
Mother worked in wave 1	0.315	0.298	0.309	0.296
	(0.465)	(0.458)	(0.462)	(0.457)
Mother attended elementary school	0.472	0.462	0.504	0.495
	(0.499)	(0.498)	(0.500)	(0.500)
Mother attended secondary school	0.271	0.279	0.231	0.242
	(0.443)	(0.448)	(0.421)	(0.428)

Appendix Table 1. (continued)

Mother graduated high school	0.077 (0.268)	0.082 (0.274)	0.066 (0.248)	0.073 (0.260)
Mother attended college	0.053 (0.223)	0.055 (0.228)	0.042 (0.201)	0.044 (0.205)
Father's wave 1 Raven's score	0.321 (0.300)	0.326 (0.304)	0.309 (0.293)	0.314 (0.298)
Father's wave 1 age	30.82 (17.61)	29.47 (17.10)		
Father worked in wave 1	0.780 (0.421)	0.777 (0.422)	0.776 (0.417)	0.778 (0.416)
Father attended elementary school	0.195 (0.394)	0.203 (0.401)	0.169 (0.375)	0.178 (0.383)
Father attended secondary school	0.084 (0.275)	0.092 (0.288)	0.074 (0.261)	0.086 (0.280)
Father graduated high school	0.077 (0.265)	0.079 (0.26913	0.070 (0.255)	0.075 (0.264)
Ratio of males to females, wave 1	0.656 (0.391)	0.632 (0.373)	0.722 (0.421)	0.679 (0.398)
Number in household, wave 1	5.88 (2.03)	5.82 (2.05)	60.30 (20.01)	60.24 (20.01)
Number adults in household, wave 1	2.82 (1.34)	2.73 (1.30)	30.03 (10.38)	20.84 (10.31)
More than two adults in household, wave 1	0.451 (0.498)	0.410 (0.493)	0.549 (0.498)	0.471 (0.500)
Border region, wave 1	0.194 (0.396)	0.195 (0.397)	0.185 (0.388)	0.187 (0.390)
Northern region, wave 1	0.178 (0.384)	0.170 .377)	0.180 (0.384)	0.174 (0.379)
Center region, wave 1	0.404 (0.491)	0.408 (0.492)	0.415 (0.493)	0.417 (0.493)
Capital region, wave 1	0.100 (0.300)	0.102 (0.301)	0.096 (0.294)	0.098 (0.297)
Yucatan region, wave 1	0.049 (0.215)	0.051 (0.218)	0.046 (0.209)	0.049 (0.215)

Appendix Table 1. (continued)

Community population 15,000-100,000	0.086 (0.283)	0.086 (0.282)	0.081 (0.272)	0.081 (0.273)
Community population 2,500-15,000	0.109 (0.310)	0.104 (0.305)	0.107 (0.308)	0.102 (0.303)
Community population 0-2,500	0.499 (0.500)	0.504 (0.500)	0.525 (0.499)	0.531 (0.499)
Number of observations	5190	3046	3741	2255
<u>"Shock" variables</u>				
Household member died between waves	0.067 (0.250)	0.064 (0.245)		
Household member became ill between waves	0.117 (0.322)	0.123 (0.329)		
Household member became unemployed between waves	0.066 (0.248)	0.066 (0.248)		
Disaster occurred between waves	0.033 (0.180)	0.034 (0.181)		
Younger sibling(s) added to the family between waves	0.176 (0.381)	0.215 (0.411)		
Change in household size	0.409 (0.836)	0.413 (0.816)		
Change in number household adults	0.817 (0.915)	0.645 (0.856)		
Decrease in number of older siblings at home between waves	0.059 (0.236)	0.077 (0.267)		
Number of observations	5190	3063		

Appendix Table 2. First-Stage Estimates of Household "Sending" Status

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All children		Young children		Later born children		Later born young children	
	Any migrant	Sibling migrant	Any migrant	Sibling migrant	Any migrant	Sibling migrant	Any migrant	Sibling migrant
1950 migration rate	0.029* (0.004)	0.023* (0.003)	0.027* (0.005)	0.021* (0.004)	0.039* (0.005)	0.032* (0.004)	0.032* (0.006)	0.028* (0.005)
1950 migration rate x Border state	-0.019** (0.009)	-0.024* (0.007)	-0.018*** (0.011)	-0.024* (0.009)	-0.034* (0.012)	-0.035* (0.010)	-0.027*** (0.014)	-0.035* (0.012)
1950 migration rate x North state	Omitted	Omitted	Omitted	Omitted	Omitted	Omitted	Omitted	Omitted
1950 migration rate x Center state	-0.013** (0.005)	-0.008*** (0.004)	-0.012*** (0.007)	-0.007 (0.005)	-0.019* (0.007)	-0.014** (0.006)	-0.014*** (0.008)	-0.012 (0.007)
1950 migration rate x Capital	-0.146** (0.067)	-0.081 (0.056)	-0.095 (0.080)	-0.011 (0.011)	-0.206** (0.095)	-0.106 (0.084)	-0.108 (0.113)	-0.004 (0.097)
F-statistic for IVs	F(4, 5044) = 20.54	F(4, 5044) = 20.05	F(4, 2954) = 10.29	F(4, 2993) =11.37	F(4, 3632) = 20.96	F(4, 3632) = 18.14	F(4, 2141) = 9.47	F(4, 2141) = 9.79
Adjusted R-squared	0.1156	0.1381	0.1107	0.1536	0.1204	0.1312	0.1172	0.1536
Observations	5097	5097	3046	3007	3683	3683	2192	2192

Notes: Coefficient estimates for instrumental variables are reported with standard errors in parentheses beneath. (*,**,**) indicates significance difference from zero in a two-tail test at the (99^{th}, 95^{th}, 90^{th}) confidence level, respectively. Errors are clustered at the household level. All specifications include a constant, child's initial Raven score, dwelling characteristics, other child characteristics, maternal and paternal characteristics, family structure variables, and geographic controls.

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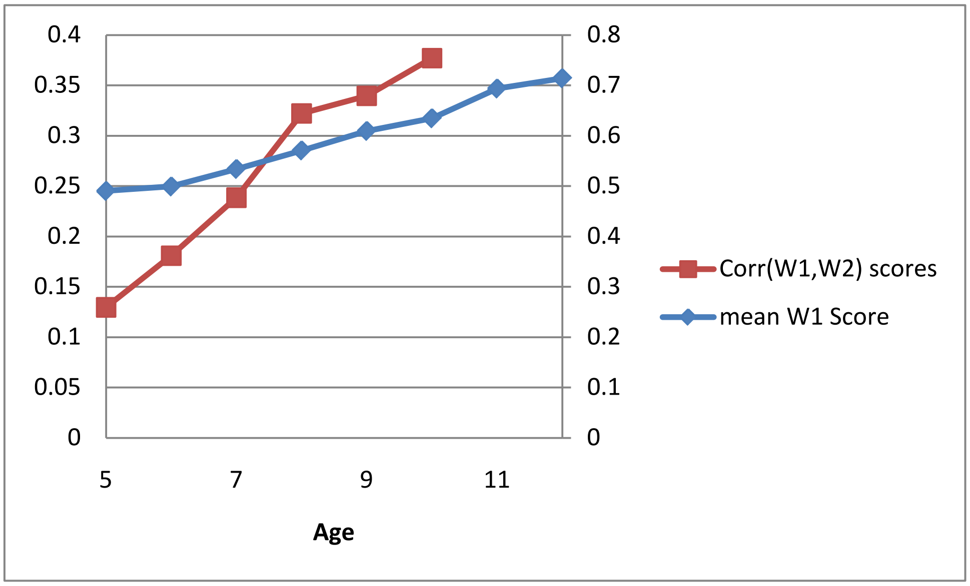
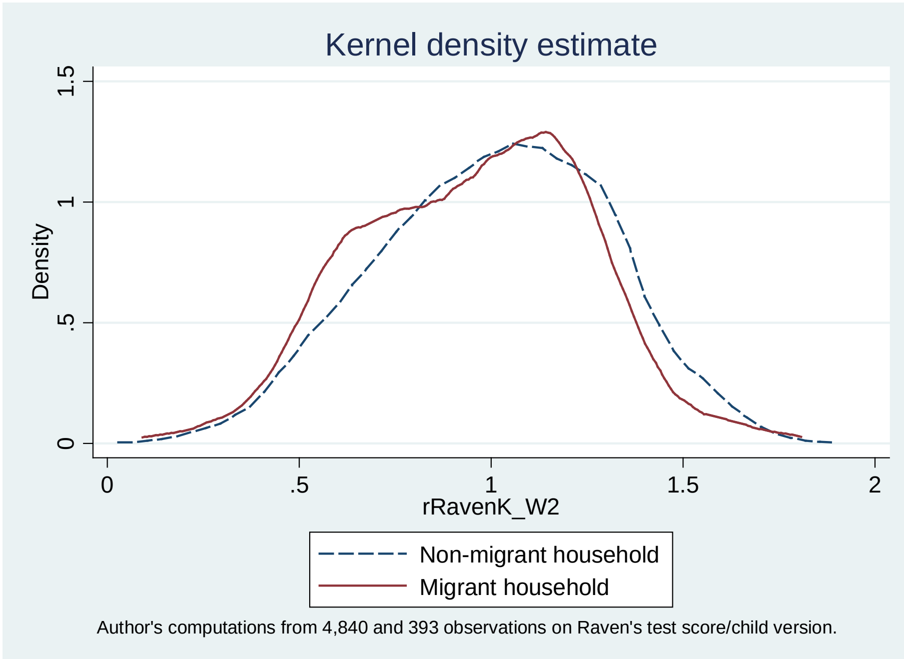
Figure 1. Averages and Interwave Correlations of Raven's Test Scores by Age



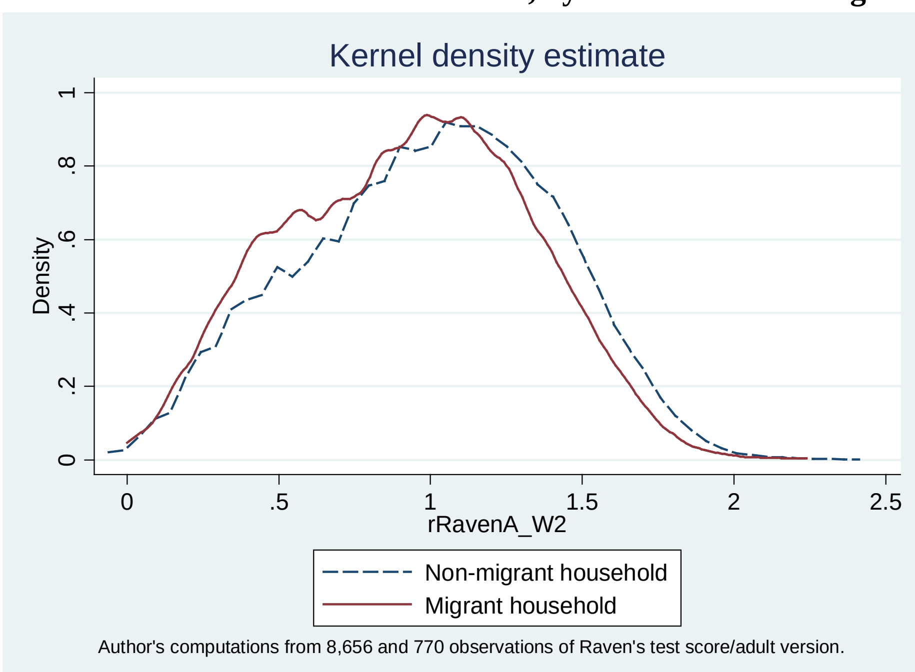
Source: Author's computations from the MxFLS data based on 5,261 observations.

Figure 2a. Wave 2 Raven Scores of Children, by Household "Sending" Status



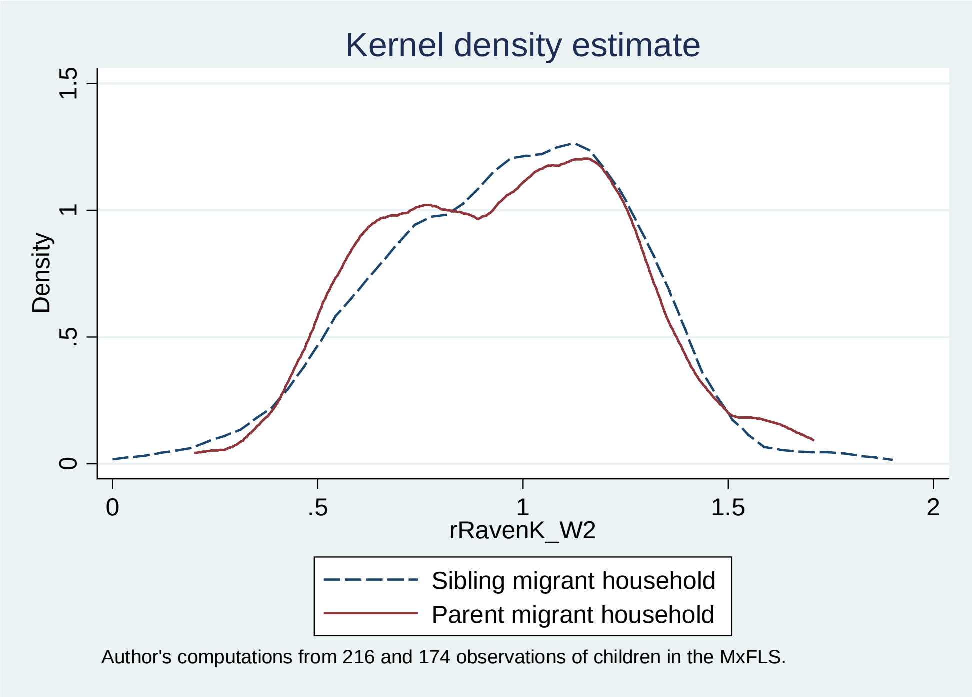
Two-sample Kolmogorov-Smirnov test for equality of distribution functions, corrected P= 0.022.

Figure 2b. Wave 2 Raven Scores of Adults, by Household "Sending" Status



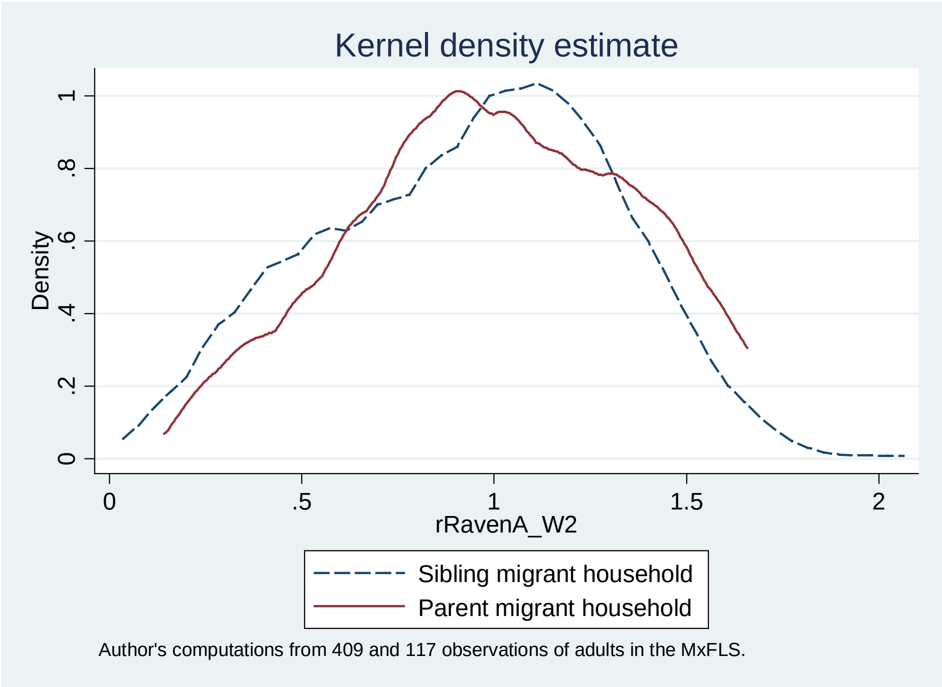
Two-sample Kolmogorov-Smirnov test for equality of distribution functions, corrected P= 0.000.

Figure 3a. W2 Raven Scores of Children, by Detailed Household "Sending" Status



Two-sample Kolmogorov-Smirnov test for equality of distribution functions, corrected P= 0.838.

Figure 3b: W2 Raven Scores of Adults, by Detailed Household "Sending" Status



Two-sample Kolmogorov-Smirnov test for equality of distribution functions, corrected P= 0.105.

Table 1. Characteristics of Adult Migrants to the United States and all Other Adults

	Non-migrant adults	Migrant adults
Age, W1	38.23 [a]	26.04[c]*
	(17.54)	(11.21)
Male	0.469	0.626*
	(0.499)	(0.484)
Child of head	0.314	0.629*
	(0.464)	(0.483)
Household head	0.358	0.223*
	(0.480)	(0.417)
Spouse of head	0.267	0.078*
	(0.442)	(0.268)
Married, W1	0.605	0.398*
	(0.489)	(0.490)
No education, W1	0.108	0.036*
	(0.310)	(0.185)
Elementary education, W1	0.389	0.367
	(0.488)	(0..482)
Secondary education, W1	0.260	0.392*
	(0.439)	(0.489)
High school education, W1	0.133	0.159***
	(0.340)	(0.366)
Worked in past 12 months, W1	0.541	0.602*
	(0.498)	(0.490)
Any earnings in past 12 months, W1	0.441	0.456
	(0.497)	(0.498)
Raven score, W1	1.00[b]	0.927[d]*
	(0.507)	(0.462)
Number of observations (except as noted)	23182	618

Notes: Sample consists of wave 1 household members located in the United States in wave 2 who are older than 14 years of age in wave 1. Each entry is the mean and standard deviation (in parentheses). (*,**,**) indicates significance at the (99th, 95th, 90th) confidence level, respectively, for t-test that the difference between columns 1 and 2 does not equal zero.

[a] 617 observations.

[b] 17714 observations.

[c] 747 observations.

[d] 510 observations.

Table 2. Characteristics of Households by United States-Migrant-Sending Status

	(1) Household has no migrant	(2) Household has any migrant	(3) Household sends sibling	(4) Household sends parent
Total household members, W1	5.35	6.76*	6.95	6.57
	(1.79)	(2.13)	(2.17)	(2.06)
Change in total household members, W1 to W2	0.397	0.417	0.379	0.407
	(0.823)	(0.742)	(0.743)	(0.658)
Total number of adults, W1	2.79	3.60*	3.72	3.43
	(1.29)	(1.52)	(1.54)	(1.51)
More than 2 adults in HH, W1	0.444	0.722*	0.771	0.640**
	(0.497)	(0.449)	(0.421)	(0.483)
Change in number adults, W1 to W2	0.717	1.07*	1.19	0.942**
	(0.877)	(0.866)	(0.817)	(0.859)
Ratio of male to female adult members, W1	0.641	0.843*	0.922	0.747**
	(0.379)	(0.499)	(0.538)	(0.373)
Historical state migration rate	1.56	2.22*	2.33	2.05
	(1.56)	(1.87)	(1.91)	(1.78)
Number of observations (except as noted)	2899	230	153	86

Notes: The underlying sample in every case is households that report a children's relative Raven score for at least one member in wave 1. Columns (2)-(4) are further restricted as indicated. In column (2), (*,**,**) indicates significance at the (99^{th}, 95^{th}, 90^{th}) confidence level, respectively, for a hypothesis test that the sample average for the subsample is equal to the sample average for the subsample in column (1). In column (4), (*,**,**) indicates significance at the (99^{th}, 95^{th}, 90^{th}) confidence level, respectively, for a hypothesis test that the sample averages for the two types of migrant households are the same (note: observations with both migrant siblings and parents are included in the migrant parents group for the t-tests).

Table 3. Single-Equation Estimates of Children's Raven's Test Scores

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Household has any migrant	-.063** (0.029)	-.060** (0.028)	- 0.057*** (0.029)	- 0.054*** (0.029)	-0.043 (0.028)	-0.042 (0.029)	-0.036 (0.029)	-0.032 (0.031)
Household sends sibling	0.029 (0.034)	0.032 (0.033)	0.048 (0.035)	0.055 (0.034)	0.045 (0.034)	0.047 (0.034)	0.040 (0.034)	0.032 (0.036)
Wave 1 Raven's test score	0.250* (0.014)	0.231* (0.014)	0.214* (0.014)	0.183* (0.014)	0.174* (0.014)	0.174* (0.014)	0.171* (0.014)	0.167* (0.015)
Maternal Raven's test score	NA	NA	NA	0.077* (0.022)	0.058* (0.022)	0.055** (0.022)	0.053** (0.022)	0.055** (0.022)
Dwelling characteristics		YES	YES	YES	YES	YES	YES	YES
Child Characteristics			YES	YES	YES	YES	YES	YES
Maternal characteristics				YES	YES	YES	YES	YES
Paternal characteristics					YES	YES	YES	YES
Detailed family structure						YES[a]	YES[a]	YES[a]
Geographic information							YES[a]	YES[a]
Shocks & change variables								YES[a]
R-squared	0.0759	0.0871	0.1036	0.1218	0.1314	0.1325	0.1354	0.1386
Observations	5190	5190	5190	5190	5190	5190	5190	5097

Notes: Coefficient estimates are reported with standard errors in parentheses beneath. (*,**,**) indicates significance at the (99^{th}, 95^{th}, 90^{th}) confidence level, respectively. Errors are clustered at the household level. See text for description of variables. All specifications include a constant, the variable "months elapsed between waves", and the variable "months elapsed between waves is missing". Samples consist of children with a child Raven score in wave 1 and a Raven score (child or adult test version) in wave 2. There are 434 cases with a wave 2 migrant in the United States

[a] The group of variables is insignificantly different from zero at standard confidence levels based on F-Test statistic.

Table 4. Single-Equation Estimates of Young Children's Raven's Test Scores

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Household has any migrant	-0.082* (0.030)	-0.080* (0.029)	-0.078* (0.028)	-0.070** (0.029)	-0.062** (0.029)	-0.061** (0.029)	-0.052*** (0.029)	-0.044 (0.031)
Household sends sibling	0.066 (0.038)	0.070*** (0.038)	0.085** (0.038)	0.092** (0.038)	0.083** (0.038)	0.085** (0.038)	0.082** (0.038)	0.066*** (0.039)
Initial Raven's test score	0.158* (0.014)	0.143* (0.014)	0.131* (0.014)	0.104* (0.014)	0.097* (0.014)	0.096* (0.014)	0.091* (0.014)	0.092* (0.014)
Maternal Raven's test score	NA	NA	NA	0.083* (0.024)	0.065* (0.024)	0.064* (0.024)	0.060** (0.024)	0.061** (0.024)
Dwelling characteristics		YES	YES	YES	YES	YES	YES	YES
Other child characteristics			YES	YES	YES	YES	YES	YES
Maternal characteristics				YES	YES	YES	YES	YES
Paternal characteristics					YES	YES	YES	YES
Family structure						YES[a]	YES[a]	YES[a]
Geographic controls							YES[a]	YES[a]
Shocks and interim changes								YES[a]
R-squared	0.0539	0.0686	0.1039	0.1317	0.1466	0.1489	0.1532	0.1544
Observations	3046	3046	3046	3046	3046	3046	3046	3007

Notes: Coefficient estimates are reported with standard errors in parentheses beneath. (*,**,**) indicates significance at the (99th, 95th, 90th) confidence level, respectively. Errors are clustered at the household level. See text for description of variables. All specifications include a constant, a variable "months elapsed between waves," and a variable "months elapsed between waves is missing." Samples consist of children with a child Raven score in wave 1 and a child Raven score in wave 2. There are 237 cases where a household member is in the United States in Wave 2.

[a]The group of variables is insignificantly different from zero at standard confidence levels based on F-Test statistic.

Table 5. Single-Equation Estimates of Children's Raven's Test Scores for Alternative Sub-Samples and Specifications

	(1) All children	(2) Young children	(3) Children not first-born	(4) Young children, not first-born
PANEL A				
Sending household	-0.036	-0.052***	-0.052	-0.062***
	(0.029)	(0.029)	(0.038)	(0.038)
Sibling is migrant	0.040	0.081**	0.055	0.095**
	(0.034)	(0.038)	(0.043)	(0.045)
Number of observations	5190	3046	3683	2223
PANEL B[a]				
Sending household	-0.031	-0.049***	-0.042	-0.057
	(0.030)	(0.029)	(0.038)	(0.038)
Sibling is migrant	0.034	0.077**	0.045	0.088***
	(0.035)	(0.038)	(0.043)	(0.045)
Number of observations	5190	3046	3683	2223
PANEL C[b]				
Sending household	-0.039	-0.055***	-0.057	-0.067***
	(0.029)	(0.029)	(0.037)	(0.037)
Sibling is migrant	0.041	0.082**	0.057	0.098**
	(0.034)	(0.038)	(0.041)	(0.044)
Number of observations	5186	3042	3680	2220
PANEL D[c]				
Sending household	-0.038	-0.063***	-0.039	-0.084***
	(0.033)	(0.033)	(0.042)	(0.044)
Sibling is migrant	0.059	0.116*	0.087***	0.141*
	(0.039)	(0.043)	(0.046)	(0.051)
Parent wave 1 household member absent in wave 2	0.001 (0.020)	0.013 (0.022)	0.020 (0.025)	0.027 (0.027)
Sibling household member from wave 1 absent in wave 2	-0.023 (0.016)	-0.033*** (0.018)	-0.023 (0.017)	-0.035*** (0.019)
Number of observations	5190	3046	3683	2223

Notes: Coefficient estimates are reported with standard errors in parentheses beneath. (*,**,**) indicates significance at the (99^{th}, 95^{th}, 90^{th}) confidence level, respectively. Errors are clustered at the household level. See text for descriptions of the specifications.

Table 6. Effect of United States Migration of a Household Member on Children's Time Use

		All children	Young children	Young children, not first born
Household chores	Any migrant	0.447	0.175	1.95
		(1.69)	(1.90)	(2.251)
	Sibling migrant	0.807	1.45	-0.157
		(2.20)	(2.49)	(2.79)
Television viewing	Any migrant	1.90	2.54***	4.11**
		(1.31)	(1.34)	(1.77)
	Sibling migrant	-2.82***	-3.14***	-4.66**
		(1.51)	(1.64)	(2.00)
Play time	Any migrant	-0.056	-1.24	-0.836
		(1.104)	(1.28)	(1.54)
	Sibling migrant	-0.349	0.434	0.263
		(1.411)	(1.70)	(1.90)
Reading	Any migrant	2.054*	2.21*	3.10*
		(0.737)	(0 .858)	(1.04)
	Sibling migrant	-1.66***	-1.75	-2.59***
		(1.00)	(1.23)	(1.39)
Sleep	Any migrant	0.076	0.251	0.280
		(0.156)	(0.162)	(0.190)
	Sibling migrant	0.024	-0.188	-0.233
		(0.188)	(0.218)	(0.241)

Notes: Coefficient estimates are reported with standard errors in parentheses beneath. (*,**,**) indicates significance at the (99th, 95th, 90th) confidence level, respectively. Errors are clustered at the household level. All specifications include a constant, a variable "months elapsed between waves," and a variable "months elapsed between waves is missing." See text for detailed description of specifications. See Table 6a for sample sizes.

Table 6a. Sample Statistics of the Time Use Variables (Dependent Variables in Table 6)

	All children[a]	Young children[b]	Young children, not first born[b]
Household chores			
Mean (standard deviation)	4.24	4.00	4.04
	(7.21)	(6.94)	(7.02)
Number of observations	1899	1526	1135
Television viewing			
Mean (standard deviation)	13.63	13.52	13.31
	(10.45)	(10.15)	(10.26)
	4238	2938	2152
Play			
Mean (standard deviation)	10.69	12.49	12.35
	(10.98)	(11.44)	(11.21)
Number of observations	4221	2918	2141
Reading			
Mean (standard deviation)	2.14	2.09	2.03
	(3.92)	(3.87)	(3.84)
Number of observations	4229	2933	2151
Sleep			
Mean (standard deviation)	8.77	8.86	8.88
	(1.34)	(1.28)	(1.26)
Number of observations	4248	2941	2156

Notes: Hours spent on the activity in the past week.
[a]Sample restricted to children who took the Raven's colored progressive matrices test in wave 1.
[b]Sample restricted to children who took the Raven's colored progressive matrices test in both waves 1 and 2.

Table 7. IV Estimates of Children's Raven's Test Scores and Time Use, Younger Children

	Young children		Young children, later born	
	Any HH migrant	Sibling migrant	Any HH migrant	Sibling migrant
Visual reasoning ability				
A. Raven's score	-1. 38	1.31	-1.43	1.46
	(0.661)**	(0.862)	(0.649)**	(0.804)***
	(0.871)	(1.136)	(1.01)	(1.23)
B. Raven's score	-1.089	1.034	-1.26	1.33
	(0.594)***	(0.778)	(0.610)**	(0.761)**
	(0.752)	(0.986)	(0.895)	(1.11)
C. Raven's score	-2.03	2.01	-2.47	2.54
	(0.930)**	1.138***	(1.14)**	(1.34)***
	(1.137)***	(1.40)	(1.66)	(1.91)
Children's time use				
Household chores	119.64**	-131.00***	104.53***	-112.59
	(58.99)	(71.01)	(58.93)	(69.32)
Television viewing	56.29***	-76.88***	45.23***	-57.92***
	(30.57)	(39.62)	(26.13)	(32.13)
Playing	144.79**	-195.72**	77.42**	-105.274**
	(70.43)	(92.03)	(38.46)	(47.52)
Reading	50.17**	-52.25***	47.19**	-45.09***
	(23.02)	(30.28)	(20.61)	(25.91)
Sleep	-1.32	3.86	1.46	-0.205
	(2.896)	(3.804)	(2.60)	(3.23)

Notes: (*,**,**) indicates significance at the (99th, 95th, 90th) confidence level, respectively. The sample of 'Young children' take the Raven's colored progressive matrices test in both waves 1 and 2. In the top panel, each cell contains the coefficient estimates with its standard error, both unadjusted and clustered on family, respectively, beneath. In the second panel, coefficients are reported with unadjusted standard errors in parentheses beneath. The top panel presents the base specification (A), the base specifications with the child's wave 1 Raven's test score omitted from the right hand side (B), and the base specifications with the addition of interim and shock variables (C). Refer to text for further details.