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The Early Academic Growth of Children of U.S. Immigrants: A Longitudinal Analysis

Por-fu A. Chen
University of Connecticut - Storrs, aspenchensoc@gmail.com

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Por-fu Aspen Chen, PhD

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Once considered academically at risk, children of immigrants are now widely regarded as beholders of educational advantages. The research evidence asserting these advantages comes mostly from examining adolescents and young adults. Contrastingly, the small number of studies on younger children disagrees over whether those with foreign-born parents lag or lead in early years of schooling. This age bias impedes a more comprehensive understanding of their academic trajectories, and limits how the educational advantages may be theorized.

This dissertation adopts a longitudinal approach to examine academic differences by parental nativity and race between kindergarten and eighth grade. Through estimating achievement gaps and growth curve models, the analysis yields three major findings: a) the academic trajectory of the average child of immigrants features a slower start and faster growth; b) subgroup analysis shows this pattern to be most salient among Black and Hispanic children; c) statistically controlling for individual differences in demographic traits and family resources changes the initial disparities considerably but does little to alter the subsequent growth. These results suggest that influences of family resources have mostly solidified by the time children start formal schooling. Furthermore, findings of an initial disadvantage challenge the view that immigrants are successful in mobilizing resources for their children's academic gains. Rather, it supports explanations that attribute the educational advantages to children's motivation and academic engagement. I conclude by discussing the importance of the social and developmental context of adolescence and distinct conditions surrounding youth of different races.

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Por-fu Aspen Chen

B.A., National Taipei University, **2002**

M.A., National Taipei University, **2005**

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The Early Academic Growth of Children of U.S. Immigrants: A Longitudinal Analysis

Presented by

Por-fu Aspen Chen, B.A., M.A.

Major Advisor ____
Simon Cheng

Associate Advisor ____
Mary J. Fischer

Associate Advisor ____
Jeremy Pais

Associate Advisor ____
Michael E. Wallace

Associate Advisor ____
David L. Weakliem

University of Connecticut
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1. Introduction

The 2012 best seller *Battle Hymn of the Tiger Mother* presented a provocative narrative about U.S. immigrants. In this title, Amy Chua, a law professor at Yale and a second-generation Chinese American, faulted "American parents" for allowing children settle for mediocrity and indulge in aimless self-exploration. She maintained that, in contrast, immigrants like her Chinese parents raised more accomplished children with a hands-on approach to childrearing, busy schedules filled with enriching activities, and high expectations for activities in which the children engage.

Mainstream public outlets now widely recognize the strengths of children of immigrants. A 2013 report published by the Pew Research Center and covered in both the *New York Times* and the *Wall Street Journal* find adult children of immigrants to have better educational and economic attainment than their foreign-born peers. According to a 2012 ABC news report based on a John Hopkins University study, these children are also more likely to succeed academically than their counterparts whose parents were born in United States. Another well-regarded 2012 book titled *The Immigrant Advantage*, authored by the senior correspondent Claudia Kolker, highlights the accomplishments of children of immigrants and calls for learning childrearing beliefs and practices from immigrant groups. Today, children of U.S. immigrants are seen as successful if not exceptional.

1.1. Changing views on U.S. immigrants and their children

Views towards children of immigrants were far less favorable for much of the twentieth century. Then turn-of-the-century studies of immigrant enclaves in Chicago were filled with alarming accounts with regard to the children; scholars noted extensively over the children's lack of motivation and moral values, the frequent involvement in crime, and the struggles at school (Addams 1897, 1912; Thomas and Znaniecki 1984). A more optimistic view emerged in the wake of World War II, as children of European immigrants move out of segregated ethnic communities and into middle-class suburbs. The once dominant “straight-line” assimilation theory (Gordon 1964; Warner and Srole 1945) argued that, by forgoing their ethnic marks and acculturating, descendants of immigrants can fully assimilate into the U.S. society. This theory did not, however, project that children of immigrants are cable outperform their peers of native parents. Concerns again emerged with the influx of non-European immigrants following the 1965 immigration reform. In a prominent essay, Herbert Gans (1992) raised the potential scenario of a “second-generation decline”, in which the native-like aspirations of dark-skinned children of immigrants are upset by harsh realities of a racialized social hierarchy and a bifurcated labor market.

In the meanwhile, social scientist research also started reporting favorable findings with regard to U.S. immigrants and their children around three decades ago. The revelation of foreign-born men earning (Chiswick 1978, 1979) more than their native-born peers after an initial adjustment period challenged previous understandings in immigration research. In studying the Hispanic population, scholars discovered a paradoxical correlation between better health outcomes and more recent ancestral presence in the United States (Abraido-Lanza et al. 1999; Markides and Coreil 1986). In contrast to the earlier consensus, these findings show that an immigrant background can offer advantages.

While unusual positive results have been demonstrated on measures like income and health, the strong educational performance of children of immigrants is most consistently found. Even though many immigrant parents speak limited English and know little about the U.S educational system, many studies show that their children nonetheless thrive at schooling. Case studies on immigrant communities (Caplan, Choy, and Whitmore 1992; Gibson 1989; Zhou and Bankston 1998) were particularly influential in

drawing attention to the children's academic strengths and distinct family beliefs and practices supposedly promoting education. Building on these studies, some scholars attributed academic strengths to the optimism in immigrant families (Kao and Tienda 1995) while others highlighted the protective effects of ethnic cultures (Portes and Zhou 1993; Zhou 1997). More extensively, John Ogbu (1978, 1991) argued that minority children whose ancestors chose to migrate on their own accord are more readily adapt to the school culture than children from minority groups whose presence in the U.S. were externally imposed.

Furthermore, a plethora of high quality large surveys on adolescents and adults made possible over a dozen quantitative studies that systematically investigated the education of children of immigrants. The list of nationally-representative surveys and corresponding studies that utilize the data include the U.S. Census (eg. Card 2005; Farley and Alba 2002; Hirschman 2001), the National Longitudinal Study of Adolescent Health (or Add Health; eg. Glick and White 2003, 2004; Greenman and Xie 2008; Greenman 2013; Harris, Jamison, and Trujillo 2008; Pong, Hao and Gardner 2005), the National Education Longitudinal Study of 1988 (or NELS:88; eg. Kao and Tienda 1995; Kao 2004), High School and Beyond (or HS&B; eg. Glick and White 2003), and the Educational Longitudinal Study (or ELS:2002; eg. Rosenbaum and Rochford 2008). There are also regional-scale projects such as the Children of Immigrants Longitudinal Study that focused on Southern Florida and Southern California (Portes, Fernández-Kelly, and Haller 2005, 2009; Portes and Rambaut 2001; Rumbaut 1994, 2008) and the Immigrant Second Generation in Metropolitan New York (Kasinitz et al. 2008; Waters et al. 2010). These studies have performed different types of comparisons across academic outcome measures including grades, standardized test scores, educational placement and educational attainment. Yet the overwhelming majority of them find that, under comparable conditions, the average child of immigrants has similar and often better educational performance relative to the average child of natives.

1.2. Contested findings over early academic performance

This extensive body of academic literature supports the notion of an academic advantage for children of immigrants, which in turn informs public discussions underlying works like those of Amy

Chua and Claudia Kolker. In addition, it has prompted scholarly attempts to explain and theorize. For example, some scholars now refer to the negative association between assimilation and educational outcomes as the "immigrant paradox" (García-Coll and Marks 2012; Palacios, Guttmannova, and Chase-Lansdale 2008; Suarez-Orozco, Rhodes, and Milburn 2009). Other proposed a “second-generation advantage” thesis (Kasinitz et al. 2008; Smith 2008) to describe the structural niche allowing children of immigrants to draw on and benefit from the best of different cultures.

The assertion of an educational advantage for children of immigrants, however, suffers empirically from an age bias. Likely stemming from the keen scholarly interest in adolescence during the late twentieth century (eg. Coleman 1981), studies on children of immigrants have devoted most attention to teens and twenty-somethings. In the qualitative and quantitative studies just mentioned, the overwhelming focus was on children of more advanced ages. In fact, all of the subjects in the surveys reviewed were at least in eighth grade.

In contrast, research on younger children is much more limited in volume. Furthermore, it has not agreed on whether children of immigrants trail or lead in early years of schooling. A few published studies examined the question using nationally representative data. Crosnoe (2007, 2012) reported that children of Mexican immigrants start school in the lowest achievement group; they then surpass children of African-Americans, but not children of native Whites or Hispanics, by fifth grade. In contrast, Palacios and her colleagues (2008) concluded that children of immigrants already have better reading skills as early as in kindergarten. Both Han (2008) and Glick and Hohmann-Marriot (2007) find the patterns to be more complex, largely dependent on the model specification and segmented by the immigrants' origins.

At least another two studies examined the same question with smaller data. De Feyter and Winsler (2009) studied a sample of preschoolers in Florida and concluded that those with immigrant parents have weaker cognitive skills but more favorable behavioral ratings. Tracing one group of children in Chicago from age six to age sixteen, Leventhal, Xue, and Brooks-Gun (2006) found that those with immigrant parents have lower initial test scores, demonstrate faster academic growth, but mostly still remain behind comparable peers with native parents by adolescence.

In sum, these studies on young children offer no obvious answer on how early academic performance differs by parental nativity. Some of them found an advantage associated with having immigrant parents, some reported the opposite, and the others produced results segmented by race, ethnicity and the national origin of immigrants. These disagreements can be driven by substantive differences such as different ages examined in cross-sectional data. Alternatively, the disparities may extend from specific decisions in the research design such as the framework for comparison or the model specification. At any rate, the contrasting findings highlight the need for further research.

1.3. A more comprehensive approach

Social science research has considerable knowledge of early achievement gaps by other demographic divides such as race (Bond and Lang 2013; Fryer and Levitt 2004; Quinn 2015), ethnicity (Reardon and Galindo 2009), and gender (DiPrete and Jennings 2012; Fryer and Levitt 2010; Penner and Paret 2008; Owens 2016). In contrast, knowledge about academic differences by parental nativity remains surprisingly limited even though children of immigrants now make up one-fourth of the child population in the United States (Hernandez 2004).

Most previous studies on the academic performance of young children of immigrants examined outcomes during only the first few years of schooling (Crosnoe 2007; Palacois et al 2008; Han 2008), drew on a single cross-sectional data (Glick and Hohmann-Marriot 2007), or focused on a specific group of children (Crosnoe 2007, 2012). The time limitations risk finding incidental results and fail to connect to the broad literature of adolescent children of immigrants, whereas results from a single group may obscure the substantial heterogeneity of immigrant groups. A longitudinal study that traces a more representative sample of children from early childhood to early adolescence can significantly help address these issues, and in doing so, provide a more complete picture.

This perspective can also inform broader questions in immigration and educational research. As discussed, immigration research has long been interested in how the children fare academically. While the academic advantage of children of immigrants exists, it can only be confidently applied to older children

and young adults. What kind of pattern precedes this advantage remains unascertained. It is possible that young children of immigrants enter school already ahead of their peers, or they may have a slower start offset later by years of faster growth.

Furthermore, this inability to determine *when* the academic advantage appears has limited *how* the advantage may be explained. Immigrant researchers generally agree that positively selected U.S immigrants benefit children's schooling through interactions in the family and the community. There are, however, competing views over the specific mechanism. These views adhere to different associated temporal assumptions. Theories that focus on immigrants' ability to instill a strong motivation drive or to shield children from negative peer influences are contingent upon the specific social and developmental state of older children. In contrast, explanations that view immigrants as adept at cultivating children's cognitive skills are far less sensitive to age variations. A more complete picture of academic growth is therefore be useful in adjudicating the competing theories.

As for educational research, studying the early years of immigrants' children dovetails with the rising interest in early child development and academic trajectories in recent years. The U.S immigrant population consists of a large number of low status families who have limited resources and are unfamiliar with the educational systems. In many regards, these families resemble native-born disadvantaged groups who are often alienated in school settings (Lareau 1989). Yet such adverse conditions do not appear to stop immigrants' children from reaching educational success. Understanding what enables the exceptional educational performance may help identify processes that can be useful for other disadvantaged children. This endeavor, however, must start with descriptively establishing the longitudinal patterns.

1.4. Overview of research and findings

This study examines how early academic performance differs by parental nativity, and how demographic traits and family resources may account for the differences. Previous studies addressing these questions either analyzed more limited periods in early and middle childhood, relied only on smaller

longitudinal data, or focused on specific immigrant groups. This dissertation seeks to advance the scholarship by using a nationally representative sample of children, examining two different outcomes, and investigating longitudinal changes between kindergarten and eighth grade. .

I estimate and compare the average academic trajectories during this period for children of immigrants and children of natives. In addition, I also estimate these differences by race. The segmented assimilation thesis (Portes and Rumbaut 2001; Portes and Zhou 1993; Zhou 1997) calls for attention to the diverse pathways in immigrants' adaptation to the host society. In the U.S. context, these pathways are often channeled through where immigrant groups fall in the racialized scheme of the society. Such recognition of vast educational disparities between racial groups has informed other studies on immigrants' children to adopt a multi-group framework for comparison (eg. Kao and Tienda 1995; Glick and White 2004; Pong, Hao, and Gardner 2005).

The empirical analysis uses the nationally representative Early Childhood Longitudinal Study—Kindergarten Cohort (ECLS-K) to assess longitudinal differences in early academic growth. The findings indicate that the average child of immigrants demonstrates a distinct academic trajectory. In general, he or she trails in both reading and math assessment when starting school, but faster growth helps gradually narrow the deficit in subsequent years. By eighth grade, the math and reading gaps are either substantially narrowed, fully closed, or even reversed. In models that statistically control for demographic traits and family resources, the average child of immigrants is found to consistently outperform the average child of natives academically by eighth grade.

Analysis at the group level reveals that having immigrant parents is particularly associated with favorable trajectories for Hispanic and Black children. Hispanic children of immigrants demonstrate the most notable upward trending pattern of all groups. The children suffer from the largest deficit at school entry. By eighth grade, however, they have substantially narrowed the gap relative to White children of natives, and virtually eliminated their differences from Hispanic children of natives.

Although past studies (Waters 2001) suggest that Black children of immigrants suffer from racialization and can become academically demoralized, the analysis still finds favorable trends for them.

During the elementary grades, Black children of immigrants demonstrate reading and math skills are similar to White children of natives. The immigrant advantage is even more pronounced in comparisons within Black children. Relative to their peers with native-born parents, Black children of immigrants enjoy a persistent and widening advantage over the course of early and middle childhood.

The disparities are not as substantial or consistently found for the other two groups. Throughout the elementary grades, three groups — White Children of immigrants, Asian children of natives, and Asian children of immigrants — demonstrate math and reading results mostly comparable to or better than White children of native.

All statistical models suggest that the effects of demographic traits and family resources on academic trajectories are likely not cumulative. While adding these controls variable alters the initial academic disparities considerably, changes in the subsequent growth trends are minimal. This finding suggests that, at least in the context of comparing children of different parental nativity, the influences mediated through gender, family socioeconomic status, and family structure on academic performance have mostly taken hold by the first year of formal schooling.

To sum, the findings help ascertain the basic patterns of academic disparities by parental nativity both at the start of formal schooling and in the subsequent years. The initial disparities differ in each racial group. When children first enter school, an immigrant background is associated with considerable academic disadvantage for Hispanic children, with some academic advantage for Black children, and with no obvious differences for White and Asian children. Statistically controlling for the demographic and family conditions can mostly account for the initial advantage of Black children of immigrants, but less so for the initial disadvantage of Hispanic children of immigrants. In the years leading up to secondary school, however, an immigrant background is more consistently associated with faster academic growth relative to children of natives. This is particularly salient for Hispanic and Black children of immigrants.

While additional research is needed to examined factors driving the academic patterns, the results strongly suggest that any positive effect on academic performance stemming from an immigrant

background does not operates through the formation of academic skills prior to school age. This differs starkly from class-based intergenerational social reproduction, in which children from privileged background develop measurable advantages early in life (eg. Alwin and Thorton 1984; Farkas and Beron 2004). Rather, findings in this study indicate that mechanisms contributing to an immigrant advantage are more likely to be found in social and development processes during primary and early secondary schooling. In this regard, theories that focus on the motivational drive of children of immigrants hold greater promise than others that highlight the ability of immigrant parents to directly cultivate cognitive skills.

1.5. Chapter outline

The remainder of the dissertation is structured in the following order. Chapter two discusses the theoretical considerations that inform the research questions and design. Drawing from educational and immigration research, I first consider general discussions about longitudinal patterns of achievement disparities and their corresponding explanations. I then propose a set of competing hypotheses based on theories focused on the academic advantage of children of immigrants. Next, I review academic differences by parental nativity both at school entry and the subsequent years. I conclude this chapter with a summary of racial and ethnic differences.

Chapter three covers the research methods and design. I introduce the data structure of the ECLS-K, and discuss the selection of the analytic samples. I explain the variables used in the analysis. I then present the descriptive statistics of the analytic samples. I end this chapter with a note on the analytic framework used in the pairwise comparisons of this study.

Chapter four assesses the longitudinal differences in reading and math gaps. I apply cross-sectional OLS models to estimate the reading and math achievement differences between groups at six time points, and infer longitudinal patterns based on these results. I also assess the potential confounding effects of demographic traits and family resources. In addition, I took advantage of the model simplicity

and conduct sensitivity analysis with different techniques or under different assumptions to ensure the results are not an artifact of one particular set of modeling decisions.

Chapter five estimates the academic trajectories using growth curve models. The growth curve approach allows for more statistically rigorous modeling of individual trajectories as well as direct comparisons of growth rates. Similar to chapter four, I also incorporate demographic traits and family resources into the modeling to assess their roles.

Chapter six concludes the dissertation. This chapter reviews the research questions and the major findings. I summarize how early academic performance differs by parental nativity and race. I discuss what these findings entail for research on immigrants' incorporation as well as educational stratification. I also identify the limitations of the findings, and suggest directions for future research.

2. Theoretical Considerations

This chapter reviews the theoretical issues most pertinent to studying early academic performance of children of immigrants. It begins with the research on achievement gaps, considering different longitudinal patterns and their corresponding explanations. Next, it draws on theories on children of immigrants to develop a pair of competing hypotheses about longitudinal differences in academic growth. After then considering previous studies related to academic disparities at school entry and the following years, this chapter ends with an overview of racial and ethnic differences in education.

2.1. Patterns of academic growth

Academic disparity has been studied extensively. Much of the previous research finds that academic disparities along the divides of gender (Ensminger and Slusarick 1992; Entwisle, Alexander, and Olson 2007), race (Fryer and Levitt 2004, 2005; Reardon and Galindo 2009) and class (Entwisle and Hayduk 1988; Heckman and Masterov 2007; Kerckhoff 1993; Stevenson and Newman 1986) persist or widen as children progress in their schooling. In most cases, children who start school with better academic performance maintain that relative success, and children who experience initial academic struggles continue to trail over time.

The endurance of achievement disparities can be attributed to two sets of complementing mechanisms. One focuses on the intrinsic, cumulative nature of skill acquisition. In a series of papers, James Heckman and his colleagues maintain that a person's level of basic skills is positively correlated with the rate at which he or she acquires additional skills, a relationship that they describe as "skills beget skills" (Cunha et al. 2005; Heckman 2008; Heckman and Masterov 2007; Knudsen et al. 2006). When it comes to academic disparities, the multiplier effect of this mechanism produces widening skill disparities over time, as children with initial cognitive advantages built on the advantages and pulls away with faster growth.

The other set of mechanisms involve extrinsic, structural forces that reinforce existing educational inequality. Renowned sociologist Ralph Turner (1960) characterizes the British educational

system as facilitating "sponsored mobility" by identifying students with marks of excellence early on, and concentrating resources to their subsequent schooling; empirical analysis has found support for Turner's assertion about the British educational system (Kerckoff 1993). More recently, researchers argue that the U.S. educational system also actively contributes to widening achievement gaps (Entwisle, Alexander, and Olson 2005; Entwisle and Hayduk 1988; Fryer and Levitt 2004). The most notable form is the institutional differentiation between (eg. school segregation) and within (eg. tracking) schools, which concentrates high-achieving students in advantageous educational settings and leaves low-achieving students in unfavorable schooling environment. Another structural factor known to similarly reinforce existing educational inequality is neighborhood differences (Ainsworth 2002; Leventhal and Brooks-Gunn 2000).[1]

There are some exceptions to this general pattern of persistent disparities. Some studies (Cappella and Weinstein 2001; Davis-Kean and Jager 2012) have identified children who have low initial academic achievement but ultimately surpasses their peers during the studied period. This type of distinct trajectories features initial academic disadvantages and faster academic growth, but it is only found in a small segment of the school-age population. Little is understood about systematic forces that drive such trajectory. Still, the finding that adolescent with immigrant parents have faster-than-average cognitive growth (Hao and Woo 2012) raises the question of whether their younger counterparts have similar academic trajectories.

[Figure 1 about here]

Based on these longitudinal patterns discussed, how early academic growth differs by parental nativity is likely captured in one of the two stylized graphs in figure 1. The two lines represent the academic trajectories for children of natives and children of immigrants. The right-hand side of the lines

[1] In addition, the concept of "Matthew effects" has also been used to conceptualize widening educational disparities. Scholars have theorized the effects as intrinsic (Stanovich 1986) and extrinsic (Kerckhoff and Glennie 1999).

is solid, indicating the asserted academic advantage of children of immigrants during adolescence. The dashed lines at the left-hand side represent parts of the trajectories where the relative positions of the two lines remain uncertain. Panel A depicts a scenario of persistent disparity in which children of immigrants always outperform children of natives. Contrastingly, the graph in panel B presents the "slower start, faster growth" scenario, in which children of immigrants have an initial disadvantage but overtake children of natives by adolescence with faster growth.[2]

2.2. Skill formation versus achievement drive

The descriptive patterns illustrated in figure 1 correspond to two contrasting sets of theories seeking to explain the educational advantage of immigrants' children. One set of theories focuses on immigrants' *skill cultivation*, or how immigrants mobilize and convert resources to cultivate the children's cognitive skills. Past studies suggest that immigrants use their knowledge to help children navigate the school system (Fernández-Kelly 2008), and place their children in supplementary courses in ethnic communities to foster educational success and cultivate cultural capital (Lu 2008; Zhou and Kim 2006). Under a more general frame, Borjas (1992) maintains that the parental investment of immigrants and the transfer of "ethnic capital" in the communities contribute to the children's human capital. Underlying these arguments is a shared reasoning that immigrants are more successful in directly promoting children's educational performance.

The other set of explanations focuses on the children's own *academic drive*. A number of theories attribute children of immigrants' academic advantage to their educational-orientation and strong motivation. The "immigrant optimism" approach (Kao and Tienda 1995) reasons that self-selected migration makes immigrants more optimistic, which in turn promote stronger emphasis on educational accomplishment in the family (Kao 2004) and the high educational expectation shared between parents

[2] Unaccounted for in both panels is the scenario of initial equality between children of immigrants and children of natives. This scenario must include faster academic growth for the former group given the asserted immigrant advantage for older children. As a result, similarities to the "slow start, faster growth" scenario are expected if no initial differences are found.

and children (Hao and Bonstead-Bruns 1998). In a similar vein, the "ethnic retention" approach (Portes and Zhou 1993; Zhou and Bankston 1998) argues that beliefs and practices in ethnic communities shield the children from demoralizing influences in the host society and keep the children academically engaged. Other studies suggest that children of immigrants feel obligated to excel because of their parents' migration history (Louie 2005), experience pressure to live up to high standards in co-ethnic communities (Purkayatha 2005; Zhou and Bankston 1998), or have a special appreciation of work ethnic after witnessing their hard-working parents (Lopéz 2001). While the specific reasoning differs, the common theme across these explanations is the view that immigrants motivate their children but provide little direct contribution to their academic performance. Under this conceptualization, influences from the immigrant background must be mediated through the children's own action to secure academic gains.

While both sets of theories anticipate an academic advantage for children of immigrants, their reasoning entails different longitudinal patterns. Under the skill cultivation thesis, the notion that immigrants directly promote the children's academic success is not tied to any particular age context. It follows that the asserted success in skill cultivation should be in effect early and continue over time. Therefore, we should expect patterns of early and enduring academic advantage.

In contrast, the achievement drive thesis suggests that influences in immigrant families and the ethnic communities mainly operate through imparting pro-education attitudes and behaviors in the children. While the achievement drive would ultimately benefit immigrants' children, converting the achievement drive into actual academic success involves the children's own initiatives and a longer process. For children of immigrants, this approach predicts no academic advantage at school entry that is followed by faster academic growth.[3]

[3] Theoretically, these two competing hypotheses inform how U.S. immigrants' positive selectivity (Borjas 1990) is transferred across generations. Under the skill formation hypothesis, the selectivity directly helps immigrants' children develop their human capital. In contrast, the achievement drive hypothesis suggests that the selectivity operates through socio-psychological mechanisms.

2.3. Explanatory factors

The hypothesized links between descriptive patterns and explanations above draw on more general theories in immigration and educational research. I next review what previous research on children of immigrants find about the academic strengths and weaknesses of children of immigrants. Because school entry represents a distinct "critical period" (Entwisle and Alexander 1989, 1993) marking the transition into full-time schooling, academic disparities at school entry and the subsequent trends are separately discussed.

Initial academic disparities

Family is the most influential social institution in child development prior to children beginning full-time schooling. Resourceful adults often actively help young children develop the skills needed for schooling success. Conversely, the lack of a resourceful home environment has adverse influences on school readiness. Overall, levels of family resources and skill development practices are positively associated with the children's early academic performance (Brooks-Gunn and Markmann 2005).

On the issue of family resources, immigrants tend to face more challenges. For one thing, a large share of the heterogeneous U.S. immigrant population are low-skill, less-educated labor migrants (Portes and Rumbaut 2001). These immigrants experienced many of the same educational and economic constraints encountered by poor and working class natives. Furthermore, cultural differences create an additional array of challenges for immigrants, impeding their engagement with formal institutions (Ambert 1994; Glick 2010; Shoho 1994). It is therefore reasonable to expect this combination of low socioeconomic status and cultural differences to limit how immigrants may facilitate the skill development of their children.

One can not automatically deduce from this resource deficit that immigrants are less engaged in skill cultivation practices. Previous studies demonstrate that active parental involvement can exist in spite of, or even as a result of, insufficient family resources (Cheng and Powell 2008; Hamilton, Cheng, and Powell 2008; Ho and Willms 1996; Kerbow and Bernhardt 1993). With regard to immigrant families,

popular narratives have offered anecdotal examples of their intensive parenting, and some academic studies document distinct practices that promote academic growth (eg. Zhou and Kim 2006). These cases suggest that immigrants may be more invested in developing their children's skills than their economic or educational levels would suggest.

Still, empirical studies have revealed various challenges for immigrants to engage in parenting activities. This occurs in school involvement (Carreón, Drake, and Barton 2005; Peña 2000; Perreira, Chapman, and Stein 2006; Suárez-Orozco and Suárez-Orozco 2001; Turney and Kao 2009b), child literacy development (Reese, Goldberg et al. 1995; Reese and Gallimore 2000), and formal child care (Crosnoe 2007; Magnuson et al. 2006). In addition, differences in parenting style (Kao 2004; Pong et al. 2005) may also prevent immigrants from doing more to enrich their children's cognitive growth.

Previous studies have found other favorable dynamics in immigrant families with young children. The parents, for example, hold higher educational expectation (Raleigh and Kao 2010), maintain more cohesive family ties (Jung, Fuller and Galindo 2012), and promote beliefs that value the schooling system (Reese, Balzano et al. 1995). While these strengths are likely effective in shaping attitudes and behaviors, they appear less useful for directly cultivating academic skills.

To recapitulate, immigrant families are expected to be overall less resourceful, and also not as actively involved in child development practices when compared to natives. These issues likely delay the growth of children's cognitive skills. In turn, they are expected to lead to weaker initial academic performance at the start of formal schooling.

Subsequent trends

Once children start formal schooling, a broader range of factors can affect academic disparities by parental nativity. These factors fall under three categories. The first concerns family influences. Many previous studies suggest that immigrant parents communicate the importance of education to their children but offer limited direct academic assistance. This distinct form of influence has been found during different phases in the children's educational careers, including early and middle childhood

(Garcia-Coll and Marks 2009; Raleigh and Kao 2010; Okagaki and Steinberg 1993) and adolescence (Kao 2004; Perreira, Harris, and Lee 2006; Pong et al. 2005; Suárez-Orozco 1995).

Next, as children's own agency play a progressively important role in their education, some researchers focus on their attitudes and behaviors. The notion that family and ethnic influences drive immigrants’ children to think and act in ways conducive to academic success is supported in studies that find immigrants' children holding higher educational aspirations (Fuligni 1997; Hao and Bonstread-Bruns 1998; Kao and Tienda 1995), and spending more time on learning (Fuligni 1997; Rumbaut 1994). These types of attitudes and behaviors are associated with better academic performance, even though some raise question with the exact causal mechanisms (see Greenman 2013).

The link from favorable attitudes and behaviors to better academic performance may manifest in several temporal patterns. In the simplest form, the positive effects may be stable over time; this is analogous to how girls’ favorable attitudes and behaviors contribute to their consistent academic advantage over boys (DiPrete and Jennings 2012). Alternatively, the attitudinal and behavioral strengths may require time to be translated into cognitive skills, and the academic strengths only gradually manifest as children age. Another potential scenario suggests a "peak" effect during adolescence: the prevalent risk of academic disengagement among U.S. adolescents (Steinberg 1996; Tyson, Darity, and Castellino 2005) can mean that the pro-education attitudes and behaviors of immigrants' children would offer the strongest benefit at a time many of their peers of native parents lose interests in scholastic endeavors.

The last category concerns contextual factors such as schools and communities. Research examining survey data finds that immigrants’ children are generally academically disadvantaged from attending schools and living in neighborhoods with lesser quality (Hao and Pong 2008; Portes and Macleod 1996; Pong and Hao 2007). Studies drawing on more in-depth observation detail the practical challenges immigrants and their children encounter when interacting with teachers or other school personnel (eg. Chavkin and Gonzalez 1995; Peña 2000). Overall, this line of research finds contextual factors to largely work against children of immigrants.

2.4. Racial variations in academic outcomes

The discussion so far only addresses general differences between children of natives and children of immigrants. The segmented assimilation approach, however, establishes that the adaptation of immigrants is generally predicated on global and local conditions, and in the U.S. context, specifically along racial divides. I hence briefly review how the academic performance of children of immigrants intersects with broad racial categories. Even though Hispanic and Asian can also be designated as ethnic or panethnic categories under official classifications (such as the U.S. Census) or according to past research (Espiritu 1992; Mora 2014), I focus on the emphasis on racialization in the segmented assimilation approach, and consider these two categories as races in this paper.

Previous studies focused mostly on Hispanic and Asian immigrants because of their large share among contemporary foreign-born. With the exception of children of Cuban or South American origins, Hispanic children general fare have below-average scholastic performance (eg. Glick and Hohmann-Marriott 2007; Kasnitz et al. 2008). This disadvantage is attributable mostly to lower socioeconomic status but also related to cultural barriers (Pierra, Harris, and Lee 2006; Reardon and Galindo 2009; Warren 1996). Among the Hispanic adolescents and adults, those of the first and second generations have relative academic success compared to their third-and-plus generation peers, particularly once the relative socioeconomic disadvantages in immigrant families are statistically controlled for (Driscoll 1999; Glick and White 2004; Harris, Jamison, and Trujillo 2008; Kasinitz et al 2008; Kao 2004; Telles and Ortiz 2008)..

Asian children have notable academic success. During adolescence, their average educational performance is comparable to or even better than White children of natives (Kao 1995). Among the Asian children, those with immigrant parents have better academic achievement during adolescence (Harris et al. 2008; Glick and White 2004; Kao and Tienda 1995; Perria, Harris, and Lee 2006). In contrast to Hispanics, the socioeconomic status of Asians is overall higher than average, and does not differ much by parental nativity.

The academic struggles of African-American children are well documented (Campbell, Hombo, and Mazzeo 2000; Coleman et al. 1966; Fryer and Levitt 2004, 2005). Children with Black immigrant parents, however, generally outperform their same race peers (Kao and Tienda 1995; Massey et al. 2007; Leventhal et al. 2006; Rong and Brown 2001). Thomas (2009) finds that much of the educational advantage of Black immigrants' children can be attributed to higher family income, more parental education, and favorable family structure. Still, the ethnography of Waters (2001) suggests that Black children of immigrants are at the risk of demoralization as they acculturate and adopt the identity of native Blacks.

I cannot find any studies that specifically focus on the education of contemporary White immigrants or their children in the United States. In more comprehensive analysis that include comparisons of White children by their parental nativity or generational status, the children of immigrants are either found to enjoy a small academic advantage over children with native parents, or perform similarly (Kao and Tienda 1995; Glick and White 2004).

3. Data and Methods

3.1. Data

The ECLS-K is a longitudinal, nationally representative survey administered and maintained by the National Center of Educational Statistics (NCES). Approximately 20,000 children were sampled based on a multi-stage, stratified and clustered frame. The ECLS-K started following the children in kindergarten in 1998, through seven waves of survey, until 2007 when most children attended eighth grade. The longitudinal design, extensive range of measures, and the size of the sample of the ECLS-K make it ideal for studying children's early education in the United States.

[Figure 2 about here]

Figure 2 illustrates the timing of data collection, sample sizes, and data sources across the seven waves of the ECLS-K. Two waves of interviews were administered in kindergarten, one in the fall of 1998 and another in the spring of 1999. The next wave occurred in the fall of 1999 at the start of first grade on a randomly selected 30% of the full sample. In the spring of first grade in 2000, the survey resumed to the full sample; this wave of data was freshened with new cases that had not attended kindergarten so that the data would be representative of all first-graders in the United States during the 1999-2000 school year. Three more waves of full sample data were collected in the spring of third grade (2002), the spring of fifth grade (2004), and the spring of eighth grade (2007).

Throughout the survey, the ECLS-K collected information from multiple sources. All seven waves of data contain information from the child assessments and the parent questionnaires. The teacher questionnaires were administrated in all but the fall of first grade wave in 1999. As shown in figure 2, the samples size decreases over the years. The reduction is the result of sample attribution due to practical field work challenges as well as deliberate decisions in the survey design.

3.2. Sample

The complete ECLS-K data contains information on 21,409 children. Not all of these cases can be applied to the analysis in this study. First, only 15,230 out of the 21,409 children have valid information on parental nativity; the ECLS-K did not begin asking the birth place of at least one parent until the spring of first grade. Consequently, parental nativity cannot be determined for children who had dropped out before the question was asked, or others who provided no valid information on the question. Second, the analysis applies to only children identified as White, Black, Hispanic, and Asian in order to maintain sufficient group sizes for intragroup comparisons; children identified as Native-American, Pacific Islanders, "others", or belonging to more than one group are thus excluded. By retaining only children with valid information on parental nativity and belonging to one of the four racial groups, the sample size is reduced to 14,400.[4] Further sample reduction was needed to address missing information on the dependent variables, the math and reading test scores in the ECLS-K as well as the time these test scores were assessed so growth variations in cognitive development can be adjusted for (see Downey, von Hippel, and Broh 2004). Among the 14,400 children, 6,311 have with complete information on the reading test scores on all six full sample waves, and 6,745 have complete information on the math test scores.

[Table 1 about here]

Table 1 demonstrates how this multi-step selection affects the distribution of basic characteristics of the sample. Overall, the sample is biased towards conditions favorable to educational success. Compared to the full sample of the ECLS-K, cases in both analytic samples have higher family income and more years of parental education, tend to come from smaller families (so every child can receive a greater share of the family resources) with two biological parents, and achieve better reading and math

[4] Some studies treat unidentifiable parental nativity as a separate category in multivariate analysis (eg. Glick and Hohmann-Marriot 2007), but Jones (2009) shows that this missing indicator method is prone to biased point estimates.

scores in kindergarten. In addition, the analytic samples are also more likely to include children from native White families. In the sensitivity analysis, I applied Heckman selection models to investigate whether and how the sample selection may bias the estimates.

3.3. Variables

This section offers an overview of the variables included in the analysis. A more technical detailed list can be found in Appendix A.

Parental nativity: Parental nativity measures whether a child has native or immigrant parents. Immigrant parents are defined as resident parents[5] born outside of the 50 states of the U.S.[6] A separate mixed immigrant family indicator variable is coded and used as a statistical control for the variation caused by families with mixed parental nativity. For a similar purpose, an indicator variable denoting first generation status of the child (born outside of the United States to one or two immigrant parents) is also included.

Young and old birth: Two indicator variables, "young summer birth" and "old fall birth", are included as statistical controls to account for known effects of premature and delayed school entry on academic achievement. Following the coding in Oshima and Domaleski (2006), I assign children who were born in Jun, July and August and less than 67 months of age at the time of their fall kindergarten test to the young summer birth group. I also assign children to belong to the old fall birth group if they were born in September, October, and November and of 67 months of age or older when their fall kindergarten test occurred.

[5] The ECLS-K distinguishes biological parents from resident parents. The later are parents or guardians who live with the child.
[6] Previous studies generally treat subjects from other U.S. territories, most notably Puerto Rico, as immigrants because of the substantial societal differences (eg. Borjas 1990; Glick and Hohmann-Marriott 2007).

Academic performance: Academic performance is assessed using the math and reading test scores from the six full sample waves in the ECLS-K; results from the reduced sample in the fall of first grade in 1999 are not utilized because it does not have sufficient sample size to support intragroup analysis. Among the several test score metrics, the Theta score are chosen for their properties of being norm-referenced both across and within waves, with values ranging between negative three and positive three.

Demographic traits: Three demographic measures of the child are used in the analysis. Gender is coded with female as the positive indicator. Age measures a child's age in September 1998 in units of number of months. The children's race is one of White, Black, Hispanic and Asian; this variable is the basis for pairwise intragroup comparisons between native and immigrant families.

Family resources: A number of variables measuring family resources are included. Economic resources is measured using family income in thousands of dollars in the spring of 1999, or in the spring of 2000 if the value from the previous year was missing. The parents' human capital is captured by parental education in years (converted from the quasi-ordinal measure in the ECLS-K); the values are averaged for children with two resident parents.

Two additional variables capture different aspects of family configuration, which affects how much resources may be available to the individual child. Family type can be two biological parent (which is associated with better academic performance; Astone and McLanahan 1991), single biological parent, or an "other family types". The number of siblings as a continuous variable assesses the extent to which family resources may be diluted (Downey 1995, 2001; Steelman and Powell 1989, 1991).[7]

[7] While also related to family resources for child development (Powell, Steelman, and Carini 2006), parental age has more missing values than family types or number of siblings. As a result, I did not include the variable in the final analysis. Preliminary analysis shows that the variable itself has statistically significant estimates, but its inclusion does not significantly alter results related to parental nativity.

3.4. Descriptive statistics

As mentioned, two separate samples are used for analysis on the reading scores (N=6,311) and the math scores (N=6,745). Here I discuss the descriptive statistics of the larger math score-based sample presented in tables 2 and 3. Results for the smaller reading score-based sample are similar and presented in Appendices B and C.

[Table 2 about here]

Table 2 contains the descriptive statistics of demographic traits and family resources. The results are grouped by race and parental nativity. The differences in group sizes are substantial. The number of White children from native families exceeds 4,000. In contrast, the sizes of both Black children from immigrant families and Asian children from native families are fewer than 100. Estimates for these two small groups are consequently expected to have larger standard errors.

With regard to demographic traits, the average age and gender ratio are very similar across groups. Differences in the average age are all within three months. The gender ratios are also all approximately .5, with the one small exception of .551 for Asian children from immigrant families.

There are considerable variations in number of siblings. At the high end are Black and Hispanic children of immigrants, both with averages greater than 1.6. They are followed by the 1.54 for Black children from native families. The means are all between 1.4 and 1.5 for White children from native families, White children from immigrant families and Hispanic children from native families. The sibling sizes are the smallest in the families of both groups of Asian children. The averages are below 1.4.

Family types also differ considerably between groups. Most likely to come from families with two-biological parents are White children of natives, White children of immigrants, and Asian children of immigrants; the shares are all over .8. This is followed by Hispanic children from both native and immigrant families, and Asian children from native families (all between .6 and .8). Black children from native families, in contrast, are more likely to come from single-parent families (.485) than two-biological

parental families (.355). This is noticeably different from the 60% of the Black children of immigrants who have two biological parents at home.[8]

There are substantial income and education disparities between groups. White and Asian families are at the top of the income distribution, all with means at approximately $70,000. The average income in families of Hispanic children of natives is slightly more than $49,000, and it is over $38,000 for Black children of immigrants. For Black children of natives and Hispanic children of immigrants, the average family incomes for both groups are less than $30,000.

White and Asian families are also the most educated. Average parental education for these groups all exceed 15 years. The average parental education for Black children of natives, Black children of immigrants, and Hispanic children from native families are between 13 and 14 years. The least educated group is Hispanic children from immigrant families, who have an average educational level of approximately 11 years.

[table 3 about here]

Table 3 summarizes the unweighted means and standard deviations of the math Theta scores. The progressively larger mean values in each row from left to right reflect the general growth in math skills over time. Comparisons between groups show that White and Asian children generally have higher math scores than Black and Hispanic children.

In addition, the table shows how the design of the Theta score metric results in contrasting scales between the magnitudes of growth during the studied period and the sizes of the intergroup differences. For example, math scores have mostly increased by over two units throughout the studied period while the between-group variation in each wave remains similarly small, usually at no more than .5 units. As a

[8] The 26.2% Asian children from native families that are classified as “other family types” is higher than other groups. Much of this is driven by the high rate of Asian children in this category (15 out of the 16 in the category) that come from families with two adoptive parents.

result of this design, any of the between-group differences must appear small when compared to the overall magnitude of growth.

3.5. Choice of reference group

Much of the subsequent analysis uses pairwise comparisons to examine differences by parental nativity in cross-sectional test scores and the rates of change. More details of these comparisons will be explained in their respective chapters. Here I briefly discuss the shared comparison framework.

The research of U.S. immigrants has adopted two different approaches to assess how immigrant groups perform. Influenced by the "straight-line" assimilation approach (Gordon 1964), earlier works generally compare immigrant groups to the "mainstream" or the dominant group; this group in practice was almost always White natives. In more recent years, however, scholars such as Portes and Zhou (1993) contested that this framework developed for studying European immigrant groups arriving during the late nineteenth century and early twentieth century does not suit the many more recent non-White immigrants. They argue that the racial hierarchy in the U.S. society undermines the economic and educational progress for dark skin immigrants. Therefore, more recent scholars tend to compare children of immigrant to children of natives from the same racial or ethnic group to conduct a more realistic assessment of the former's progress in adaptation.

These two approaches are not mutually exclusive and can actually complement each other. Within group comparisons helps accounts for the structural constraints minority children may face and can separate the confounding effects of race and parental nativity. Comparing all groups of children of immigrants to the large and still dominant group of White children of natives, however, offers a more comprehensive assessment of how children of immigrants fare academically. Analysis in the next two chapters incorporates both approaches in the pairwise comparisons; in assessing both the achievement gaps and rates of change, children of immigrants are compared to White children as well as children of natives of the same race.

4. Reading and Math Gaps

4.1. Cross-sectional OLS models

In this chapter, differences in academic growth are first assessed through cross-sectional models. This approach estimates math and reading gaps using individual OLS regressions for each wave in the survey. Mathematically, these cross-sectional models can be expressed as:

$$\theta_{it} = \boldsymbol{\beta}\mathbf{X} + \Delta_{\mathbf{t}}\mathrm{I_i} + (\boldsymbol{\gamma}\mathbf{Z}) + \varepsilon_{it} \ldots\ldots \text{(equation 1.1)}$$

$$\theta_{it} = \boldsymbol{\beta}\mathbf{X} + \Delta_{1t}\mathrm{WI_i} + \Delta_{2t}\mathrm{BN_i} + \Delta_{3t}\mathrm{BI_i} + \Delta_{4t}\mathrm{HN_i} + \Delta_{5t}\mathrm{HI_i} + \Delta_{6t}\mathrm{AN_i} + \Delta_{7t}\mathrm{AI_i} + (\boldsymbol{\gamma}\mathbf{Z}) + \varepsilon_{it} \ldots\ldots \text{(equation 1.2)}$$

The outcome variable θ_{it} denotes the math or the reading Theta score for child *i* in wave *t*. The Δ in equations 1.1. and 1.2 represents the gap estimates between two groups. The $\mathrm{I_i}$ in equation 1.1 is an indicator variable signaling whether child *i* comes from an immigrant family; native family is the reference category for which a value zero would be assigned. In equation 1.2, an eight-group classification for the grouping based on parental nativity and race is applied. The seven indicator variables start with the two letter acronyms WI_i, BN_i, BI_i, HN_i, HI_i, AN_i and AI_i; the *W*, *B*, *H*, and *A* in the first letter stands for, respectively, White, Black, Hispanic, and Asian group, and the *N* and *I* in the second letter indicate native families and immigrant families. The reference category in equation 1.2. is White children from native families.

X represents a vector of five *adjustment covariates*. Variations in the indicator variables of first generation status and mixed immigrant family can complicate estimates of Δ, and hence are explicitly accounted for in the modeling. The other three variables—month of assessment, young summer birth, and old fall birth—adjust for the developmental differences in children's cognitive skills. The estimates of $\boldsymbol{\beta}$ have no substantive interests.

Z denotes the vector of control variables that measure demographic traits and family resources: female, age, parental education, family income, family types, and number of siblings. Their inclusion provides estimates of Δ under the equality assumption on these variables. The coefficients in $\boldsymbol{\gamma}$ are also not of interest for this analysis.

For each equation, two sets of models are applied. Model 1 contains the achievement gap estimate(s), the corresponding indicator variable(s), and the five adjustment covariates presented in $\boldsymbol{\beta}\mathbf{X}$ This model generates the baseline gap estimates. Model 2 further adds the demographic traits and family resources variables in $\boldsymbol{\gamma}\mathbf{Z}$ to assess the associated changes in the gap estimates**.** I estimate these cross-sectional equations for all but the third, reduced sample wave of the survey.[9] All estimates also adjust for the complex survey design in the ECLS-K. The ECLS-K provides multiple options for such adjustment. I use the Taylor linearization method to estimate the standard errors based on the longitudinal weight variable *C1_7FC0* and its corresponding primary sampling unit and strata parameters. These parameters lead to more conservative standard error estimates than other cross-sectional parameters available in the dataset.

4.2. Reading and math gaps by parental nativity

[table 4 about here]

Table 4 summarizes the average reading and math gaps by parental nativity for six waves of survey data using equation 1.1. For the reading scores, the overall disadvantage of immigrants' children in model 1 narrows over time. The initial reading gap in fall kindergarten is a statistically significant deficit at -.115 ($p<.01$), or about one-fifth of the standard deviation. Starting in the spring kindergarten wave, however, the deficit has dropped to a statistical insignificant -.023, and remained at this level for the

[9] In the reduced sample of the third wave, reliable estimates cannot be obtained for the two smallest groups, which have with fewer than 20 observations.

subsequent three waves (the springs of first grade, third grade, and fifth grade). In eighth grade, the gap remains within sampling errors, although its point estimate has become positive at .018. Overall, the reading performance of children of immigrants relative to children of natives begins with a minor statistically significant deficit, and gradually improves to a small and statistical insignificant lead.

Compare these results to model 2, in which the reading gap begins at a small and statistically insignificant -.036. The following gap estimates have all become positive, but only the last and largest estimate at .075 in eighth grade is statistically significant ($p<.001$). These results demonstrates that, with statistically controlling for demographic traits and family resources, children of immigrants begin with a reading disadvantage that is not statistical significant, and gradually move to a statistically significant reading advantage.

The trends in the math score estimates reveal a less drastic relative improvement. In model 1, the initial baseline disparity is -.306 ($p<.001$), which is over half of the standard deviation. The gap then narrows steadily over time, finally dropping to -.086 ($p<.01$) in eighth grade. This means that the disparity starts as a sizable and statistically significant disadvantage, and then becomes a small and inconsequential disadvantage. With the statistical controls in model 2, the achievement gap moves from the initial small deficit at -.139 ($p<.001$) to a positive value of .070 ($p<.01$) in eighth grade.

To sum, none of these results resemble the prevalent longitudinal pattern of persistent academic disparity. Instead, they offer varying support to the alternative scenario of slower start and faster growth. The baseline gap estimates from model 1 show that an average child from an immigrant family faces initial disadvantages in reading and math. These disadvantages narrow substantially over time or completely disappear by eighth grade, entailing trends of faster growth. Still, the academic advantage expected for children of immigrants at adolescence is not found in the baseline gap estimates at eighth grade. Only when demographic traits and family resources are statistically controlled for do we observe late academic advantages for children of immigrants.

4.3. Reading gaps by parental nativity and race

[figure 3 and 4, and table 5 about here]

I next estimate the reading and math gaps by parental nativity within each of the four racial groups using equation 1.2. Because these comparisons involve eight groups over six waves of data, the discussion uses graphic presentation as the main tool to communicate the overall patterns and draws on detailed numeric estimates where better precision is desired. The baseline estimates of reading gaps are reported in figures 3 and 4 as well as table 5. Figure 3 incorporates all point estimates in one large graph. Figure 4 illustrates the point estimates and their 95% confidence intervals in four graphs separated by race. For both figures, the expected test scores for White children from native families (the reference group in equation 1.2) are fixed at the horizontal line at value zero on the vertical axis.[10] Table 5 reports all numeric estimates.

In figures 3 and 4, the reading score estimates of White children of immigrants are very close to zero for the entire studied period. The absolute values of the point estimates never exceed .04, and the 95% confidence intervals always include zero. This suggests that there are no statistical significant differences in the reading scores between White children of natives and White children of immigrants.

Among the Black children, the differences by parental nativity are considerable. For children from native families, the initial estimate in fall kindergarten at -.258 (or over half of the overall standard deviation) is the second to the lowest estimate among the eight groups in this wave. The value then drops to the lowest of all groups in the next, spring kindergarten wave, and stays at the bottom from this point forward; in eighth grade the estimate remains still the lowest at -.361. In comparison, Black children from immigrant families have an initial estimate at -.077, which is much closer to zero. Over time, this deficit

[10] While it is technically possible to plot the predicted values for the reference group, the much greater magnitude of academic growth over time would make the small intergroup differences impossible to visually discern.

expands moderately. It reaches its lowest values at -.141 in fifth grade (the only statistically significant value on this line at the p<.01 level), and then moved up somewhat in eighth grade.

The longitudinal patterns for Hispanic children also differ by parental nativity considerably. The children of natives have an average initial reading deficit at -.185 (p<.001) in fall kindergarten. This deficit shrinks over the next few years, but eventually reverts to -1.43 (p<.001) in eighth grade. Meanwhile, Hispanic children of immigrant begin with the lowest average reading estimate (-.380; p<.001) of all groups, but this deficit is soon cut in half at the spring first grade survey (-.174; p<.001). While this relative growth tapers off from this point forward, the eighth grade average reading score (-.129, p<.001) is statistically indistinguishable from that of Hispanic children of natives (-.143, p<.001).

For Asian children, their reading scores are similar to or better than White children. Both Asian children of native and immigrant parents have small reading advantages over White children of natives up to the spring first grade wave. After this, the differences become statistically indistinguishable. Among the Asian children, the better reading scores of children with native parents are within sampling errors relative to those with immigrant parents.

[figure 5 and 6, and table 6 about here]

The reading score estimates that control for demographic traits and family resources are presented similarly in figures 5 and 6 as well as table 6. The addition of control variables does not alter much of the patterns: White and Black Children of immigrants still have reading scores comparable to White children of natives. Asian children still outperform White children of natives until their trajectories converge in third grade. The reading growth of Black children of natives still shows a relative downward trend compared to both White and Black children of natives. The initial gap between Black and White children of natives is still present but ceases to be statistical significant (now at -.06, compared to the -.258 in table 5). The magnitude of their subsequent differences is also now smaller.

The most substantial difference between estimates produced using model 1 and model 2 is found among the Hispanic children. While the reading gap estimates for Hispanic children of natives remain mostly negative with the additional control variables, these estimates are nonetheless smaller in magnitude. Furthermore, the consistent statistically significance in the baseline estimates are now only so in the first and last two waves. For Hispanic children from immigrant families, the additional statistically control can account for a large portion of their reading disadvantages found in the baseline estimates. Apart from a still considerable initial deficit (-.171, $p<.001$), Hispanic children of immigrants now mostly have reading performance comparable to that of White children of natives.

On the question of how children of immigrants fare compared to their same race peers, there are two contrasting patterns. Having immigrant parents appears to not be associated with much negative reading performance for White or Asian children. Between kindergarten and eighth grade, none of the gaps found for White or Asian children are statistically significant. This holds true even when statistically controlling for demographic traits and family resources.

Having immigrant parents appears to be associated with favorable results for both Black and Hispanic children, albeit in very different ways. The story for Black children is one of divergent trends. In the baseline estimates, Black children of immigrants already have better initial reading scores than Black children of natives, but this gap is within sampling error. As the reading performance of the latter grows slower relative to the former, the initial disparity exacerbates and becomes statistically significant in middle childhood. Additional statistical control shows that this divergence cannot be fully attributed to the higher income and parental education in the families of Black immigrants.

In contrast, the longitudinal patterns of the two groups of Hispanic children feature convergence. In kindergarten and first grade, Hispanic children from immigrant families have worse reading performance than their peers from native families. Starting in third grade, however, the gap between the two groups has narrowed to within sampling errors. Once demographic and socioeconomic differences are accounted for, Hispanic children of immigrants still have worse initial reading scores. They, however, outperform Hispanic children of natives by eighth grade.

4.4. Math gaps by parental nativity and race

[figures 7 and 8, and table 7 about here]

The same set of analysis is applied to the math scores. The baseline math gap estimates are presented in figures 7 and 8 as well as table 7. Relative to White children of natives, White children of immigrants have a minor initial math deficit of the size of approximately -.1. This deficit holds until first grade, after which it diminishes to within sampling errors. A similar pattern is found for Black children. Between kindergarten and first grade, Black children from immigrant families have statistically significant math deficits relative to White children of natives ranging from -.1 to -.2. From third grade and forward, however, the deficits have dropped to lesser than -.1 and are no longer statistically distinguishable from zero. Meanwhile, the math disadvantage of Black children of natives first appears in the fall kindergarten wave (at -.343) and exacerbates over time. Their math deficit in eighth grade reaches -.459, or approximately the size of a standard deviation.

The math growth of Hispanic children of natives features stable and moderate disadvantage. From kindergarten to eighth grade, their math deficits fluctuate between -.2 and -.1 and are always statistically significant ($p<.001$). In comparison, the Hispanic children of immigrants suffer from a substantial math disadvantage (-.513) in fall kindergarten. They have relative improvement steadily over time, but this can only reduce the deficit to by close to half at -.278 in eighth grade.

In the first few years of schooling, the math scores of both groups of Asian children are comparable to White children of natives. Faster math growth then starts giving Asian children of natives a lead in third grade. Eventually, this lead expands to a sizable .307. Asian children of immigrants also have early math trajectories similar to White children of natives that become a small math advantage from fifth grade forward.

[figures 9 and 10, and table 8 about here]

Math gaps estimates that control for demographic traits and family resources are presented in figures 9 and 10 as well as table 8. For White and Black children of immigrants, the estimates are similar to the baseline estimates. Relative to White children of natives, both groups begin with a small math disadvantage in kindergarten and first grade, but soon catch up to include zero in their respective 95% confidence intervals. With regard to Black children of natives, accounting for demographic traits and family resources reduces the magnitudes of the gaps but not the substantive conclusion about them. Under model 2, these children have an initial moderate deficit at -.179. Instead of improving, the math deficit of Black children of natives exacerbates over time. The deficit at -.304 in eighth grade almost doubles the initial value.

The additional control variables included in model 2 appear to account for much of the math disadvantage of Hispanic children. Rather than the consistent and moderate disadvantage found in the baseline, Hispanic children of natives now only have statistically significant math deficit relative to White children of natives in kindergarten and first grade. As for Hispanic children of immigrants, their math scores now starts much closer to zero; the initial deficit is only half of that in model 1. The size of the deficit further decreases over time and eventually closes out in eighth grade.

Estimates for Asian children remain mostly unaltered under model 2. Between kindergarten and third grade, the point estimates (but not the confidence intervals) for the two groups of Asian children stays above zero. Starting in fifth grade, however, the math advantages of both groups begin to exceed sampling errors and become statistically significant.

The conclusions drawn from examining the reading scores are mostly also applicable to the math tests. For both White and Asian children, no math advantage is found for those with immigrant parents. In the contrary, there is circumstantial evidence for the opposite conclusion including the initial math deficit

for White children of immigrant and the consistently lower point estimates for Asian children of immigrant relative to Asian children of natives.[11]

An immigrant background is associated with more positive math skill growth over time for Black and Hispanic children. Between kindergarten and first grade, the average math scores are statistically indistinguishable between Black children of different parental nativity. Starting in third grade, however, the relative growth of children of natives gradually slows down. At the same time, the relative math growth of children of immigrant begins to accelerate before it reaches and holds at a level statistically indistinguishable from zero. Including the demographic traits and family resources in the models brings the two groups of Black children closer in the first two years, but their trajectories still diverge starting in third grade.

Among Hispanics, the children of natives are found to have a moderate and stable math disadvantage throughout the studied period. In the baseline estimates, the children of immigrants have an initial deficit three times that of the children of natives. Steady improvement does reduce the gap to approximately two times by eighth grade. This improvement is even more salient under model 2 with differences in demographic traits and family conditions accounted for. While the initial disparity remains, no statistically significant differences are found between the two groups between first grade and eighth grade.

4.5. Sensitivity analysis

The robustness of these findings is supported by other estimation and modeling techniques. First, I re-estimated the standard errors using the Paired Jackknife method (JK2); the replicate weights needed for this method are readily available in the ECLS-K data. Even though the standard errors generated from using this method are slightly different from what the Taylor linearization method offered, none of the changes are remotely close to altering the substantive conclusions.

[11] No statistical significant differences are found for the math gaps among Asian children. This inability to separate the two groups may be an artifact of the small group size for Asian children from native families in this sample. Other large data sources are needed to further assess this comparison.

Next, I applied Heckman selection models to examine if accounting for the sample selection mechanisms still produces the same results. Specifically, I used the children's age, gender, and their race as independent variables in logistic regressions that predict selection from the complete data of 21,409 cases into the two analytic samples. The selection function was in turn combined with the reading and math gap estimates.[12] The standard errors were estimated both using the Taylor linearization method as well as the Paired Jackknife methods. Results from the Heckman selection models differ from the original findings mainly in magnitude: the estimates are smaller for the late disadvantages of the Hispanic children, and larger for the late advantage of Asian children. Conclusions pertaining to disparities by parental nativity, however, remain unchanged.

Lastly, I used multiple imputation techniques to analyze if the value assignment performed on two adjustment covariates, first generation status and mixed immigrant family, affects the gap estimates. For a few dozen cases that did not have sufficient information to definitively conclude values on these two variables, I chose to assign values based on additional assumptions and arbitrary decisions. [13] Results from applying multiple imputation suggest that this value assignment can alter the coefficients of first generation status and mixed immigrant family, but does not affect the achievement gap estimates.

4.6. Summary

In this chapter, I used OLS models to estimate cross-sectional reading and math gaps. Overall, the results indicate a disadvantaged start followed by faster growth for children of immigrants in general. These children initially suffer from deficits in both reading and math scores. By eighth grade, however,

[12] Maximum likelihood estimates (MLE) are used in the Heckman selection models because the complex survey parameters restrict the use of the more stable two-step estimation process.

[13] The ECLS-K has insufficient information to unequivocally determine the values on these two variables for between 30 and 42 cases (depending on specific variable and the analytic sample). For first generation status, I assigned values to most of these children based on assumptions about the child age and the immigrant mother's years since arriving the United States; for the few children (one in the reading sample, and three in the math sample) whom I could not make the determination, I arbitrarily assigned them to not be first generation. Similarly for the mixed immigrant family determination, I made assumptions about one parent's language use based on his or her country of birth, and compare this guess to the language use in the family. For the two cases (in both samples) where this solution did not suffice, I arbitrarily assigned them to have mixed immigrant status families.

the reading deficit has closed, and the math disparity has narrowed considerably. Statistically controlling for demographic traits and family resources accentuates the faster growth. With the additional control variables, children of immigrants not only begin with reading scores indistinguishable from children of natives, but also outperform them by eighth grade. On math scores, the initial math disadvantage of children of immigrants turns into an advantage over the studied period. Overall, the slower start, faster growth, or the combination of both for children of immigrants supports the achievement drive hypothesis. In addition, results from models with the additional statistical control suggest that the initial academic disadvantage of children of immigrants can be attributed to demographic differences or, more likely, lesser family resources.

Further analysis by racial groups reveals three general patterns. First, there is limited disparity by parental nativity in the academic growth of White and Asian children. With few exceptions, White children of immigrants have reading and math scores that are statistically comparable to those of White children of natives. Both groups of Asian children enjoy a small and not always consistent academic advantage over White children of natives, but very little difference exists between the two groups of Asian children.

For Black children, diverging trends are found in the academic growth of children of natives and children of immigrants. When compared to White children of natives, Black children of natives begin with reading and math deficits that both exacerbate overtime, particularly between fifth grade and eighth grade. In comparison, the reading scores of Black children of immigrants are mostly comparable to that of White children of natives. What is also worth noting is how patterns diverge between the two groups of Black children. Black children of immigrants start school with performance comparable to Black children of natives. Over time, however, reading and math skills of the former grow noticeably faster than the latter.

Lastly, the math and reading growth converges between the two groups of Hispanic children. On both math and reading scores, children of immigrants start school with worse performance than the children of natives. The gap between them then shrinks over time. In eighth grade, the reading difference

is fully closed and the math difference is substantially narrowed. In analyses that control demographic and family variables, the contrast between the two groups of Hispanic children is lessened, and the deficits of both relative to White children of natives are also reduced.

5. Growth rates

5.1. Growth curve models

The cross-sectional OLS models yield reliable estimates of the reading and math gaps with a relatively simple modeling approach. Still, growth curve models can offer a number of distinct advantages for understanding academic trajectories in ways that the cross-sectional OLS models cannot. Growth curve models provide explicit parametization of growth trajectories. Rather than inferring change from cross-sectional estimates, individual trajectories are formally parameterized in the form of growth rate estimates. These estimates enable researchers to directly compare growth rates between groups, and perform formal statistical tests on the comparisons. In addition, growth curve models can incorporate individually varying times (Mehta and West 2000) of the outcome measures in its modeling. Failure to incorporate these measures in studies using the ECLS-K to estimate academic trajectories has been shown to lead to biases that can alter conclusions (Downey, von Hippel, and Broh 2004).

The specification of growth curve models can adopt multiple forms. For this analysis, I use a spline function[14] for the fixed effect (systematic) and assume the random effects (non-systemic) follow linear slopes. Specifically, the fixed effect of the modeling in this analysis is summarized in one intercept and six slope estimate. The random effects are captured in individually varying intercepts and single slopes. The detailed are:

$$\theta_{it} = \pi_{1i0} + \pi_{2i0}I_i + \sum_{t=1}^{6} \pi_{1it} T_{it} + \sum_{t=1}^{6} \pi_{2it} I_{it} T_{it} + \boldsymbol{\beta}\mathbf{x} + (\boldsymbol{\gamma}\mathbf{Z}) + \nu_{0i} + \nu_{1i} T_{it} + \varepsilon_{it}$$

$$\begin{pmatrix} \nu_{0i} \\ \nu_{1i} \end{pmatrix} \sim N\left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \tau_{00} & \tau_{01} \\ \tau_{01} & \tau_{11} \end{pmatrix}\right) \ldots \text{ (equation 1.3)}$$

[14] Polynomial specifications for the fixed effects have been attempted. They offer similar substantive results, but the estimates have lesser model fit and are more difficult to interpret.

$$\theta_{it} = \pi_{1i0} + \pi_{2i0}WI_i + \pi_{3i0}BN_i \ldots \pi_{8i0}AI_i + \sum_{t=1}^{6} \pi_{1it}T_{it} + \sum_{t=1}^{6} \pi_{2it}WI_iT_{it} + \sum_{t=1}^{6} \pi_{3it}BN_iT_{it} + \cdots \sum_{t=1}^{6} \pi_{8it}AI_iT_{it} + \boldsymbol{\beta}\mathbf{X} + (\boldsymbol{\gamma}\mathbf{Z}) + \nu_{0i} + \nu_{1i}T_{it} + \varepsilon_{it}$$

$$\begin{pmatrix} \nu_{0i} \\ \nu_{1i} \end{pmatrix} \sim N\left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \tau_{00} & \tau_{01} \\ \tau_{01} & \tau_{11} \end{pmatrix}\right) \ldots \text{(equation 1.4)}$$

In the interest of consistency, these two equations adheres to the notational conventions used in equations 1.1 and 1.2. The dependent variable θ_{it} denotes the reading or math Theta score for child *i* in wave *t*. The **βX** term represents the vector of adjustment covariates multiplied by their coefficients. In these two equations, the four adjustment covariates are first generation status, mixed immigrant family, young summer birth, and old fall birth. Month of assessment was an explicit adjustment covariate in equations 1.1. and 1.2. Under the growth curve modeling approach, however, it is incorporated as individually varying times. The control variables, the demographic traits and family resources, and their coefficients are captured under **γZ**. The *I* in equation 1.4, indicator variables of group membership are named using a similar convention in equation 1.2, with the first letter representing race and the second letter indicating parental nativity.

This analysis is mainly interested in the fixed effect coefficients, which are denoted by π. These coefficients model the intercept and six growth rates in a growth trajectory. The intercept represents the initial test score at moth zero. The six growth rate estimates represent changes in test scores per month in six intervals between month zero and month one-hundred-and-eight. These intervals are delimited by the individualized months of survey. Because the unevenly spaced intervals are progressively longer, estimates of later intervals weigh heavier in the overall trend of the trajectories. In the subsequent presentation of these estimates, all intervals are referred to by the time of their end points, namely fall kindergarten, spring kindergarten, spring first grade, spring third grade, spring fifth grade, and spring eighth grade.

In equation 1.3, different intercepts and growth rates are modeled for children of natives and children of immigrants. In equation 1.4, eight sets of intercept and growth rates are estimated for the eight groups based on parental nativity and race.[15]

The random effects parameters ν_{0i} and ν_{1i} represent the random intercepts and random slopes. The parameterization allows varying starting values (when time T_{ti} is set at 0) and linear slopes between individual children. The mean values of these random effects are set at zero, their distributions are multivariate normal, and their unconstrained variances and covariance are denoted as τ_{00}, τ_{11}, and τ_{01}.

Similar to the analysis in chapter four, both equations are estimated with two models. The baseline intercept and growth rate estimates come from model 1, which does not control for demographic traits and family resources. Model 2 adds these control variables (the $\boldsymbol{\gamma}\mathbf{Z}$ part of the equation) to examine the potential changes in estimates. Statistical methods still have not agreed upon the most proper way to incorporating strata and clusters in growth curve models. Following recommendations from the NCES, I use design effect adjusted weights based on the longitudinal weight *C1_7FC0* to approximate potential estimates from the complex survey design. Because the data has a nested structure, I follow Carle (2009) to scale the weights to account for its multilevel nature.[16]

5.2. Differences in trajectories by parental nativity

[Table 9 and figure 11 about here]

[15] To operationalize equation 1.4., I calculate six range variables based on the child's month of assessment. These values are then multiplied to group membership indicators for the seven groups other than White/Native. This design allows the intercept and the coefficients of the six range variables to be the baseline and growth rate estimates for White/Native. The other coefficients indicate the differences from the reference group.

[16] The design effect adjusted weight is acquired through a two-step process. First, the weight is normalized by the sample size, and then divided by the squared value of the design effect constant. This process can be expressed as $w_i^* = \frac{w_i(\frac{n_i}{\sum_i w_i})}{DEF^2}$, where *i* represents the individual child. To scale the weight for multilevel models, the data is first transformed into the long format, and adjusted by the child cluster using $w_{ij}^{**} = w_{ij}^*(\frac{nj}{\sum_i w_{ij}})$. In the latter equation, *i* indicates an individual data point, and j represents a child.

Table 9 presents estimates of the baseline intercepts and growth rates for children of natives and children of immigrants. The “difference” column is computed by subtracting values in the “native” column from corresponding values in the “immigrant” column. A positive value in the "difference" column indicates advantage for children of immigrants, and a negative difference suggests the reverse. Asterisks indicate the results of the Student's *t* test on the differences

To help visualize the estimates, the predicted reading and math trajectories are plotted in figure 11 using information from table 9. The meaning of figure 11 differs from graphic presentation of reading and math gaps in chapter four. These previous figures plot *relative difference* to the reference group. In contrast, figure 11 and other figures in this chapter present the *actual predicted scores*. As a result, the differences between groups appear small relative to the magnitude of growth.

Overall, the results in table 9 show that children of immigrants have less favorable initial scores, and comparable or faster academic growth relative to children of natives. All four differences in intercepts are negative, and three of them are at least statistically significant at the .01 level. For the growth rates, 18 out of the 24 differences are positive, and 12 out of these 18 are statistically significant (at the .01 level). In contrast, the six negative differences in growth rate are all within sampling errors. Substantively, these results indicate a slower academic start and faster growth for children of immigrants.

We consider these results in more detail. In both models predicting the reading scores, children of immigrants have lower intercepts, and these differences are statistically significant. In both models, faster growth is found for four of the six differences, indicated by positive and statistically significant growth rates. As figure 11 shows, the dashed lines representing children of immigrants start at a lower point, but have outpaced the solid lines representing natives’ children by the last data point at eighth grade. In addition, differences between model 1 and model 2 are found mostly between the intercept and the first interval. This suggests that controlling for demographic traits and family resources reduces the initial disparity, but does little to alter most differences between subsequent growth rates.

The findings are similar for the math trajectories. In model 1, children of immigrants also suffer from a statistically significant initial math deficit. The six differences in growth rates are evenly split

between positive and negative values, but the negative values are all within sampling errors while the two of the three positive values are statistically significant. In figure 11, the predicted trajectories suggest a narrowing trend: the initial disadvantage of children of immigrants decreases over time, but it does not fully close in eighth grade. In model 2, the additional control variables help reduce the starting gap to within sampling errors, but they do little to alter the growth rate differences beyond the intercept and the first interval. According to the graphic presentation, the two trajectories converge at around the point of 40 months (between second to third grade for most children), and continue to overlap throughout the remainder of the studied period.

5.3. Reading trajectories by parental nativity and race

[Table 10 about here]

Table 10 presents results using model 1 to predict the reading Theta scores. The "intercept" column contains the estimated starting values. The other columns indicate values of the growth rate for the particular interval ending at the time point specified in the column name. For example, the "spring kindergarten" column indicates the estimated rate of change between fall kindergarten and spring kindergarten. The rows are separated by race into four sections marked under "White", "Black", "Hispanic", and "Asian", each section covering estimates for children in that racial group. The specific group or combination of groups concerned in each row is denoted by using the two letter acronyms presented in equation 1.4.

The design of table 10 is the same as all remaining tables in this study. The first row, labeled as "WN", presents the intercept and all growth rate estimates for White children of natives. This group is used consistently a reference group in subsequent comparisons. The second row, labeled as "WI-WN", presents the differences of subtracting estimates for White children of natives from estimates for White

children of immigrants. Student's t tests are conducted for all differences by dividing the difference over the pooled standard error.[17]

While calculating arithmetic differences is useful for assessing statistical significance, the sizes of arithmetic difference are not always easy to interpret. Due to the scaling of the Theta score in the ECLS-K, the ranges of the growth rate can vary notably: estimates for earlier intervals are noticeably greater than those of later intervals. As a result, there is no one obvious basis for evaluating whether an arithmetic difference is large or small. To address this problem, I also divide each arithmetic difference to its subtrahend to calculate ratios of the differences. These ratios can be alternatively calculated as the fraction between two estimates minus one. For example, the label of the third row indicates the calculation of the ratio as (WI/WN)-1. Each ratio is included immediately below its corresponding arithmetic difference. Substantively, these ratios represent how much larger or smaller (shown as negative values) the growth rate estimates of one group are relative to the estimates of reference group. Ratios for the intercepts cannot serve the same purpose and are hence not calculated.

To illustrate the structure of the results in an example, consider the value in its second column of the second row. The difference at 0.0201 indicates that being a White child of immigrants is expected to have growth rates at 0.0201 units per month faster than a White child of natives between the first month and the fall kindergarten survey. Accounting for its standard error at .0319 listed in the parenthesis suggests that this difference may be due to sampling errors and cannot be generalized to the population. As for the ratio, the .2215 value indicates that before the first child assessment, a White child of immigrant parents is expected to enjoy a 22.15% faster growth rate than that of a White child of natives.

In table 10, the differences are calculated for all pairwise comparisons; the ratios are calculated for all rates of changes. Two types of pairwise comparisons are conducted. First, all groups are compared to White children of natives. For Black, Hispanic, and Asian children of immigrants, their estimates are also compared to the children of natives of the same race.

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[17] According to Clogg, Petkova , and Haritou (1995), the pooled standard error for coefficients b_1 and b_2 in the same model can be calculated as $SE_{\text{pooled}} = \sqrt{Var(b_1) + Var(b_2)}$

With the design of the table explained, we now discuss the actual results. The first row presents estimates for White children of natives. These are values against which all four groups are referenced. The initial reading score begins with a negative value at -1.289.[18] The positive values in all of the subsequent columns indicate increases in reading score across all six intervals.

The second and third rows compare the estimates of White children of immigrants to that of White children of natives. These comparisons suggest indistinguishable growth. Both the intercept and the subsequent growth rates are within sampling errors. The ratios further indicate that, while their initial value is lower, White children of immigrants have growth rates that are more often faster than their counterparts of native parents than not.

[Figure 12 about here]

Graphic presentation can help visualize the differences in predicted trajectories. Corresponding to table 10, figure 12 illustrates the reading trajectories predicted by growth curve specifications in model 1. The solid lines represent trajectories of children of natives whereas the dashed lines represent trajectories of children of immigrants. In the upper left panel for White children, the two lines are separated during approximately the first 45 months, and then overlaps for the rest of the period. This reinforces the conclusion from table 10 that the two groups mostly have similar trajectories.

According to table 10, the two groups of Black children have contrasting trajectories. First, Black children with native parents have substantially lower initial reading scores relative to White children of native parents. Even though the Black children at times have faster growth rates, none of the differences in the subsequent five intervals register statistical significant. Furthermore, the significantly slower growth rate starting at around fifth grade (a -.0032 difference per month, $p<.001$; this is 40% slower and lasted approximately 40 months) is enough to offset any of the prior gains.

[18] Note that this value does not represent the predicted intercept, which would require also incorporating estimates of the control variables.

With regard to Black children of immigrants, their differences relative to White children of natives are mostly negative, but still smaller in magnitude and not statistically significant. The initial deficit is negligible (-.0791; p>.05). Three of the six growth rate differences are negative and indicate slower growth rates by 10% or more. Meanwhile, the positive differences are all small; the most sizable is the 6% faster growth between the fall and spring of kindergarten. The lack of statistical significance in most of these measures may be driven by the small group size and the associated large standard errors of Black children of immigrants.[19]

Comparing Black children of immigrants to Black children of natives reveals three patterns. First, children of immigrants have a favorable start. Their initial difference of approximately .2 is sizable even though statistical significance may have been prevented by the large standard error. Second, the children of immigrants have relatively slow in the early growth rates. They are 48.5% slower in the first interval, and 10.9% slower in the third interval (also p<.05); the positive ratios in the second and forth intervals are much smaller. Third, later trends favor children of immigrants. The 46.5% faster growth in the last, longest interval (p>.05, again likely due to the large standard error) offers children of immigrants a considerable boost. As the predictions in figure 12 shows, children of immigrants pull away noticeably in the last leg.

In the first two rows under the "Hispanic" section, comparing Hispanics children of natives to White children of natives results in a lower starting point (a difference of -.13; p<.001) and overall slower growth. The growth is approximately 20% slower in the first interval, but approximately 10% faster in the second interval. The growth rate differences are practically negligible between spring kindergarten and spring fifth grade. In the last interval, however, the Hispanic children’s growth rate is again slower by approximately 20% (a difference of -.0016 and p<.001).

The next two rows compare Hispanic children of immigrants to White children of natives. The Hispanic children have a large initial reading deficit at .31 (p<.001). Their growth in the first interval is

[19] All standard errors are approximately three times that of Black children of natives, and approximately two times that of White children of immigrants.

slower by almost 25%. Between the second and the fifth intervals, however, faster growth is found for the Hispanic children of immigrants. The ratios in these four intervals are, respectively, 20.8%, .4.4%, 5.5%, and 2.1%; the first three differences are also at least statistically significant at the .05 level. In the last interval, however, the Hispanic children revert back to slower growth by around 7.6%.

Between the two groups of Hispanic children, those from native families have an early lead over those from immigrant families. This gap, however, shrinks as the latter experience relatively faster growth. While children of natives have both a .17 ($p<.01$) units higher initial score and a 5% faster growth in the first interval, children of immigrants consistently have faster growth in the rest of the studied period; their faster growth ranges between 1.4% and 10.5%, and are statistically significant in the second and third intervals. This trend can also be seen in figure 12, as the dashed line representing children of children starts lower but gradually converges with the solid line representing children of natives.

In the last section, Asian children of natives are first compared to White children of natives in the top two rows. None of the differences are statistically significant (at .05), potentially because of the smaller group size and larger standard errors. Judging from the ratios, the Asian children do slightly perform better with a marginally higher intercept and considerably faster growth in the first (close to 40% faster) and the last (17.2% faster) intervals, but there are also smaller negative differences between the third and the fifth intervals.

The differences between Asian children of immigrants and White children of natives are more often statistically significant. Their intercepts are comparable, but the Asian children demonstrate faster growth prior to first grade; their growth is 62% faster ($p<.05$) in the first interval and 10.3% faster ($p<.01$) in the second. Immediately following this, however, is slower growth in the third (9.8% slower; $p<.001$) and fourth (19.5% slower; $p<.001$) intervals. In the last interval, the Asian children again have faster reading growth at 19.5% ($p<.01$).

Comparisons between the two groups Asian children may also be impacted by the large standard errors associated with children of natives. According to the ratios, their differences are sizable in the early four intervals—children of immigrants grow 17.1% faster in the first and 9.6% faster in the second, only

to become 9.6% slower in both the third and fourth intervals. Nevertheless, only the difference in the third interval registers a borderline level of statistical significance ($p<.05$). According to predicted trends shown in figure 12, children of immigrants (the dashed line) do accumulate moderately greater reading growth over time.

While they are not the primary focus, the random effect estimates reported in the notes of table 10 suggest two things. First, the correlation at -.753 suggests that overall, children who have high initial reading scores tend to grow slower than children who have low initial reading scores. This indicates a narrowing rather than widening trend overall. Furthermore, the variance of the intercept at .1444 suggests that the overall standard deviation at the intercept is its square root at .38. This provides a basis to assess the sizes of differences in the intercepts. When compared to White children of natives, the largest initial deficits are found for Black children of natives (-.298) and Hispanic children of immigrants (-.3107). The sizes of the deficits for both are considerable, at approximately four-fifths of the standard deviation.[20]

To sum, the results lend varying degrees of support to the notion of an immigrant advantage in early years of schooling. Strong evidence of a slower start and faster growth pattern is found among Hispanic children of immigrants. These children have low initial reading scores but faster growth than either their same race peers or White children of native. The faster growth is particular salient between the end of kindergarten and third grade.

There is also suggestive evidence indicating faster growth among the Black and Asian children of immigrants, particularly over their same race peers. Even though they do not trend positively relative to White children of natives, Black children of immigrants enjoy a sizable initial lead and relatively faster growth over Black children of natives. A cautionary note is that large standard errors made determining statistical significance for these advantages difficult.

[20] The intraclass correlation (icc) of random slope models can not reach the simple interpretation available in random intercept modes. Still, the much greater variance at the intercept (.1444) relative to the residual variance (.0392) suggest that considerable variation in reading scores over time is captured by modeling child-level trajectories.

Overall, the growth rates of Asian children of immigrants alter between faster and slower relative to both White children as well as Asian children of natives. While no clear pattern can be asserted from their potentially offsetting patterns, the predicted trajectories in figure 12 shows a small immigrant advantage for Asian children.

[Table 11 and figure 13 about here]

Table 11 and figure 13 present the same set of estimates using model 2. The most important finding from adding the demographic traits and family resources as statistical control is the lack of major changes in the estimates. A simple "eyeballed" comparison between figures 12 and 13 reveals little differences despite substantial disparities in parental education and family income between groups. The most discernible contrast appears at the intercept in the panel for Black children. For the Black children, the starting point for children of natives (solid line) is not as low relative to the starting point of children of immigrants (dashed line) under model 2. In contrast, remaining parts of the trajectories appears largely the same between the two figures.

Predicted trajectories for Hispanic and Asian children suggest that children of immigrants may have better relative growth after including statistical control. While the two trajectories of Hispanic children gradually converge under model 1, figure 13 now shows those with immigrant parents outperforming those with native parents in the last two legs. For the Asian children, the slight lead enjoyed by children of immigrants in figure 12 has expanded moderately with the addition of demographic traits and family resources in figure 13.

These observations are supported by the numeric estimates. An overview of all pairwise comparisons in tables 10 and 11 suggests that changes under model 2 are most salient at the intercept and the first interval. Changes at the intercept relative to White children of natives are most notable for three groups: Black children of natives (a .1289 increase), Hispanic children of natives (a .0567 increase), and Hispanic children of immigrants (a .1156 increase). In addition, the relative difference between the two

groups of Asian children has also shrunk by a somewhat noticeable .0602. Beyond the first two columns, however, none of the changes in the ratios from table 10 to table 11 exceed 1%. Furthermore, additional statistical controls are associated with notable differences in early parts of the trajectories of Hispanic and Asian children.

The stable pattern found in results under model 2 indicates that demographic and resource disparities in early childhood likely have little impact on the early reading trajectories beyond the first two years. Even in cases where the intercepts are substantially altered, the subsequent growth rate differences remain largely the same.

5.4. Math trajectories by parental nativity and race

[Table 12 about here]

We now consider the math growth curve estimates using model 1. The results, presented in table 12, are arranged similarly to tables 10 and 11. Two points can be concluded from the random effects parameters in the notes of table 12. The variance of the intercept at .1021 indicates that the baseline standard deviation is the square root at .348; this value serves as a reference to assess the sizes of group differences in baseline values. Similar to results from the reading scores, the negative correlation between the intercept and the slope at -.365 indicates that higher initial math scores are correlated with slower growth. While this represents a converging pattern across the children, the values suggest that the association is weaker than that in models predicting reading trajectories. Put different, the patterns of math growth appears to include greater individual variation than the patterns of reading growth.

For the fixed effect, the first two rows show White children of immigrants overcoming a minor early deficit relative to White children of natives. The children of immigrants have a lower intercept as well as slower growth in the first interval. The differences become negligible in the next two intervals.

Faster growth for the children of immigrants then emerges during the third grade and fifth grade intervals; their growth rates are 8.4% and 11.1% faster respectively; both values are statistically significant.

[Figure 14 about here]

Predicted trajectories in figure 14 visually support these findings. The dashed line in the figure representing White children of immigrants begins at a lower position than the solid line indicating White children of natives. Over time, however, these two lines converge amidst their upward growth.

For the Black children, those with native parents have substantially lower initial math scores than White children with native parents. The magnitude of the initial difference at .411 is greater than the standard deviation of the intercept of the random effects at .348, With regard to the growth rates, Black children of natives have sizable and statistically significant slower growth between spring kindergarten (4.6%; $p<.01$) and spring third grade (11.6%; $p<.001$); the faster growth found before fall kindergarten (58.7% faster but $p>.05$) only lasts for several month and is insufficient to offset the later disadvantages.

The differences between Black children of immigrants and White children of natives are less pronounced. While still sizable, the initial deficit at -.292 is not as large as it is for Black children of natives. The subsequent differences in growth rate are also small in magnitude, and alternate between positive and negative signs. Black children of immigrants have slower growth during the first interval (18.1% slower but $p>.05$), and faster growth during the fourth interval (17.2% faster and $p<.01$).

Three patterns are apparent in the comparison between the two groups of Black children. First, children of immigrants have a moderate lead of .119 in the initial math scores over children of natives. Next, the immigrants' children encounter some stretches of slower growth early in the trajectory: they are 48.4% slower in the first interval and 3.5% slower in the third interval. Third, the relative acceleration for children of immigrants in the last three intervals is substantial: their growth rate is 22.8% faster in the fourth interval, 11.7% faster in the fifth, and 9.4% faster in the sixth. The combined effects of the positive and negative results are plotted in the predicted trajectories in figure 14. The line representing children of

immigrants start off somewhat higher, move closer to the line representing children of natives up to around the 30 month point, and then pull away with much faster growth afterwards. Despite inconsistent at times, Black children of immigrants start with an advantage that they subsequently maintain and build on.

For Hispanic children, those with native parents and those with immigrant parents fare similarly in their respective comparison to White children of native parents. While the magnitude is greater for the immigrants' children, both Hispanic groups have lower initial math scores ($p<.001$ for both) and slower growth in the first interval (not significant). Again for both groups, the growth is faster in the next three intervals between fall kindergarten and spring third grade, but diminishes in the subsequent intervals. In the last interval, the growth rates are both approximately six or seven percent slower.

Comparisons between the two Hispanic groups suggest that those with immigrant parents have lower initial math scores (.28 units lower and $p<.001$) as well as slower growth in the first interval (3% slower) than children of natives. The relation is reversed in all of the subsequent intervals, during which children of immigrants grow 2.4%, 15.2% (and $p<.001$), 4%, 4.4%, and 1.3% faster. Still, as the predicted trajectories in figure 14 shows, these stretches of late acceleration are insufficient to offset the early deficit. In the graph for Hispanic children, the dashed line remains consistently below the solid line.

Asian children of natives mostly have more favorable math growth patterns compared to White children of natives. Nevertheless, all of these differences are not statistical significant. Asian children of natives do have a small deficit at the intercept (-.05 and $p>.05$) and 12% slower growth in the second interval, but the growth rates are faster in all other intervals, with differences ranging between .7% and 125.4%.

Asian children with immigrant parents also have favorable overall math growth patterns compared to White children with native parents. In addition to a small lead at the intercept, the Asian children have faster growth in four of the six intervals, and the differences in three of the four are statistically significant, with ratios ranging from 5.5% to 19.4%.

The immigrant advantage revealed from comparisons between the two groups of Asian children is minor and tentative. Immigrants' children enjoy a .105 lead over natives' children at the intercepts. Predicted trajectories are more useful to assess the subsequent differences since the growth rates differences fluctuate between positive and negative values. As figure 14 shows, children of immigrants enjoy a small initial lead, but the two lines soon converge and overlap for much of the projected period. Children of immigrants only begin retaking the lead during the last leg in their trajectories.

[Table 13 and figure 15 about here]

Table 13 and figure 15 present, respectively, the estimates and trajectories from using model 2 to predict the math scores. Similar to the analysis of reading scores, the addition of demographic traits and family resources overall does not alter most of the previous conclusions. An "eyeballed" comparison suggests virtually identical patterns between figure 14 and figure 15 in the two panels for White children and for Asian children. The major difference for the Black children appears to a more narrowed baseline difference. The most noticeable change occurs among the Hispanic children. The trajectory of Hispanic children of immigrants is less removed from the trajectory of Hispanic children of natives in figure 15.

Numeric results in table 13 support these visual observations. First, all differences that register statistical significance at the .05 level lead to identical conclusions between table 12 and table 13. Their signs are all the same, and the absolute sizes of the growth rate differences do not differ by more than 1.6%.[21]

Second, the most substantial numeric changes occur at the intercepts. The sizes of the intercept differences in table 13 are mostly reduced for Black and Hispanic children, and increased for Asian children. To quantify, eight of the ten intercept differences in table 13 reflect changes of 30% or more relative to their corresponding values in table 12.

[21] This percentage is calculated by subtracting estimates in table 12 from estimates in table 13, and then dividing these differences over the estimates in table 12.

Lastly, we consider in more detail how academic trajectories of Black and Hispanic children differ once demographic traits and family resources are controlled for. The initial math difference between Black children of immigrants and Black children of natives dropped from a moderate .119 in table 12 to an inconsequential .006 in table 13. Furthermore, the ratio in the first interval changed from -48.4% to 7.9%. The subsequent differences, however, all reflect inconsequential changes within less than 1%. This suggests that accounting for basic background factors primarily alters the early math disparity, but not the subsequent growth trends. The change in the comparison between two groups Hispanic children is also confined to earlier disparities. Additional control variables reduced the initial disadvantage of children of immigrants from -.28 to -.16. In the subsequent growth rate comparisons, however, none of the changes in ratios exceed 3%. Judging from the predicted trajectories, the addition of control variables appear to mostly move the predict trajectories of Black and Hispanic children vertically without altering much of their shape.

To sum, the growth curve analysis of the math scores finds favorable results for White, Black, and Hispanic children of immigrants. Among the White children, those with immigrant parents have a moderately slower start and also moderately faster growth in math performance. This contrasts with the analysis on reading trajectories, which reveals no differences between the two groups of White children.

Among Black children, having immigrant parents is associated with better initial math scores as well as faster growth in middle to late childhood. Much of the initial advantage can be accounted for by the more advantageous family resources of Black immigrants. Nevertheless, this statistical control does not take away their advantage in later stages of the studied period. It should also be note that Black children of natives demonstrate relatively slower growth compared to White children of natives, whereas Black children of immigrants fare comparably to if not better relative to the same reference group.

The relative math trajectories of both groups of Hispanic children follow patterns of slower start and faster growth; the curvature of the trajectories is more pronounced for children of immigrants. When compared to White children of natives, Hispanic children of natives demonstrate a moderately lower math

starting point as well as somewhat faster growth; Hispanic children of immigrants have the largest initial math deficit, but their faster growth are also more consistent and at a higher rate.

5.5. Summary

Growth curve models offer a more technically rigorous modeling approach for examining academic trajectories as well as a substantially useful tool to directly compare the growth rates of different groups. Using a spline specification, the growth curve analysis in this chapter yields findings suggesting slower start and faster growth for children of immigrants in varying forms and degrees. In spite of their notably unfavorable initial performance on the both reading and math scores, Hispanic children of immigrants most consistently have faster growth rates and can catch up to their same race peers of native parents by eighth grade. Comparisons that involve Black children and Asian children are complicated by large standard errors stemming from their small group sizes. Still, there is suggestive evidence of faster academic growth among those with immigrant parents.

The analysis also demonstrates how demographic traits and family resources account for some initial academic disparities between children of immigrants and children of natives. As findings in chapter four also demonstrate, subsequent trends do not seem to be altered much by these statistical controls. While scholars widely accepts family resources as important determinants in educational disparity, the findings in these two chapters suggest that the effects may be most concentrated at achievement gaps prior to formal schooling rather than at the subsequent growth trajectories.

6. Conclusion

6.1. Research findings

Interests in the education of children of immigrants have a long history in the United States. For much of the twentieth century, leading scholars time after time voiced concerns over the risk of growing up in immigrant families where the resource was scarce, the parents had little schooling, and the customs were foreign. Reaching parity with their peers was viewed as possible for immigrants' children, but only at the cost of completely forgoing markers of ethnicity and fully assimilating to the mainstream culture. Changes began in the last three or four decades, as research started revealing the exceptional educational strength children of immigrants. The shift from presenting the immigrant background as a liability to as an asset has been rapid and widely embraced in contemporary mainstream narratives.

Yet this new understanding suffers from an age bias that depends heavily on research of children in middle school, high school, or beyond. Studies on younger children of immigrants remain both limited in volume and in disagreement over the patterns of early academic disparities. As a result, we still cannot ascertain at what stage the academic advantage emerges. This in turn limits the endeavor to explain the advantage, and hence perpetuating the debate between theories that highlight the social and development specificities of adolescence, and others insensitive to age.

Meanwhile, the last two decades have witnessed a confluence of new scholarly interests on the education and skill growth of young children. These works have different agenda: some are tracing the roots of educational inequality to disparities during early childhood (Entwisle and Alexander 1993; Entwisle, Alexander and Olson 2005, 2007; Kerckhoff 1993). Some conclude the early years are the optimal time to make the most cost-effective educational investment (Doyle et al. 2009; Heckman and Masterov 2007). And some others focus on the efficacy of early interventions for underprivileged children (Reynolds, Ou, and Topitzes 2004; Temple, Reynolds, and Miedel 2000). What these strands of research share in common is an interest in how early academic growth differs between subpopulations. Children of immigrants, however, have not been a major focus in this discussion.

Conclusion

This study examines the early academic growth of children of immigrants. I asked how the academic trajectory of children of immigrants differs from that of children of natives. Previous studies on this issue have reported conflicting findings. To obtain a reliable and complete picture, I examine the best available, nationally representative data in the ECLS-K and focus on the longitudinal patterns. I apply two different modeling approaches, with additional sensitivity checks to examine the early reading and math trajectories from kindergarten to eighth grade. The results suggest the following.

Slower start and faster growth

While most academic trajectories are stable relative to one another over time, the academic trajectory of children of immigrants (relative to that of children of natives) follows an uncommon pattern of slower start and faster growth. At the beginning of formal schooling, they have lower reading and math scores relative to children of natives. The deficits then narrow over time as children of immigrants have faster academic growth in the elementary grades. By eighth grade when the last wave of data was collected, the baseline reading or math performance of children of immigrants may not have reached parity with children of natives. Still, in analyses that control the demographic and family differences, the former have outpaced the latter on reading and math scores at the end of the studied period.

Even though results disagree over how academic disparity by parental nativity look likes in eighth grade, the findings overall agree on a trajectory of lower initial performance and faster growth for children of immigrants. It stipulates that children of immigrants do not achieve stronger academic performance until a few years into their formal schooling. This conclusion has important theoretical implication. In chapter two, I have discussed the competing views between explanations focusing on children's own achievement drive and theories that highlight immigrant parents' strength in skill cultivation. The analysis has found no evidence suggesting immigrant parents are successful in directly cultivating the children's cognitive skills at a young age. It is far more plausible that immigrant families and communities promote characteristics that have little immediate return when children first enter school, but in the long run keep the children motivated and ensure lasting academic gains.

Segmented patterns by race

Breaking down the trajectories by race reveals segmented patterns. The most salient finding is the initial disadvantage and faster growth of Hispanic children with immigrant parents. All analyses find them to have an initial deficit relative to White or Hispanic children of natives. The cross-sectional analysis shows the deficit to narrow over time, and, to the same effect, the growth curve models suggest that Hispanic children of immigrants have faster growth rates. A sizable part of the deficits in the baseline models can be attributed to the lack of resources in the families of Hispanic immigrants.

The other more noticeable pattern is the widening disparity between Black children of different parental nativity. For these children, the immigrant families often have more family resources than native families. Likely as a result, children from the former have better initial academic performance than children from the latter. Over early years of schooling, the academic gap between the two groups of Black children expands. In addition, the academic performance of Black children of immigrants is similar or close to White children of natives. Compared to the same reference group, however, Black children of immigrants have statistically significantly slower growth on both reading and math performance, even when their disadvantage in family resources is controlled for.

Findings for White and Asian children are less conclusive. Point estimates for White children of immigrants suggest they have lower initial achievement and faster academic growth when compared to White children of natives. Nevertheless, the magnitudes of these disparities are small and within sampling errors. For the Asian children, results from applying the achievement gap approaches indicate neutral or slightly negative trends for those who have immigrant parents. The growth curve analysis, however, finds minor positive trends associated with the immigrant background. Again, these findings pertaining to Asian children are both limited in size and inconsistent in the Student's *t* test results of the coefficients.

Limitation of demographic traits and family resources

Another unexpected finding is how statistically controlling for demographic traits and family resources changes the initial disparities, but not the subsequent differences. This is most obvious in the growth curve analysis, where statistical controls reduces the distances between the starting points of trajectories notably, but brings little additional changes to the differences in growth rates. This finding entails that differences in how academic growth develops by parental nativity and race are largely independent of the children's demographic traits or the resources their family can offer.

6.2. Implications

The results from examining how early academic trajectories differ by parental nativity and race have the following implications.

Meaning and scope of the "immigrant advantage"

The results call for reassessing the meaning and the scope of the asserted immigrant advantage in education. The academic strength of children of immigrants has often been presented as a static attribute. A close look at the analysis in many studies suggests that the found advantages are snapshots at particular times or short periods in children's academic trajectory. What is problematic with this approach is that, results from early-stage assessment can be inconsistent depending on children's age and model specification.

A longitudinal perspective that traces academic trajectories over longer periods offers an alternative research approach that assesses trends rather than specific time points. Hao and Woo (2012) have demonstrated the faster growth of children of immigrants in their transition into adulthood, and this dissertation finds the same pattern beginning when they enter formal schooling. These findings suggest the immigrant advantage may be better understood as positively trending academic development rather than a static advantage.

The descriptive finding in this study also has major theoretical implications for highlighting the need to consider the social and development contexts in children's academic growth. First of all, the

findings of a slower start and faster growth suggest that immigrant families and communities are not advantageous in cultivating strong cognitive skills. At the very least, there is no evidence of such strength prior to formal schooling. The systematic findings in this study offers little support to tales of successful intensive parenting in immigrant families.

Next, for theories that focus on the academic drive of children of immigrants, the results call for greater attention to the age context in which the causal mechanisms occur. Established theories maintain that immigrants may indeed impart specific attributes to the children (Kao and Tienda 1995; Kao 2004), or arrange conditions that shield children from negative influences (Portes and Zhou 1993; Zhou and Bankston 1998). While these theories offer sensible explanations, they often do not place the specific mechanisms or processes in the corresponding social or development context.

One example that explicitly establishes how an immigrant background contributes to academic strength in the context of adolescence can be found in Gibson's (1988) study of a Sikh community in California. Gibson explicitly contrasted Sikh adolescents who are encouraged to focus exclusively on learning, and the local White high schoolers whose families value extracurricular activities or immediate employment. In addition to identifying distinct traits and processes associated with the immigrant background, this study takes the additional step to explain how the traits and processes work together to generate academic strengths at a specific age (and in a localized context).

Moreover, the findings conclusively support an immigrant advantage for Black or Hispanic children, but not for White or Asian children. In the former two groups, children of immigrants have definite faster growth. In the latter two groups, however, the academic trajectories of children of immigrants do not consistently differ from their same race peers. This entails that the “immigrant advantage” might be limited in scope, or as Portes and his colleagues (Portes and Zhou 1993; Zhou 1997; Portes and Rumbaut 2001) argue, segmented by race. The faster academic growth of Black and Hispanic children of immigrants also suggest that being dark skin children of immigrants in the United States may not carry the same level of disadvantages illustrated in the "second-generation decline" scenario (Gans 1992).

Disparities do not always persist

Educational research on achievement gaps and academic trajectories suggests disparities along socioeconomic, racial, and gender divides tend to persist over time. The existing literature also identifies both intrinsic and extrinsic mechanisms that contribute to enduring intragenerational educational inequality. While some studies have found individuals with growth patterns that deviate from the norm of persistent disparities, they are a small minority and have not been found to represent any major social or demographic group.

For this scholarship, this study has identified a sizable child population featuring the latter, distinct growth trajectory. The consistently faster academic growth found for the average child of immigrants suggest that their early academic disadvantage is unlikely to persist. Analysis at the racial group level suggests that this trend is most pronounced for Hispanic children, who constitute the largest group among children of immigrants. What accounts for these results requires additional research, but the salience of the finding suggests that longitudinal patterns in academic trajectories can be more diverse than what the current literature indicates.

Intersection between race and parental nativity

Lastly, the results present strong evidence of parental nativity intersecting with race in the context of early academic growth. What drives the noticeably faster academic growth among Black and Hispanic children of immigrants, but not their Asian and White counterparts, is an important question in need of more empirical research. Furthermore, the difference between the converging trends of Hispanic children and the diverging trajectories of Black children may require separate explanations.

The segmented assimilation framework is critically related to the first question (Portes and Zhou 1993; Zhou 1997). This theory posits that children of dark skin immigrants are at particular risk of "downward assimilation", a scenario in which racialization causes the children to identify with their same-race native peers, adopt the latter's aspiration, and only to become disillusioned and demoralized.

Some immigrant groups, however, use the strategy of "ethnic retention" to form boundaries based on ethnic identity and maintain a strong motivational drive. More research is needed to examine whether this theory may explain the racial disparity found in the results of this study.

6.3. Limitations

Estimates of early academic trajectories in this dissertation strive for rigorous analysis. Using the best available data, the analysis applied two modeling approaches to cross-examine the results. The reading and math gap approach allows for additional sensitivity analysis to confirm the robustness of the findings. The growth curve approach directly incorporates individual trajectories in its statistical modeling. These steps are taken to ensure the estimates are reliable and permit statistical inferences at the population level.

There are, however, several limitations to the findings. Most obviously, the small sample sizes of Black children of natives and Asian children of immigrants tend to inflate standard errors and produce conservative estimates. These conservative estimates can conceal valid differences between academic trajectories. Substantively, the issue may be part of the reason for inconsistencies and lack of statistical significance in analysis that involve these two groups.

Furthermore, the limited sample size precludes sub-group analysis based on parents' nation of origins. The analysis has confound more sophisticated ethnic heterogeneity and rely on the broad classification scheme of White, Black, Hispanic, and Asian.[22] We cannot examine the supposedly important differences in academic trajectories between, say, children with Lao parents and children with Japanese parents.

In addition, the statistical control variables used for family resources have captured major variations in socioeconomic differences but may have overlooked other forms of resources. For example, the English proficiency of the parents may drive differences in how well the children are prepared for

[22] The only group that has sufficient observations in both the native and the immigrant groups are those with Mexican origins. Reardon and Galindo (2009) have already compared the trajectories between first, second, and third generation Mexicans.

schooling. Unfortunately, the ECLS-K does not provide more sophisticated measures beyond whether the parents speak English or not (analysis incorporating this binary variable does not alter the conclusions).

6.4. Recommendation for future research

Based on these findings, I argue that additional research on early academic trajectories of children of natives and children of immigrants can help advance knowledge in various bodies of literatures. For immigration research, this life course perspective offers a dynamic alternative to the current more static approach in studying immigrants' adaptation. For the areas of education and social stratification, the findings of the slower start and faster growth present opportunities to explore factors that may help children overcome initial academic setbacks.

Some more research on the descriptive aspects of the early academic trajectories is needed. In particular, data with larger samples of the subgroups should be collected so trajectories with smaller sampling errors can be estimated and the differences in origins within the racial groups can be examined. In the two samples used in this study, the numbers of Black children of immigrants and the numbers of Asian children of natives never exceed 70. Even the number of White children of immigrants and Asian children of immigrants are relative limited (between 180 and 190 for the former, and 226 or 227 for the latter) for additional sub-group analysis.

There are also explanatory questions to address. What may, other than the demographic traits and early family resources, account for the disparities between the trajectories of different groups? Following from the literature review, I recommend future research to investigate factors along three aspects. First, family influences other than parental education, early family income, or early family structure should be studied. For example, the popular narrative that immigrant parents are more actively invested in child development demands a systemic analysis on how they practice different forms of parental involvement. At a minimum, descriptive comparisons of child development practices in early childhood should be provided. Alternatively, immigrants' faster growth in earnings (Chiswick 1979) may also potentially

account for the children's faster academic growth trajectories; this conjecture can be tested by including time-varying measures of income in growth curve models.

Second, child characteristics likely mediate the link between immigrant families and academic achievement. While the temporal patterns predicted in the achievement drive hypothesis are supported in this dissertation, more direct evidence is needed to substantiate the thesis that immigrants' children are more attitudinally and behavioral disposed to academic success. Measures of attitudinal and behavioral advantages may come from children' self-reported views regarding education—educational expectation is a strong predictor of educational performance for older children. Alternatively, external assessment of children's actions, beliefs, and skills are reasonable measurement of achievement drive.

Third, contextual factors need to be examined. While school and neighborhood context tends to be unfavorable for immigrants' older children (Hao and Pong 2008; Pong and Hao 2007), the effects on young children have not been studied. Future research should investigate whether differences in academic trajectories between children of natives and children of immigrants widen or narrow when accounting for schools or neighborhoods in the statistical modeling.

Table 1. Summary statistics for the sample selection

Selection criterion	(a) Full Sample (N=21,409)		(b) Parental nativity and race (N=14,400)		(c) Parental nativity, race, and reading scores (N=6,311)		(d) Parental nativity, race, and math scores (N=6.745)	
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
Child age (in months)	75.022	4.396	75.125	4.283	75.122	4.129	75.049	4.143
Female	0.488	0.500	0.489	0.500	0.504	0.500	0.501	0.500
Race								
White	0.552	0.497	0.632	0.482	0.723	0.448	0.683	0.466
Black	0.151	0.358	0.136	0.343	0.104	0.305	0.100	0.300
Hispanic	0.179	0.383	0.176	0.381	0.127	0.333	0.174	0.380
Asian	0.064	0.245	0.056	0.230	0.046	0.209	0.043	0.203
Immigrant parents	0.182	0.386	0.181	0.385	0.122	0.327	0.167	0.373
Family income (thousands of dollars)	52.040	56.399	55.731	58.858	62.619	56.729	60.024	55.920
Parental education (in years)	13.887	3.035	14.088	3.044	14.648	2.746	14.367	3.044
Number of siblings	1.479	1.183	1.466	1.139	1.440	1.053	1.459	1.073
Family type								
Two-biological parent	0.660	0.474	0.703	0.457	0.762	0.426	0.761	0.426
Single-parent	0.214	0.410	0.186	0.389	0.149	0.356	0.150	0.357
Other family types	0.127	0.333	0.110	0.313	0.089	0.285	0.089	0.285
Initial reading score	-1.299	0.515	-1.253	0.509	-1.202	0.497	-1.207	0.498

(a) includes the full sample of the ECLS-K.
(b) removes from (a) children with unidentifiable parental nativity, or whose designated race is not White, Black, Hispanic, or Asian.
(c) removes from (b) children missing either month of assessment or reading scores in one of the six full-sample waves.
(d) removes (c) children missing either month of assessment or math scores in one of the six full-sample waves.

Table 2. Summary statistics on selective variables for the math score-based sample (N=6,745)

		White		Black		Hispanic		Asian	
		Native	Immigrant	Native	Immigrant	Native	Immigrant	Native	Immigrant
Age (in months)	Mean	63.351	63.075	62.764	60.936	63.010	61.957	62.127	61.938
	SD	4.183	3.888	4.001	3.802	4.126	4.000	3.871	3.606
Female	Mean	0.500	0.495	0.493	0.511	0.504	0.501	0.508	0.551
	SD	0.500	0.501	0.500	0.505	0.500	0.500	0.504	0.499
Number of siblings	Mean	1.430	1.441	1.552	1.638	1.441	1.655	1.286	1.339
	SD	1.012	1.075	1.325	1.293	1.052	1.186	0.851	1.169
Family type									
Two-biological parent	Mean	0.812	0.849	0.349	0.596	0.691	0.773	0.667	0.916
	SD	0.391	0.359	0.477	0.496	0.463	0.419	0.475	0.278
Single-parent	Mean	0.105	0.113	0.485	0.362	0.189	0.154	0.079	0.070
	SD	0.306	0.317	0.500	0.486	0.392	0.361	0.272	0.257
Other family types	Mean	0.084	0.038	0.166	0.043	0.120	0.073	0.254	0.013
	SD	0.277	0.191	0.372	0.204	0.325	0.261	0.439	0.114
Family income (in $1,000)	Mean	69.102	72.481	28.944	38.334	48.981	29.610	73.051	68.396
	SD	59.384	66.684	27.375	26.651	40.043	28.567	35.925	64.864
Parental education (in years)	Mean	15.007	15.567	13.041	13.660	13.641	10.959	16.198	15.174
	SD	2.547	2.763	2.127	3.093	2.442	4.275	2.494	3.502
N		4,418	186	627	47	508	669	63	227

(table 2 continued)

		White		Black		Hispanic		Asian	
		Native	Immigrant	Native	Immigrant	Native	Immigrant	Native	Immigrant
First generation	Count	0	14	0	7	0	78	0	15
Mixed immigrant family	Count	0	86	0	4	0	62	0	15
Young summer birth	Mean	0.215	0.129	0.276	0.234	0.250	0.256	0.333	0.220
	SD	0.411	0.336	0.447	0.428	0.433	0.437	0.475	0.415
Old winter birth	Mean	0.179	0.145	0.167	0.106	0.177	0.123	0.095	0.084
	SD	0.384	0.353	0.374	0.312	0.382	0.328	0.296	0.278
N		4,418	186	627	47	508	669	63	227

All variables are based on the two kindergarten waves of survey with the exception of mixed immigrant family, which uses information from the first grade, third grade, and fifth grade surveys. Missing information on family type, number of siblings, family income and parental education from the kindergarten surveys is supplemented with information from the first grade survey; this use of first grade information does not exceed 142 cases for any of these variables.

Table 3. Summary statistics on math Theta scores for the math score-based sample (N=6,745)

		White		Black		Hispanic		Asian	
		Native	Immigrant	Native	Immigrant	Native	Immigrant	Native	Immigrant
Fall 1998	Mean	-0.971	-1.002	-1.335	-1.257	-1.182	-1.480	-0.899	-0.918
(Kindergarten)	SD	0.431	0.418	0.415	0.456	0.428	0.434	0.449	0.494
	N	4418	186	627	47	508	669	63	227
Spring 1999	Mean	-0.500	-0.523	-0.864	-0.793	-0.665	-0.945	-0.476	-0.441
(Kindergarten)	SD	0.401	0.409	0.422	0.505	0.392	0.443	0.373	0.444
	N	4418	186	627	47	508	669	63	227
Fall 1999	Mean	-0.246	-0.358	-0.595	-0.452	-0.421	-0.673	-0.368	-0.153
(First grade)	SD	0.404	0.397	0.432	0.449	0.387	0.439	0.359	0.396
	N	1329	65	187	16	150	206	12	59
Spring 2000	Mean	0.209	0.181	-0.132	-0.088	0.064	-0.102	0.235	0.227
(First grade)	SD	0.361	0.347	0.399	0.371	0.348	0.396	0.331	0.369
	N	4418	186	627	47	508	669	63	227
Spring 2002	Mean	0.859	0.882	0.486	0.677	0.722	0.580	0.933	0.912
(Third grade)	SD	0.342	0.330	0.352	0.403	0.347	0.357	0.359	0.375
	N	4418	186	627	47	508	669	63	227
Spring 2004	Mean	1.249	1.315	0.832	1.054	1.109	0.984	1.371	1.377
(Fifth grade)	SD	0.358	0.345	0.382	0.423	0.360	0.376	0.373	0.394
	N	4418	186	627	47	508	669	63	227
Spring 2007	Mean	1.584	1.652	1.145	1.398	1.419	1.298	1.743	1.765
(Eighth grade)	SD	0.398	0.390	0.385	0.497	0.405	0.424	0.419	0.436
	N	4418	186	627	47	508	669	63	227

Table 4. Reading and math gaps by parental nativity

	Reading (N=6,311)		Math (N=6,745)	
	Model 1	Model 2	Model 1	Model 2
Fall Kindergarten	-0.115**	-0.036	-0.306***	-0.139***
	(0.043)	(0.035)	(0.031)	(0.026)
Spring Kindergarten	-0.023	0.043	-0.261***	-0.107***
	(0.039)	(0.032)	(0.030)	(0.027)
Spring First Grade	-0.019	0.032	-0.172***	-0.046*
	(0.028)	(0.023)	(0.024)	(0.022)
Spring Third Grade	-0.021	0.018	-0.132***	-0.009
	(0.022)	(0.016)	(0.025)	(0.020)
Spring Fifth Grade	-0.025	0.015	-0.085**	0.047
	(0.022)	(0.017)	(0.029)	(0.024)
Spring Eighth Grade	0.018	0.075***	-0.086**	0.070**
	(0.026)	(0.019)	(0.030)	(0.023)

*p<.050, **p<.010, ***p<.001; Standard errors in parentheses. Model 1 controls for first generation status, mixed immigrant family, month of assessment, younger summer birth, and older fall birth. Model 2 further includes female, age, parental education, family income, family types, and number of siblings.

Table 5. Cross-sectional reading gaps and other estimates (model 1)

	Fall kindergarten	Spring kindergarten	Spring first grade	Spring third grade	Spring fifth grade	Spring eighth grade
Reading score statistics						
Mean	-1.249	-0.676	0.177	0.834	1.082	1.332
Standard deviation	(0.497)	(0.476)	(0.420)	(0.294)	(0.282)	(0.373)
OLS estimates						
Grouping						
White/Immigrant	-0.030	0.023	-0.017	-0.021	-0.021	0.040
	(0.065)	(0.068)	(0.055)	(0.036)	(0.039)	(0.038)
Black/Native	-0.258***	-0.265***	-0.225***	-0.235***	-0.249***	-0.361***
	(0.041)	(0.040)	(0.034)	(0.029)	(0.026)	(0.033)
Black/Immigrant	-0.077	0.011	-0.077	-0.062	-0.141**	-0.123
	(0.114)	(0.122)	(0.073)	(0.047)	(0.047)	(0.082)
Hispanic/Native	-0.185***	-0.073	-0.092*	-0.091***	-0.093***	-0.143***
	(0.038)	(0.045)	(0.036)	(0.023)	(0.019)	(0.028)
Hispanic/Immigrant	-0.380***	-0.242***	-0.174***	-0.129***	-0.123***	-0.129***
	(0.043)	(0.042)	(0.035)	(0.022)	(0.023)	(0.026)
Asian/Native	0.237*	0.207**	0.200*	0.096	0.038	0.086
	(0.106)	(0.066)	(0.078)	(0.070)	(0.050)	(0.071)
Asian/Immigrant	0.150*	0.199**	0.151***	0.023	0.019	0.069
	(0.074)	(0.064)	(0.037)	(0.026)	(0.024)	(0.040)

(Table 5 continued)

First generation	-0.083	-0.146	-0.031	0.034	0.072	0.070
	(0.112)	(0.124)	(0.161)	(0.051)	(0.056)	(0.072)
Mixed status	0.085	0.030	0.051	0.084	0.046	0.023
	(0.054)	(0.050)	(0.055)	(0.047)	(0.059)	(0.045)
Young summer birth	-0.073**	-0.061**	-0.022	-0.006	-0.005	-0.013
	(0.023)	(0.023)	(0.024)	(0.016)	(0.015)	(0.017)
Old fall birth	0.151***	0.127***	0.131***	0.074***	0.048**	0.024
	(0.030)	(0.028)	(0.021)	(0.018)	(0.016)	(0.024)
Month of assessment	0.054*	0.001	0.036	-0.014	-0.004	-0.020
	(0.021)	(0.022)	(0.019)	(0.009)	(0.009)	(0.012)
Intercept	-1.268***	-0.639***	-0.493	1.478***	1.400*	3.476**
	(0.034)	(0.168)	(0.374)	(0.410)	(0.581)	(1.255)
R^2	0.097	0.076	0.069	0.107	0.118	0.141
F	16.195	13.635	15.437	12.189	12.294	16.458

*p<.050, **p<.010, ***p<.001; Standard errors in parentheses for all OLS estimates. N=6,311.

Table 6. Cross-sectional reading gaps and other estimates (model 2)

	Fall kindergarten	Spring kindergarten	Spring first grade	Spring third grade	Spring fifth grade	Spring eighth grade
Reading score statistics						
Mean	-1.137	-0.658	-0.084	0.743	1.124	1.439
Standard deviation	(0.467)	(0.455)	(0.399)	(0.385)	(0.409)	(0.451)
OLS estimates						
Grouping						
White/immigrant	-0.039	0.018	-0.018	-0.022	-0.021	0.034
	(0.061)	(0.062)	(0.052)	(0.032)	(0.036)	(0.034)
Black/native	-0.060	-0.088*	-0.081*	-0.122***	-0.144***	-0.223***
	(0.038)	(0.038)	(0.037)	(0.027	(0.024)	(0.027)
Black/immigrant	0.039	0.115	0.012	-0.005	-0.092*	-0.063
	(0.093)	(0.086)	(0.067)	(0.036)	(0.038)	(0.052)
Hispanic/native	-0.086*	0.011	-0.024	-0.037	-0.040*	-0.071**
	(0.035)	(0.044)	(0.035)	(0.022)	(0.017)	(0.026)
Hispanic/immigrant	-0.171***	-0.064	-0.034	-0.018	-0.014	0.025
	(0.040)	(0.042)	(0.032)	(0.020)	(0.020)	(0.023)
Asian/native	0.141	0.118*	0.132	0.042	-0.015	0.015
	(0.078)	(0.056)	(0.072)	(0.059)	(0.043)	(0.061)
Asian/immigrant	0.143*	0.189***	0.141***	0.011	0.008	0.053
	(0.060)	(0.055)	(0.032)	(0.019)	(0.021)	(0.032)

(Table 6 continued)

First generation	-0.118	-0.175	-0.050	0.015	0.048	0.039
	(0.090)	(0.095)	(0.136)	(0.034)	(0.038)	(0.044)
Mixed status	0.024	-0.027	0.001	0.043	0.006	-0.030
	(0.052)	(0.048)	(0.050)	(0.043)	(0.054)	(0.040)
Young summer birthday	-0.008	-0.016	0.012	-0.004	-0.014	-0.026
	(0.022)	(0.025)	(0.026)	(0.017)	(0.015)	(0.018)
Old winter birthday	0.049	0.052	0.071**	0.059**	0.049**	0.025
	(0.034)	(0.033)	(0.024)	(0.018)	(0.016)	(0.020)
Month of assessment	0.060***	0.008	0.025	-0.012	0.005	-0.004
	(0.017)	(0.018)	(0.018)	(0.008)	(0.007)	(0.011)
Female	0.120***	0.110***	0.093***	0.052***	0.035**	0.071***
	(0.020)	(0.019)	(0.020)	(0.012)	(0.012)	(0.015)
Child age	0.025***	0.019***	0.015***	0.005*	0.002	0.002
	(0.004)	(0.004)	(0.003)	(0.002)	(0.002)	(0.002)
Family income	0.001***	0.001***	0.000***	0.000***	0.000***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Parental education	0.054***	0.045***	0.036***	0.029***	0.030***	0.044***
	(0.004)	(0.004)	(0.004)	(0.002)	(0.002)	(0.003)

(Table 6 continued)

Family type						
Single parent	-0.107***	-0.116***	-0.118***	-0.085***	-0.065***	-0.076***
	(0.028)	(0.034)	(0.030)	(0.021)	(0.018)	(0.023)
Other family type	-0.092**	-0.072*	-0.058	-0.050*	-0.044*	-0.066*
	(0.029)	(0.032)	(0.033)	(0.023)	(0.020)	(0.026)
Number of sibling	-0.064***	-0.064***	-0.044***	-0.034***	-0.033***	-0.036***
	(0.009)	(0.011)	(0.011)	(0.007)	(0.006)	(0.006)
Intercept	-3.627***	-2.534***	-1.734***	0.644	0.272	1.014
	(0.249)	(0.304)	(0.428)	(0.390)	(0.480)	(1.107)
R^2	0.272	0.221	0.186	0.244	0.255	0.293
F	46.321	46.895	37.064	36.400	41.061	49.217

*p<.050, **p<.010, ***p<.001; Standard errors in parentheses for all OLS estimates. N=6,311.

Table 7. Cross-sectional math gaps and other estimates (model 1)

	Fall kindergarten	Spring kindergarten	Spring first grade	Spring third grade	Spring fifth grade	Spring eighth grade
Math score statistics						
Mean	-1.137	-0.658	-0.084	0.743	1.124	1.439
Standard deviation	(0.467)	(0.455)	(0.399)	(0.385)	(0.409)	(0.451)
OLS estimates						
Grouping						
White/Immigrant	-0.123**	-0.087	-0.089*	-0.020	0.045	0.019
	(0.046)	(0.053)	(0.038)	(0.036)	(0.046)	(0.043)
Black/Native	-0.343***	-0.365***	-0.314***	-0.359***	-0.420***	-0.459***
	(0.030)	(0.033)	(0.027)	(0.029)	(0.030)	(0.030)
Black/Immigrant	-0.249*	-0.261*	-0.269***	-0.107	-0.099	-0.105
	(0.104)	(0.107)	(0.052)	(0.092)	(0.110)	(0.123)
Hispanic/Native	-0.182***	-0.121***	-0.123***	-0.102***	-0.110***	-0.137***
	(0.034)	(0.033)	(0.025)	(0.027)	(0.029)	(0.033)
Hispanic/Immigrant	-0.513***	-0.446***	-0.302***	-0.283***	-0.261***	-0.278***
	(0.030)	(0.032)	(0.027)	(0.024)	(0.028)	(0.028)
Asian/Native	0.175	0.133	0.089	0.180*	0.195*	0.307*
	(0.096)	(0.092)	(0.079)	(0.091)	(0.083)	(0.120)
Asian/Immigrant	0.063	0.042	-0.001	0.025	0.117*	0.171*
	(0.053)	(0.061)	(0.051)	(0.050)	(0.053)	(0.069)

(Table 7 continued)

First generation	-0.034	-0.052	0.039	0.032	0.075	0.088
	(0.072)	(0.077)	(0.055)	(0.053)	(0.054)	(0.063)
Mixed status	0.187***	0.138**	0.127***	0.055	0.049	0.091
	(0.041)	(0.049)	(0.037)	(0.045)	(0.050)	(0.049)
Young summer birthdays	-0.089***	-0.091***	-0.050*	-0.033	-0.026	-0.024
	(0.021)	(0.019)	(0.020)	(0.020)	(0.019)	(0.020)
Old fall birthdays	0.165***	0.147***	0.107***	0.069**	0.035	0.033
	(0.028)	(0.026)	(0.019)	(0.023)	(0.023)	(0.029)
Month of assessment	0.021	-0.007	0.030	-0.013	0.020*	0.007
	(0.019)	(0.018)	(0.018)	(0.013)	(0.010)	(0.012)
Intercept	-1.053***	-0.495***	-0.424	1.377*	-0.131	0.796
	(0.029)	0.132)	(0.345)	(0.558)	(0.679)	(1.247)
R^2	0.196	0.182	0.135	0.153	0.165	0.164
F	35.379	30.015	25.698	21.187	27.168	30.448

*p<.050, **p<.010, ***p<.001; Standard errors in parentheses for all OLS estimates. N=6,745.

Table 8. Cross-sectional math gaps and other estimates (model 2)

	Fall kindergarten	Spring kindergarten	Spring first grade	Spring third grade	Spring fifth grade	Spring eighth grade
<u>Math score statistics</u>						
Mean	-1.137	-0.658	-0.084	0.743	1.124	1.439
Standard deviation	(0.467)	(0.455)	(0.399)	(0.385)	(0.409)	(0.451)
<u>OLS estimates</u>						
Grouping						
White/immigrant	-0.111**	-0.074	-0.076*	-0.009	0.054	0.029
	(0.042)	(0.051)	(0.036)	(0.032)	(0.039)	(0.042)
Black/native	-0.179***	-0.213***	-0.189***	-0.238***	-0.284***	-0.304***
	(0.027)	(0.029)	(0.028)	(0.027)	(0.028)	(0.027)
Black/immigrant	-0.146	-0.166*	-0.196***	-0.059	-0.055	-0.060
	(0.082)	(0.084)	(0.051)	(0.066)	(0.079)	(0.084)
Hispanic/native	-0.090**	-0.036	-0.052*	-0.032	-0.032	-0.047
	(0.028)	(0.030)	(0.023)	(0.024)	(0.026)	(0.030)
Hispanic/immigrant	-0.265***	-0.218***	-0.109***	-0.098***	-0.058*	-0.038
	(0.032)	(0.036)	(0.029)	(0.024)	(0.028)	(0.027)
Asian/native	0.112	0.073	0.041	0.143	0.158*	0.259*
	(0.071)	(0.076)	(0.065)	(0.080)	(0.070)	(0.108)
Asian/immigrant	0.074	0.055	0.009	0.032	0.112*	0.157*
	(0.042)	(0.053)	(0.043)	(0.042)	(0.046)	(0.061)

(Table 8 continued)

First generation	-0.078	-0.098	0.000	-0.008	0.032	0.048
	(0.061)	(0.066)	(0.047)	(0.044)	(0.044)	(0.052)
Mixed status	0.116**	0.071	0.066	-0.003	-0.015	0.010
	(0.037)	(0.048)	(0.034)	(0.041)	(0.044)	(0.048)
Young summer birthday	-0.001	-0.005	0.002	-0.011	-0.034	-0.050*
	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)
Old winter birthday	0.042	0.035	0.037	0.043	0.043	0.058*
	(0.028)	(0.027)	(0.021)	(0.024)	(0.024)	(0.029)
Month of assessment	0.025	0.002	0.020	-0.009	0.031***	0.025*
	(0.016)	(0.014)	(0.016)	(0.012)	(0.009)	(0.011)
Female	0.037*	0.010	-0.008	-0.073***	-0.081***	-0.041*
	(0.015)	(0.017)	(0.017)	(0.014)	(0.014)	(0.016)
Child age	0.028***	0.026***	0.016***	0.008**	0.001	-0.003
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Family income	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Parental education	0.041***	0.038***	0.034***	0.033***	0.037***	0.047***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)

(Table 8 continued)

Family type						
Single parent	-0.070**	-0.080**	-0.064**	-0.059*	-0.066**	-0.082**
	(0.023)	(0.025)	(0.024)	(0.025)	(0.022)	(0.026)
Other family type	-0.103***	-0.074*	-0.055*	-0.068*	-0.118***	-0.137***
	(0.029)	(0.029)	(0.026)	(0.028)	(0.026)	(0.028)
Number of sibling	-0.037***	-0.037***	-0.027***	-0.024***	-0.026***	-0.019*
	(0.008)	(0.009)	(0.008)	(0.006)	(0.007)	(0.008)
Intercept	-3.429***	-2.761***	-1.743***	0.279	-1.391*	-1.465
	(0.192)	(0.234)	(0.346)	(0.536)	(0.651)	(1.167)
R^2	0.340	0.310	0.241	0.261	0.290	0.297
F	59.342	59.532	46.299	41.346	58.552	59.751

*p<.050, **p<.010, ***p<.001; Standard errors in parentheses for all OLS estimates. N=6,745.

Table 9. Initial disparities and growth rate differences by parental nativity

Reading scores (37,866 observations nested within 6,311 children)

	Model 1					Model 2				
	Native	Immigrant	Difference		Ratio	Native	Immigrant	Difference		Ratio
Intercept	-1.1502	-1.4247	-0.2745	***		-2.5064	-2.6328	-0.1264	***	
Fall Kindergarten	0.0841	0.0869	0.0029		0.03	0.0685	0.0552	-0.0134		-0.19
Spring Kindergarten	0.0769	0.0816	0.0047	***	0.06	0.0769	0.0817	0.0047	***	0.06
Spring First Grade	0.0595	0.0650	0.0054	***	0.09	0.0595	0.0649	0.0054	***	0.09
Spring Third Grade	0.0273	0.0291	0.0018	***	0.07	0.0273	0.0291	0.0018	***	0.07
Spring Fifth Grade	0.0166	0.0181	0.0015	***	0.09	0.0166	0.0181	0.0015	***	0.09
Spring Eighth Grade	0.0092	0.0093	0.0001		0.01	0.0091	0.0093	0.0001		0.02

Math scores (40,470 observations nested within 6,745 children)

	Model 1					Model 2				
	Native	Immigrant	Difference		Ratio	Native	Immigrant	Difference		Ratio
Intercept	-1.3443	-1.4393	-0.0950	**		-2.2693	-2.3105	-0.0412		
Fall Kindergarten	0.1013	0.1151	0.0138		0.14	0.0879	0.0969	0.0090		0.10
Spring Kindergarten	0.0920	0.1027	0.0108	***	0.12	0.0919	0.1028	0.0109	***	0.12
Spring First Grade	0.0704	0.0692	-0.0012		-0.02	0.0704	0.0691	-0.0013		-0.02
Spring Third Grade	0.0276	0.0269	-0.0007		-0.03	0.0277	0.0269	-0.0007		-0.03
Spring Fifth Grade	0.0107	0.0106	-0.0001		-0.01	0.0107	0.0107	-0.0001		0.00
Spring Eighth Grade	0.0075	0.0083	0.0009	**	0.11	0.0075	0.0083	0.0009	**	0.11

*p<.050, **p<.010, ***p<.001. Model 1 controls for first generation, mixed immigrant family, young summer birth, and old fall birth. Model 2 further controls for age, gender, parental education, family income, family types, and number of siblings.

Table 10. Reading trajectory estimates and comparisons (model 1)

	Intercept	Fall kindergarten	Spring kindergarten	Spring first grade	Spring third grade	Spring fifth grade	Spring eighth grade
White							
WI	-1.2890***	0.0910***	0.0909***	0.0704***	0.0277***	0.0107***	0.0080***
	(0.0122)	(0.0064)	(0.0007)	(0.0004)	(0.0002)	(0.0002)	(0.0001)
WI-WN	-0.0650	0.0201	0.0028	-0.0003	0.0007	-0.0004	0.0010
	(0.0626)	(0.0319)	(0.0034)	(0.0018)	(0.0009)	(0.0009)	(0.0006)
(WI/WN)-1	-	0.2215	0.0307	-0.0036	0.0268	-0.0360	0.1247
Black							
BN-WN	-0.2980***	0.0193	0.0016	0.0005	-0.0003	0.0001	-0.0032***
	(0.0332)	(0.0192)	(0.0019)	(0.0010)	(0.0005)	(0.0005)	(0.0004)
(BN/WN)-1	-	0.2121	0.0174	0.0065	-0.0121	0.0072	-0.4062
BI-WN	-0.0791	-0.0342	0.0055	-0.0073*	0.0002	0.0000	-0.0010
	(0.1256)	(0.0611)	(0.0069)	(0.0035)	(0.0018)	(0.0019)	(0.0013)
(BI/WN)-1	-	-0.3760	0.0610	-0.1036	0.0062	-0.0046	-0.1300
BI-BN	0.2189	-0.0535	0.0040	-0.0078*	0.0005	-0.0001	0.0022
	(0.1299)	(0.0640)	(0.0072)	(0.0036)	(0.0019)	(0.0020)	(0.0013)
(BI/BN)-1	-	-0.4852	0.0428	-0.1093	0.0186	-0.0117	0.4652

*p<.050, **p<.010, ***p<.001. Standard errors in parentheses. 37,866 data points nested in 6,311 children. For all two letter acronyms, the W, B, H, and A in the first letter represent, respectively, White, Black, Hispanic, and Asian; the N and I in the second letter denote, respectively, native and immigrant. Other independent variables include first generation, mixed immigrant family, young summer birth, and old fall birth. Random effects estimates at the child level include the variance of the intercept at .1444, the variance of time at 1.17×10^{-5}, and their correlation at -.753. The residual variance is .0392. The AIC is 7894, the BIC is 8441, and the loglikelihood is -3883.

(Table 10 continued)

	Intercept	Fall kindergarten	Spring kindergarten	Spring first grade	Spring third grade	Spring fifth grade	Spring eighth grade
Hispanic							
HN-WN	-0.1359***	-0.0181	0.0085***	-0.0003	0.0001	0.0001	-0.0016***
	(0.0354)	(0.0199)	(0.0021)	(0.0011)	(0.0006)	(0.0006)	(0.0004)
(HN/WN)-1	-	-0.1986	0.0936	-0.0047	0.0033	0.0068	-0.2054
HI-WN	-0.3107***	-0.0224	0.0189***	0.0031*	0.0015*	0.0002	-0.0006
	(0.0435)	(0.0239)	(0.0026)	(0.0013)	(0.0007)	(0.0007)	(0.0005)
(HI/WN)-1	-	-0.2458	0.2081	0.0446	0.0553	0.0208	-0.0759
HI-HN	-0.1748**	-0.0043	0.0104**	0.0035*	0.0014	0.0001	0.0010
	(0.0561)	(0.0311)	(0.0033)	(0.0017)	(0.0009)	(0.0009)	(0.0006)
(HI/HN)-1	-	-0.0589	0.1048	0.0496	0.0518	0.0138	0.1631
Asian							
AN-WN	0.0311	0.0349	0.0006	-0.0002	-0.0030	-0.0003	0.0014
	(0.1065)	(0.0574)	(0.0056)	(0.0030)	(0.0016)	(0.0016)	(0.0011)
(AN/WN)-1	-	0.3834	0.0063	-0.0026	-0.1099	-0.0256	0.1716
AI-WN	0.0594	0.0564*	0.0094**	-0.0069***	-0.0054***	-0.0002	0.0015**
	(0.0567)	(0.0287)	(0.0031)	(0.0016)	(0.0008)	(0.0009)	(0.0006)
(AI/WN)-1	-	0.6201	0.1031	-0.0980	-0.1949	-0.0149	0.1949
AI-AN	0.0283	0.0215	0.0088	-0.0067*	-0.0024	0.0001	0.0002
	(0.1206)	(0.0642)	(0.0064)	(0.0034)	(0.0018)	(0.0018)	(0.0012)
(AI/AN)-1	-	0.1711	0.0962	-0.0957	-0.0955	0.0110	0.0198

*p<.050, **p<.010, ***p<.001. Standard errors in parentheses. The data includes 37,866 data points nested in 6,311 children.

Table 11. Reading trajectory estimates and comparisons (model 2)

	Intercept	Fall kindergarten	Spring kindergarten	Spring first grade	Spring third grade	Spring fifth grade	Spring eighth grade
<u>White</u>							
WI	-2.1402***	0.0842***	0.0909***	0.0704***	0.0277***	0.0107***	0.0080***
	0.0701	0.0059	0.0007	0.0004	0.0002	0.0002	0.0001
WI-WN	-0.0690	0.0264	0.0029	-0.0003	0.0008	-0.0004	0.0010
	0.0576	0.0291	0.0034	0.0018	0.0009	0.0009	0.0006
(WI/WN)-1	-	0.2905	0.0315	-0.0042	0.0271	-0.0352	0.1242
<u>Black</u>							
BN-WN	-0.1690***	0.0109	0.0015	0.0005	-0.0004	0.0001	-0.0032***
	0.0310	0.0175	0.0019	0.0010	0.0005	0.0005	0.0004
(BN/WN)-1	-	0.1196	0.0164	0.0074	-0.0128	0.0081	-0.4066
BI-WN	-0.0670	0.0203	0.0050	-0.0071*	0.0001	0.0000	-0.0010
	0.1156	0.0557	0.0069	0.0035	0.0018	0.0019	0.0013
(BI/WN)-1	-	0.2232	0.0555	-0.1003	0.0048	-0.0042	-0.1297
BI-BN	0.1020	0.0094	0.0036	-0.0076*	0.0005	-0.0001	0.0022
	0.1197	0.0584	0.0072	0.0036	0.0019	0.0020	0.0013
(BI/BN)-1	-	0.0925	0.0385	-0.1069	0.0178	-0.0121	0.4665

*p<.050, **p<.010, ***p<.001. Standard errors in parentheses. 37,866 data points nested in 6,311 children. For all two letter acronyms, the W, B, H, and A in the first letter represent, respectively, White, Black, Hispanic, and Asian; the N and I in the second letter denote, respectively, native and immigrant. Other independent variables include first generation, mixed immigrant family, young summer birth, old fall birth, age, gender, parental education, family income, family types, and number of siblings. Random effects estimates at the child level include the variance of the intercept at .1234, the variance of time at 1.17×10^{-5}, and their correlation at -.766. The residual is .0392. The AIC is 6720, the BIC is 7326, and the loglikelihood is -3289.

(Table 11 continued)

	Intercept	Fall kindergarten	Spring kindergarten	Spring first grade	Spring third grade	Spring fifth grade	Spring eighth grade
Hispanic							
HN-WN	-0.0791*	-0.0158	0.0086***	-0.0004	0.0001	0.0001	-0.0016***
	0.0327	0.0181	0.0021	0.0011	0.0006	0.0006	0.0004
(HN/WN)-1	-	-0.1732	0.0951	-0.0051	0.0029	0.0083	-0.2061
HI-WN	-0.1951***	-0.0208	0.0194***	0.0029*	0.0016*	0.0002	-0.0006
	0.0404	0.0218	0.0026	0.0013	0.0007	0.0007	0.0005
(HI/WN)-1	-	-0.2292	0.2134	0.0415	0.0564	0.0221	-0.0771
HI-HN	-0.1159*	-0.0051	0.0108**	0.0033	0.0015	0.0001	0.0010
	0.0520	0.0283	0.0033	0.0017	0.0009	0.0009	0.0006
(HI/HN)-1	-	-0.0677	0.1080	0.0468	0.0534	0.0137	0.1626
Asian							
AN-WN	-0.0132	0.0429	0.0004	-0.0001	-0.0031*	-0.0003	0.0014
	0.0981	0.0523	0.0056	0.0030	0.0016	0.0016	0.0011
(AN/WN)-1	-	0.4717	0.0041	-0.0015	-0.1104	-0.0239	0.1712
AI-WN	0.0945	0.0340	0.0094**	-0.0069***	-0.0054***	-0.0002	0.0015**
	0.0522	0.0261	0.0031	0.0016	0.0008	0.0009	0.0006
(AI/WN)-1	-	0.3734	0.1037	-0.0986	-0.1944	-0.0150	0.1947
AI-AN	0.1077	-0.0089	0.0091	-0.0068*	-0.0023	0.0001	0.0002
	0.1112	0.0585	0.0064	0.0034	0.0018	0.0018	0.0012
(AI/AN)-1	-	-0.0668	0.0992	-0.0973	-0.0944	0.0092	0.0201

*p<.050, **p<.010, ***p<.001. Standard errors in parentheses. The data includes 37,866 data points nested in 6,311 children.

Table 12. Math trajectory estimates and comparisons (model 1)

	Intercept	Fall kindergarten	Spring kindergarten	Spring first grade	Spring third grade	Spring fifth grade	Spring eighth grade
White							
WI	-1.0745***	0.0686***	0.0765***	0.0592***	0.0274***	0.0168***	0.0093***
	(0.0136)	(0.0077)	(0.0006)	(0.0003)	(0.0002)	(0.0002)	(0.0001)
WI-WN	-0.0255	-0.0398	0.0010	-0.0006	0.0023**	0.0019*	0.0001
	(0.0685)	(0.0377)	(0.0031)	(0.0016)	(0.0008)	(0.0009)	(0.0006)
(WI/WN)-1	-	-0.5801	0.0137	-0.0096	0.0843	0.1114	0.0056
Black							
BN-WN	-0.4111***	0.0402	0.0000	0.0012	-0.0012**	-0.0019***	-0.0006
	(0.0368)	(0.0230)	(0.0018)	(0.0009)	(0.0005)	(0.0005)	(0.0003)
(BN/WN)-1	-	0.5868	0.0005	0.0211	-0.0456	-0.1157	-0.0648
BI-WN	-0.2921*	-0.0124	0.0015	-0.0009	0.0047**	-0.0002	0.0002
	(0.1413)	(0.0733)	(0.0062)	(0.0031)	(0.0016)	(0.0017)	(0.0011)
(BI/WN)-1	-	-0.1810	0.0192	-0.0147	0.1716	-0.0127	0.0228
BI-BN	0.1189	-0.0527	0.0014	-0.0021	0.0059***	0.0017	0.0008
	(0.1460)	(0.0768)	(0.0065)	(0.0033)	(0.0017)	(0.0018)	(0.0012)
(BI/BN)-1	-	-0.4839	0.0187	-0.0351	0.2276	0.1165	0.0937

*p<.050, **p<.010, ***p<.001. Standard errors in parentheses. 40,470 data points nested in 6,745 children. For all two letter acronyms, the W, B, H, and A in the first letter represent, respectively, White, Black, Hispanic, and Asian; the N and I in the second letter denote, respectively, native and immigrant. Other independent variables include first generation, mixed immigrant family, young summer birth, and old fall birth. Random effects estimates at the child level include the variance of the intercept at .1208, the variance of time at 7.69×10^{-6}, and their correlation at -.365. The residual variance is .0330. The AIC is 4045, the BIC is 4596, and the loglikelihood is -1959.

(Table 12 continued)

	Intercept	Fall kindergarten	Spring kindergarten	Spring first grade	Spring third grade	Spring fifth grade	Spring eighth grade
Hispanic							
HN-WN	-0.1885***	-0.0102	0.0055**	0.0018	0.0003	-0.0001	-0.0007
	(0.0379)	(0.0233)	(0.0019)	(0.0010)	(0.0005)	(0.0005)	(0.0004)
(HN/WN)-1	-	-0.1488	0.0719	0.0302	0.0099	-0.0088	-0.0717
HI-WN	-0.4685***	-0.0284	0.0074***	0.0110***	0.0014**	0.0006	-0.0006
	(0.0332)	(0.0201)	(0.0017)	(0.0009)	(0.0005)	(0.0005)	(0.0003)
(HI/WN)-1	-	-0.4135	0.0972	0.1862	0.0502	0.0343	-0.0600
HI-HN	-0.2800***	-0.0182	0.0019	0.0092***	0.0011	0.0007	0.0001
	(0.0504)	(0.0308)	(0.0025)	(0.0013)	(0.0007)	(0.0007)	(0.0005)
(HI/HN)-1	-	-0.3110	0.0237	0.1515	0.0400	0.0435	0.0126
Asian							
AN-WN	-0.0513	0.0860	-0.0092	0.0004	0.0021	0.0019	0.0011
	(0.1202)	(0.0692)	(0.0052)	(0.0027)	(0.0014)	(0.0014)	(0.0010)
(AN/WN)-1	-	1.2544	-0.1203	0.0074	0.0759	0.1155	0.1182
AI-WN	0.0541	-0.0082	0.0009	-0.0032*	0.0015*	0.0033***	0.0015**
	(0.0635)	(0.0344)	(0.0028)	(0.0015)	(0.0008)	(0.0008)	(0.0005)
(AI/WN)-1	-	-0.1199	0.0121	-0.0532	0.0546	0.1943	0.1654
AI-AN	0.1054	-0.0942	0.0101	-0.0036	-0.0006	0.0013	0.0004
	(0.1360)	(0.0773)	(0.0059)	(0.0031)	(0.0016)	(0.0016)	(0.0011)
(AI/AN)-1	-	-0.6096	0.1506	-0.0602	-0.0198	0.0706	0.0422

*p<.050, **p<.010, ***p<.001. Standard errors in parentheses. The data includes 40,470 data points nested in 6,745 children.

Table 13. Math trajectory estimates and comparisons (model 2)

	Intercept	Fall kindergarten	Spring kindergarten	Spring first grade	Spring third grade	Spring fifth grade	Spring eighth grade
White							
WI	-2.3006***	0.0605***	0.0765***	0.0592***	0.0274***	0.0168***	0.0093***
	(0.0815)	(0.0071)	(0.0006)	(0.0003)	(0.0002)	(0.0002)	(0.0001)
WI-WN	-0.0288	-0.0304	0.0011	-0.0006	0.0023**	0.0019*	0.0001
	(0.0633)	(0.0347)	(0.0031)	(0.0016)	(0.0008)	(0.0009)	(0.0006)
(WI/WN)-1	-	-0.5017	0.0146	-0.0102	0.0846	0.1113	0.0056
Black							
BN-WN	-0.2799***	0.0365	0.0000	0.0013	-0.0013**	-0.0019***	-0.0006
	(0.0345)	(0.0212)	(0.0018)	(0.0009)	(0.0005)	(0.0005)	(0.0003)
(BN/WN)-1	-	0.6036	0.0000	0.0216	-0.0460	-0.1153	-0.0650
BI-WN	-0.2743*	0.0442	0.0011	-0.0007	0.0047**	-0.0002	0.0002
	(0.1305)	(0.0675)	(0.0062)	(0.0031)	(0.0016)	(0.0017)	(0.0011)
(BI/WN)-1	-	0.7300	0.0146	-0.0125	0.1713	-0.0134	0.0232
BI-BN	0.0056	0.0076	0.0011	-0.0020	0.0059***	0.0017	0.0008
	(0.1350)	(0.0707)	(0.0065)	(0.0033)	(0.0017)	(0.0018)	(0.0012)
(BI/BN)-1	-	0.0788	0.0146	-0.0333	0.2278	0.1153	0.0943

*p<.050, **p<.010, ***p<.001. Standard errors in parentheses. 40,470 data points nested in 6,745 children. For all two letter acronyms, the W, B, H, and A in the first letter represent, respectively, White, Black, Hispanic, and Asian; the N and I in the second letter denote, respectively, native and immigrant. Other independent variables include first generation, mixed immigrant family, young summer birth, old fall birth, age, gender, parental education, family income, family types, and number of siblings. Random effects estimates at the child level include the variance of the intercept at .1021, the variance of time at 7.69×10^{-6}, and their correlation at -.374. The residual variance is .0330. The AIC is 2928, the BIC is 3539, and the loglikelihood is -1393.

(Table 13 continued)

	Intercept	Fall kindergarten	Spring kindergarten	Spring first grade	Spring third grade	Spring fifth grade	Spring eighth grade
Hispanic							
HN-WN	-0.1199***	-0.0097	0.0056**	0.0018	0.0003	-0.0001	-0.0007
	(0.0352)	(0.0214)	(0.0019)	(0.0010)	(0.0005)	(0.0005)	(0.0004)
(HN/WN)-1	-	-0.1595	0.0734	0.0297	0.0098	-0.0084	-0.0720
HI-WN	-0.2846***	-0.0241	0.0076***	0.0110***	0.0014**	0.0006	-0.0006
	(0.0313)	(0.0185)	(0.0017)	(0.0009)	(0.0005)	(0.0005)	(0.0003)
(HI/WN)-1	-	-0.3979	0.0988	0.1853	0.0505	0.0345	-0.0602
HI-HN	-0.1647***	-0.0144	0.0019	0.0092***	0.0011	0.0007	0.0001
	(0.0471)	(0.0283)	(0.0025)	(0.0013)	(0.0007)	(0.0007)	(0.0005)
(HI/HN)-1	-	-0.2836	0.0237	0.1512	0.0403	0.0433	0.0128
Asian							
AN-WN	-0.0918	0.0954	-0.0093	0.0005	0.0021	0.0019	0.0011
	(0.1112)	(0.0636)	(0.0052)	(0.0027)	(0.0014)	(0.0014)	(0.0010)
(AN/WN)-1	-	0.2649	-0.0668	-0.0250	-0.0093	0.0081	0.0766
AI-WN	0.1078	-0.0370	0.0010	-0.0032*	0.0015*	0.0033***	0.0015**
	(0.0587)	(0.0317)	(0.0028)	(0.0015)	(0.0008)	(0.0008)	(0.0005)
(AI/WN)-1	-	-0.6123	0.0133	-0.0540	0.0550	0.1942	0.1652
AI-AN	0.1996	-0.1325	0.0103	-0.0037	-0.0006	0.0013	0.0004
	(0.1257)	(0.0711)	(0.0059)	(0.0031)	(0.0016)	(0.0016)	(0.0011)
(AI/AN)-1	-	-0.8496	0.1534	-0.0615	-0.0193	0.0705	0.0422

*p<.050, **p<.010, ***p<.001. Standard errors in parentheses. The data includes 40,470 data points nested in 6,745 children.

Figure 1. Two scenarios of academic disparity

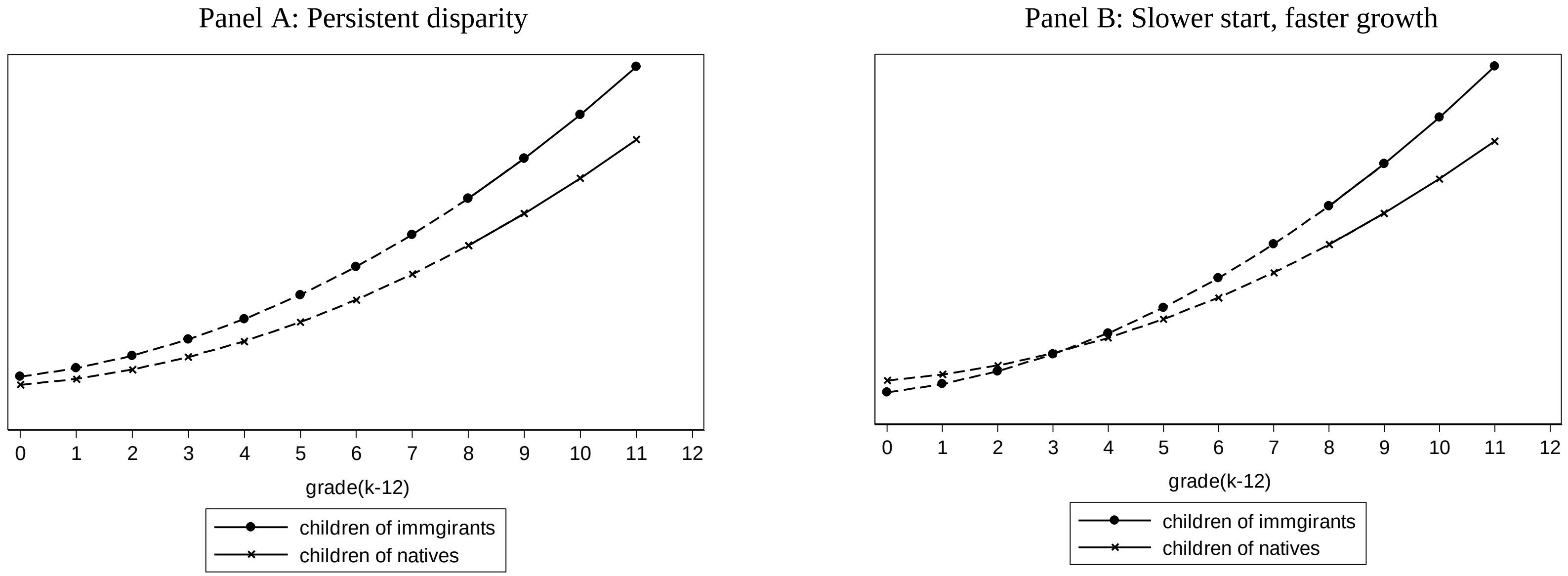
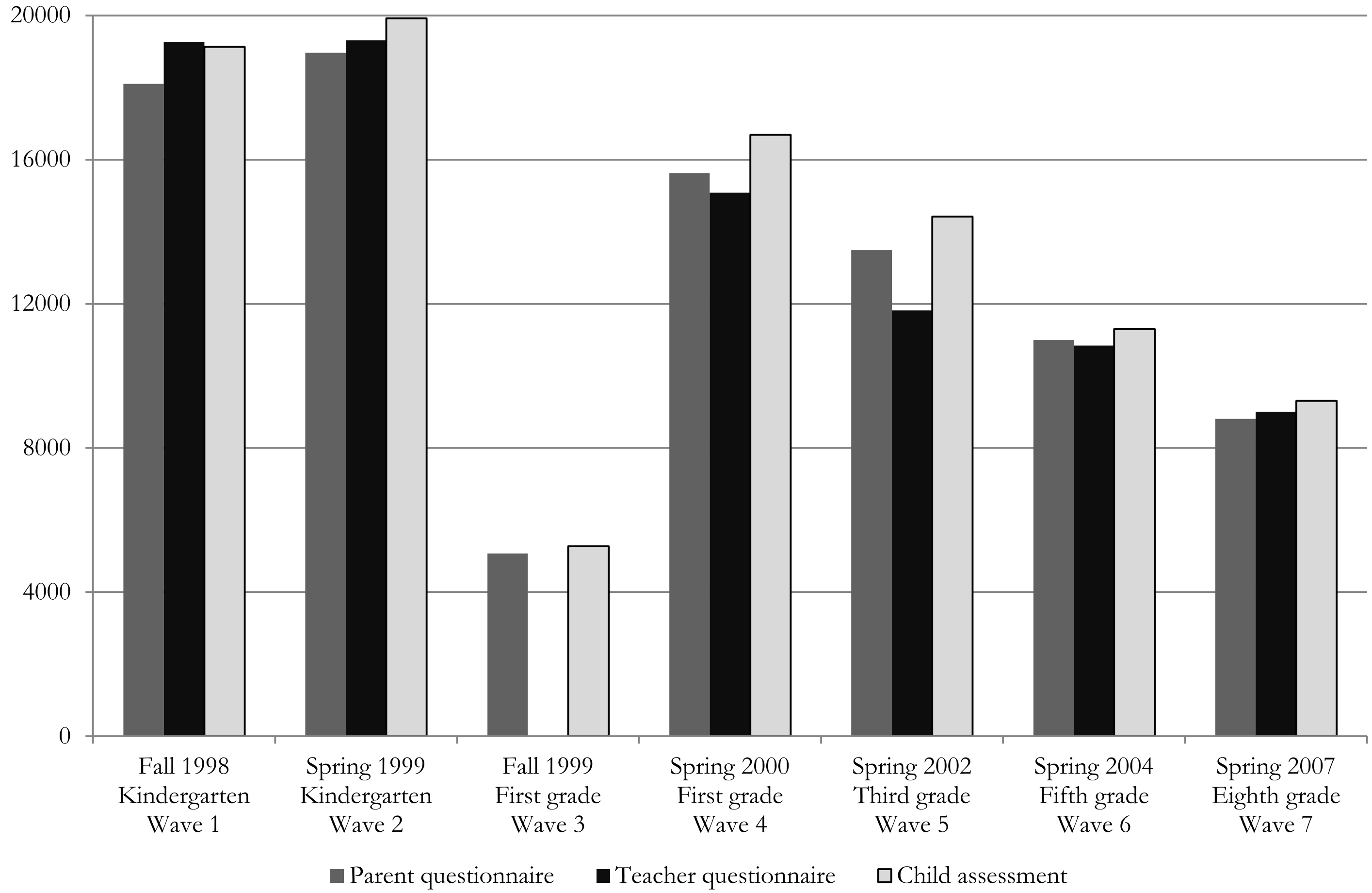


Figure 2. Data structure of the ECLS-K



The ECLS-K consists of seven waves of data surveyed between the fall of 1998 and the spring of 2007. Data were collected separately from the children, the parents, and the teachers. This figure summarizes the number of valid cases for each data source in all seven waves.

Figure 3. Point estimates of reading gaps (model 1)

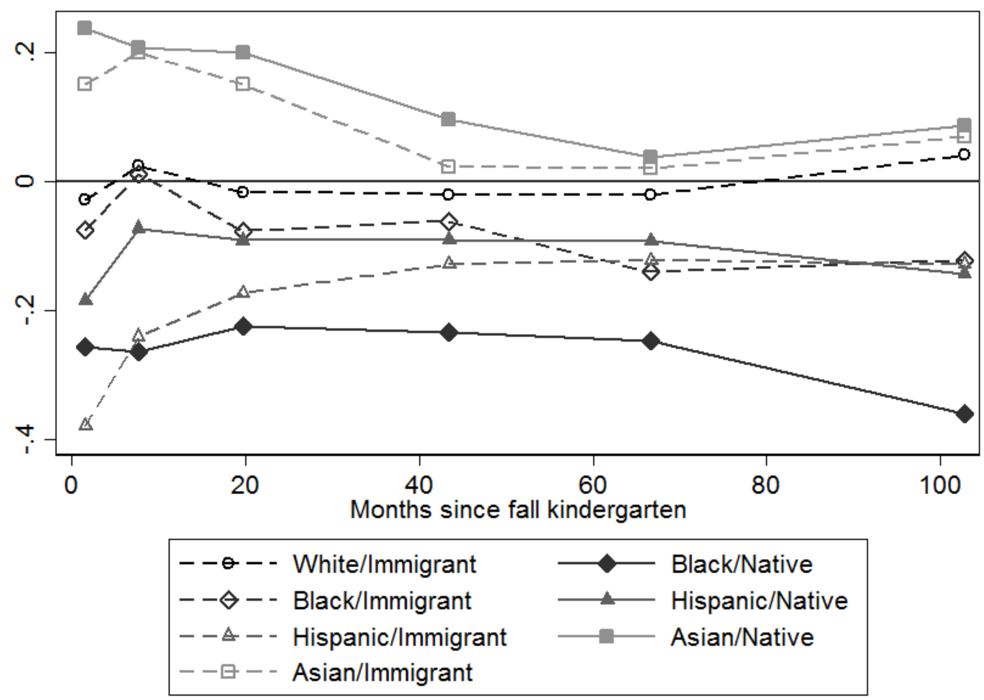


Figure 4. Point estimates and 95% confidence intervals of reading gaps (model 1)

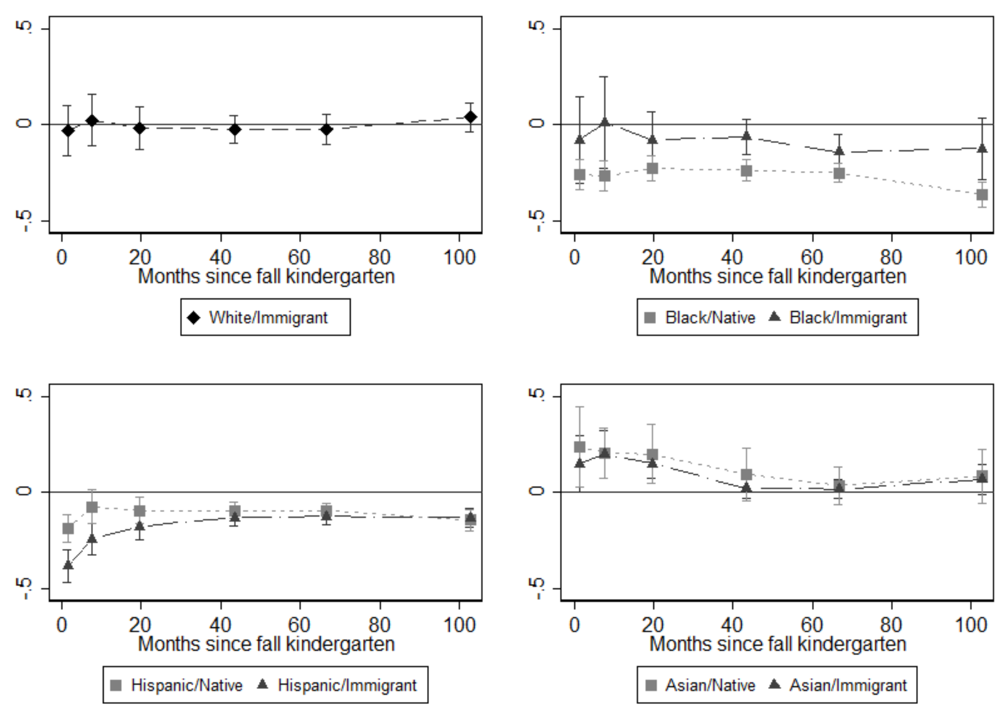


Figure 5. Point estimates of reading gaps (model 2)

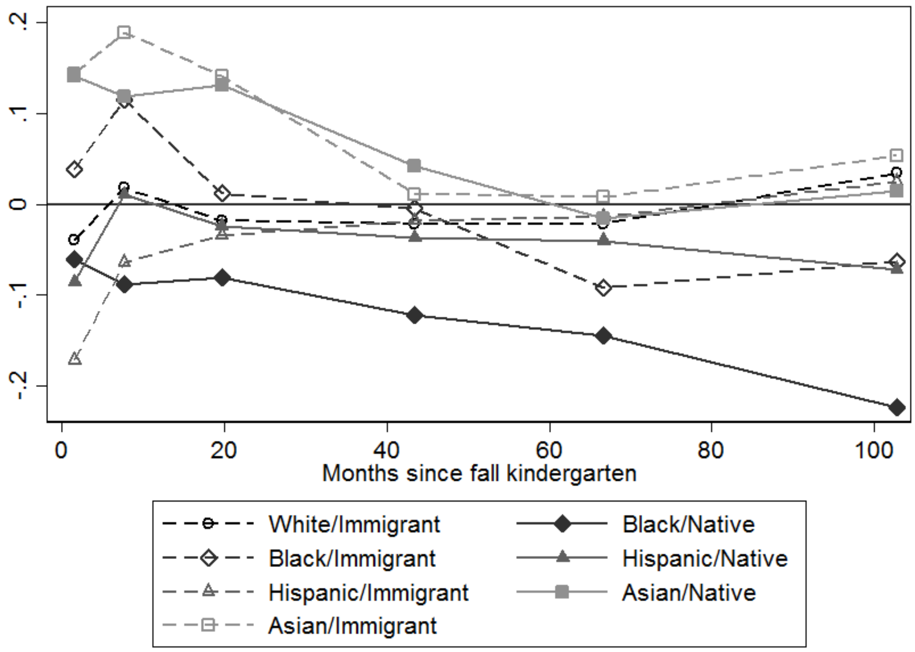


Figure 6. Point estimates and 95% confidence intervals of reading gaps (model 2)

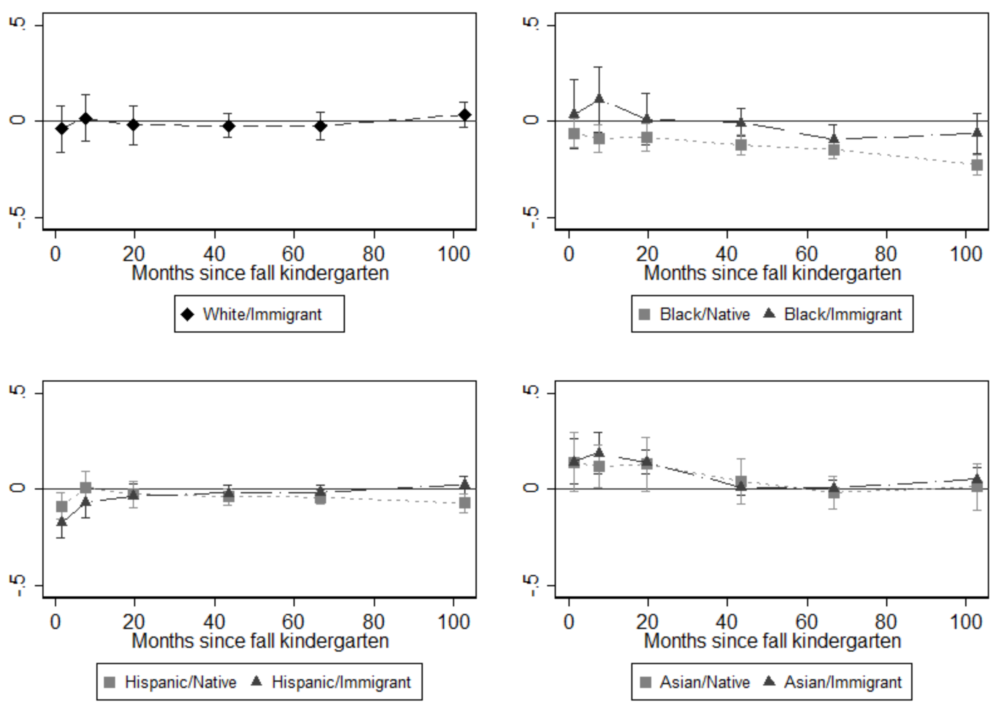


Figure 7. Point estimates of math gaps (model 1)

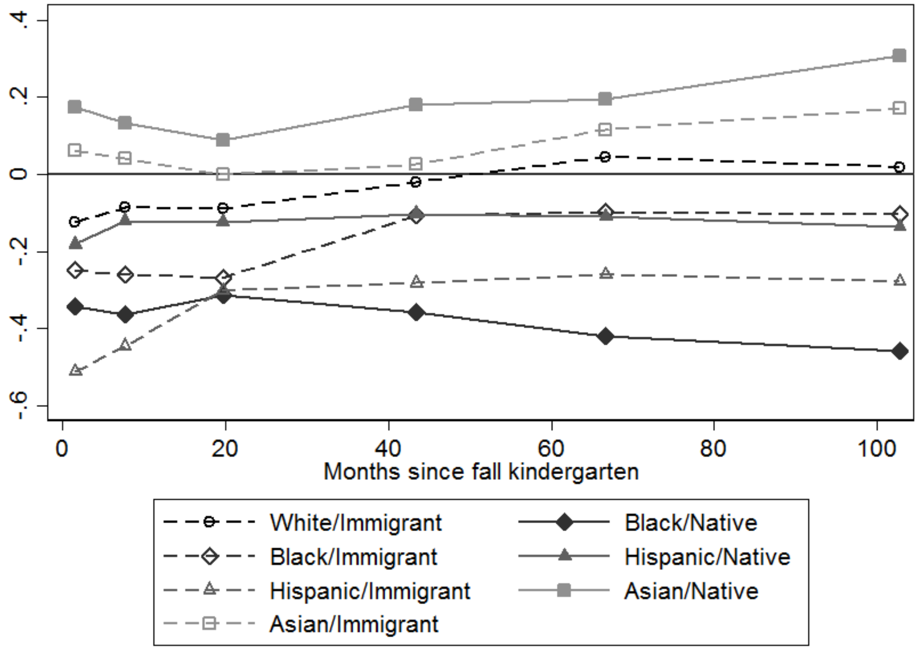


Figure 8. Point estimates and 95% confidence intervals of math gaps (model 1)

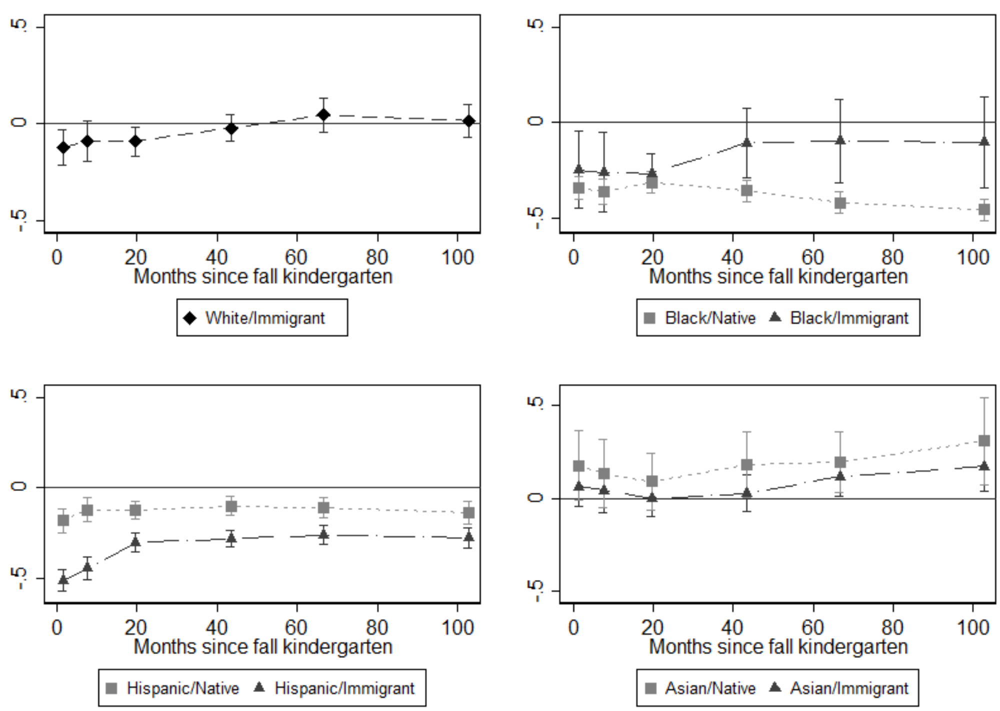


Figure 9. Point estimates of math gaps (model 2)

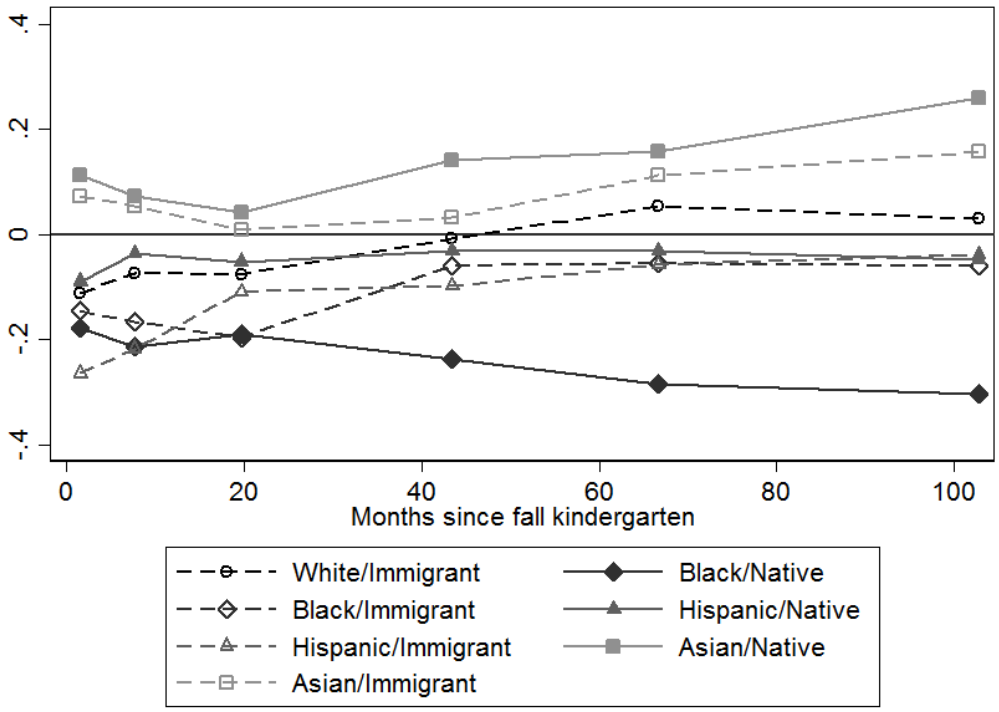


Figure 10. Point estimates and 95% confidence intervals of math gaps (model 2)

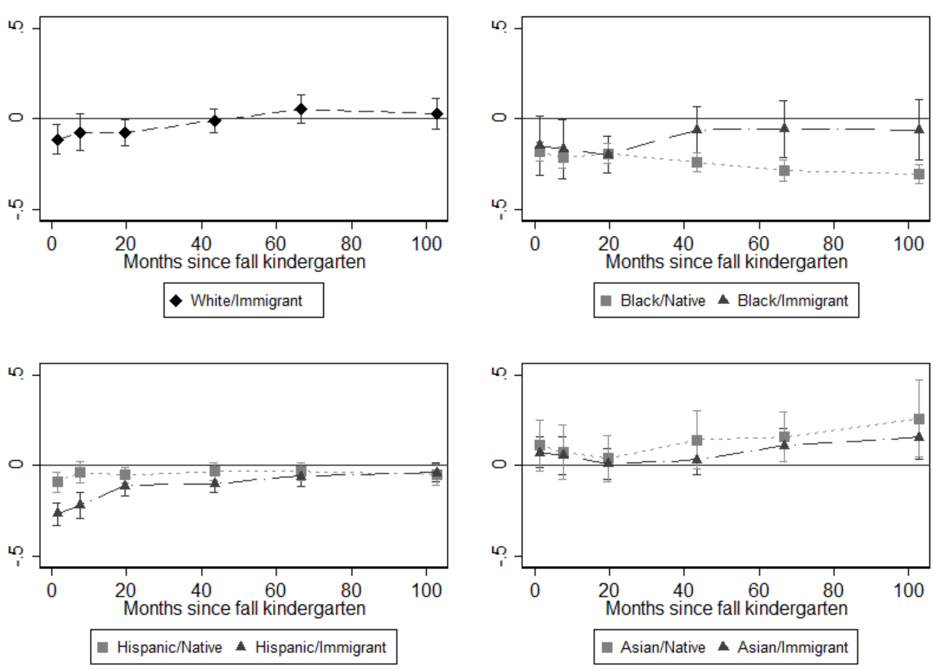


Figure 11. Predicted reading and math trajectories by parental nativity

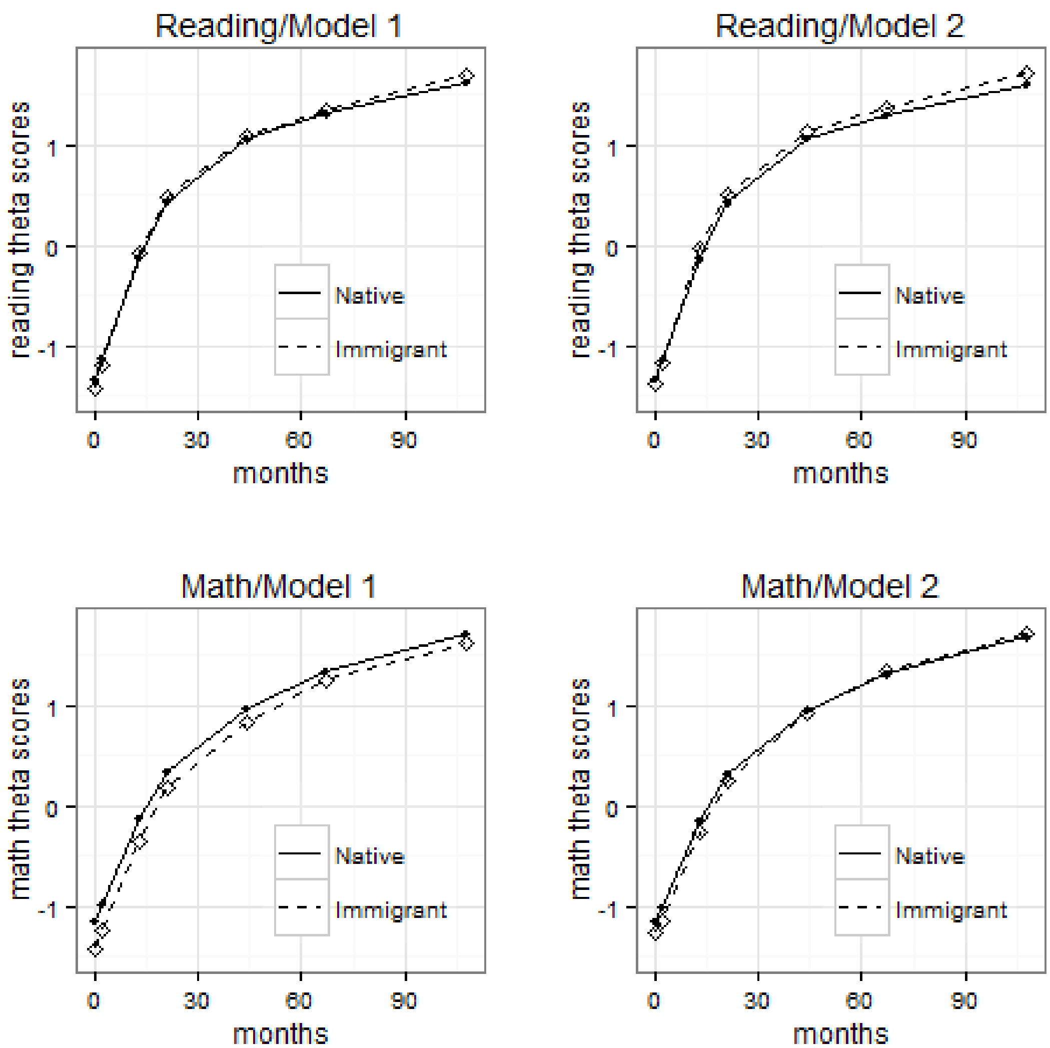


Figure 12. Predicted reading growth trajectories by parental nativity and race (model 1)

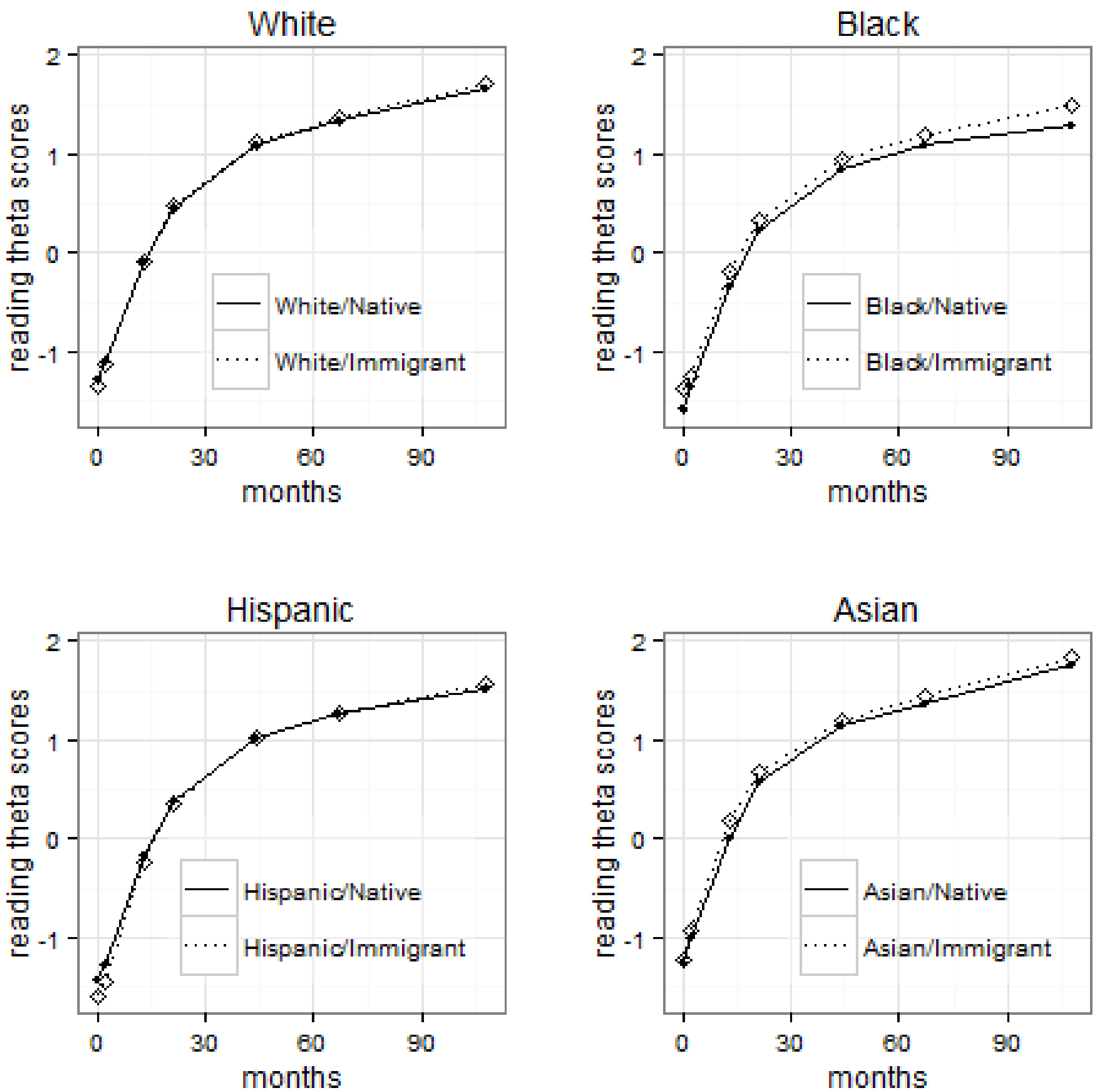


Figure 13. Predicted reading growth trajectories by parental nativity and race (model 2)

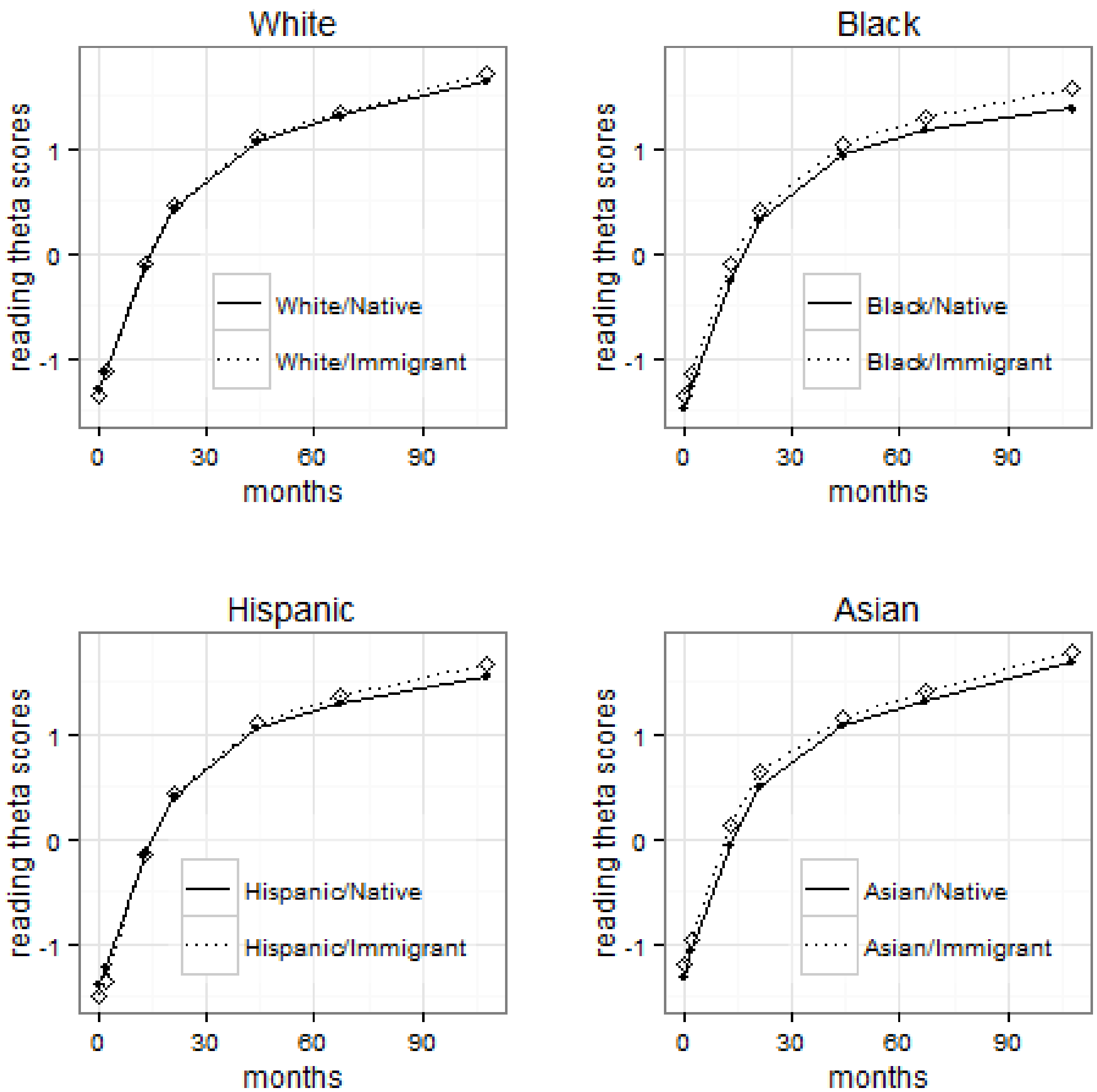


Figure 14. Predicted math growth trajectories by parental nativity and race (model 1)

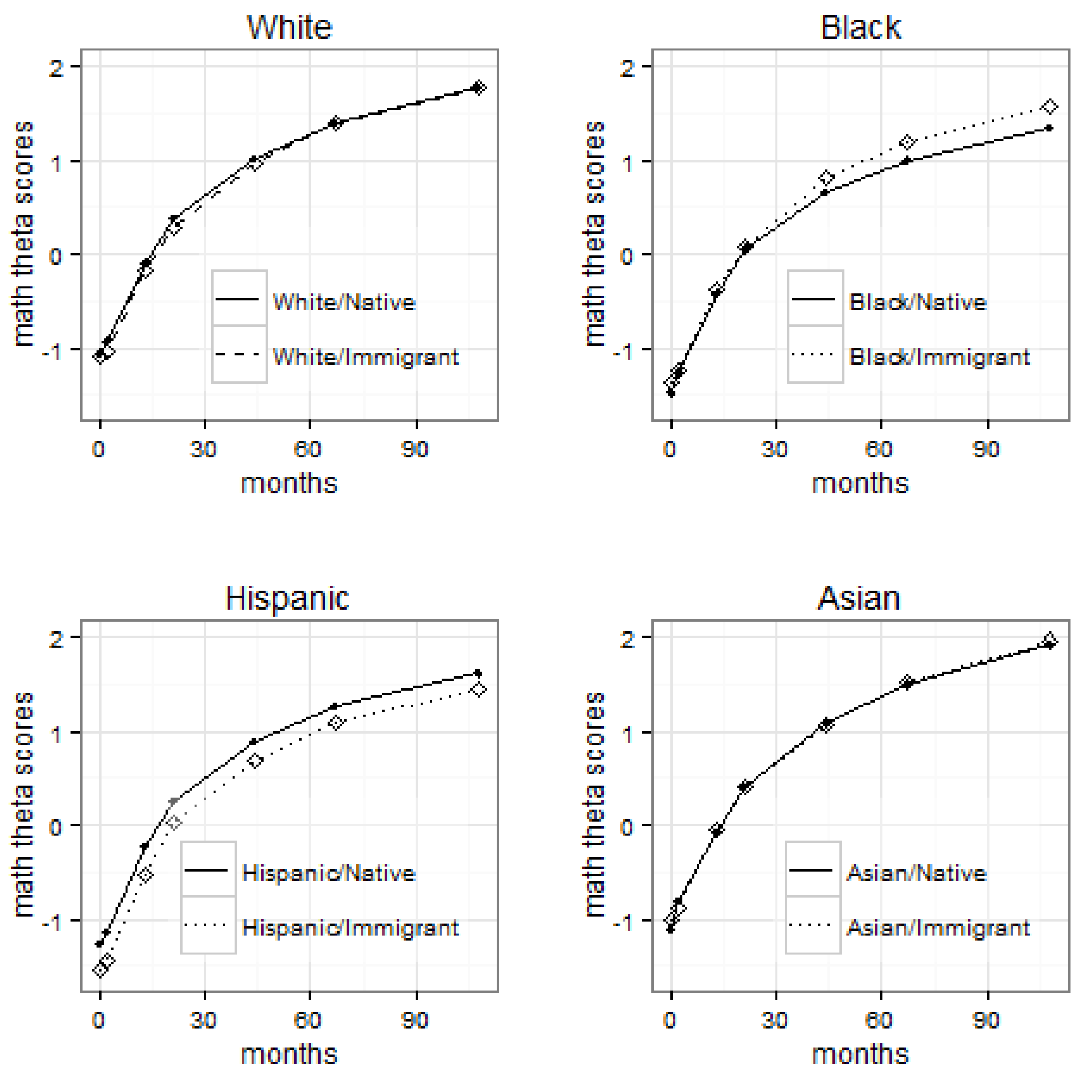
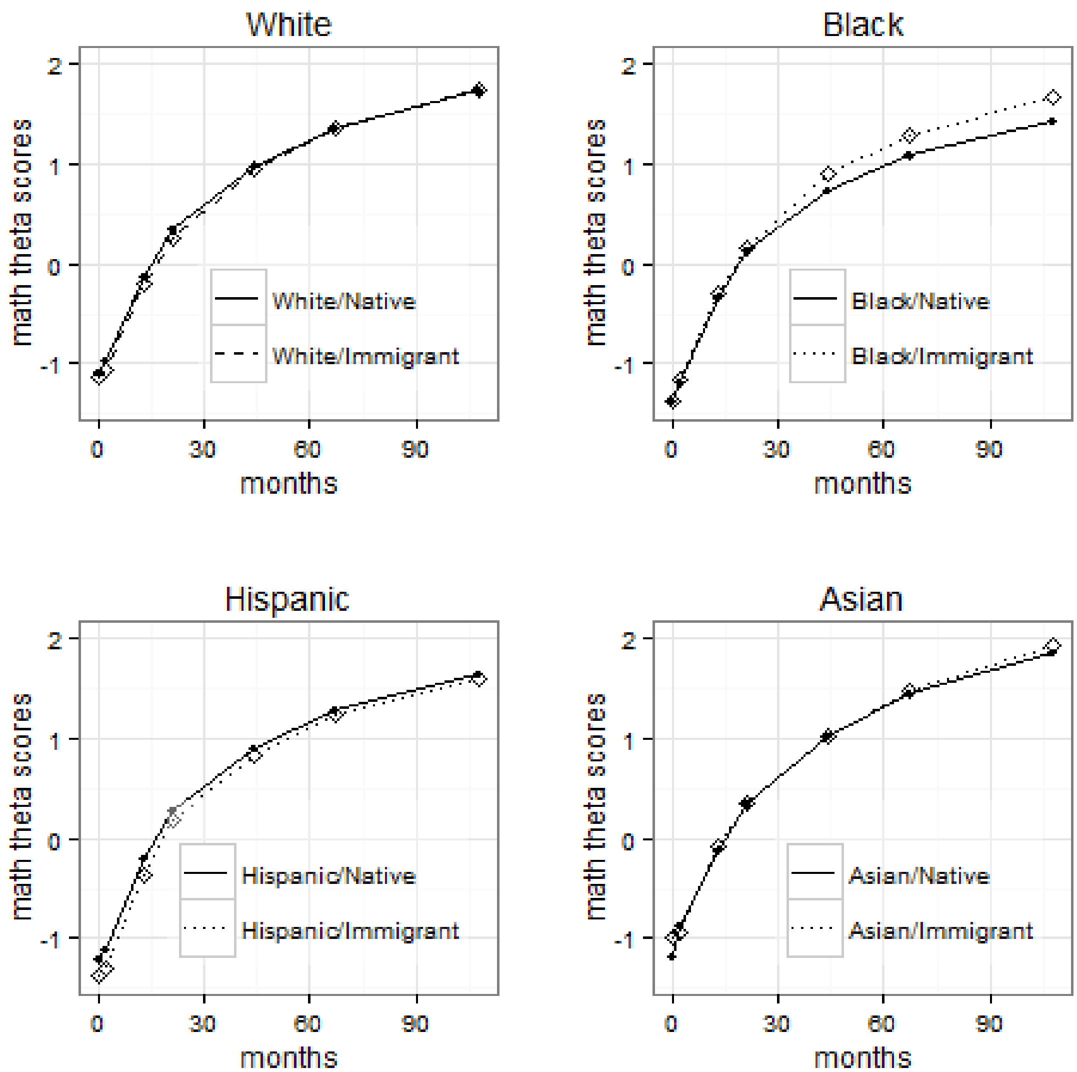


Figure 15. Predicted math growth trajectories by parental nativity and race (model 2)



Appendix A. List of variables

Variable	Description/Values
Immigrant parents	At least one parent was born outside of the 50 states of the U.S.
First generation	Child came from an immigrant family and was born in the U.S.
Mixed immigrant family	One parent is foreign-born and the parent is native-born
Young summer birth	Born in June, July, or August, and were less than 67 months of age at the first wave of child assessment
Old fall birth	Born in September, October, or November, and were 67 months of age or older at the first wave of child assessment
Demographic Traits	
Age	In months, calculated at September 1998
Female	1 = female; 0 = male
Race	White(reference group), Black, Hispanic and Asian
Family Resources	
Family income	In thousands of U.S. dollars
Parental education	Reported levels of education converted following a quasi-midpoint rule: "8th grade or below"=4, "9th-12th grade"=10.5, "High school diploma/equivalent"=12, "Vocational/technical program"=13, "Some college"=14, "Bachelor's degree"=16, "Graduate/professional school-no degree"=17, "Master's degree (MA, MS)"=18, and "Doctorate or professional degree"=21. The values are averaged for children with two parents.
Family type	Two biological parents (reference group), single biological parent, and others
Number of siblings	Number of siblings
Academic Achievement	
Math score	Using the Theta score metric with values ranging between -3 and 3
Reading score	Using the Theta score metric with values ranging between -3 and 3

Appendix B. Summary statistics on selective variables for the reading score-based sample (N=6,311)

		White		Black		Hispanic		Asian	
		Native	Immigrant	Native	Immigrant	Native	Immigrant	Native	Immigrant
Age	Mean	75.35	75.08	74.72	72.93	75.01	74.31	74.13	73.93
	SD	4.19	3.85	3.90	3.86	4.08	4.03	3.87	3.61
	N	4380	182	611	45	488	316	63	226
Female	Mean	0.50	0.50	0.50	0.49	0.51	0.50	0.51	0.55
	SD	0.50	0.50	0.50	0.51	0.50	0.50	0.50	0.50
	N	4380	182	611	45	488	316	63	226
Number of siblings	Mean	1.43	1.46	1.54	1.62	1.42	1.50	1.26	1.34
	SD	1.01	1.08	1.32	1.32	1.06	1.00	0.83	1.18
	N	4335	178	578	45	472	308	61	208
Family type									
Two-biological parent	Mean	0.81	0.86	0.36	0.58	0.69	0.77	0.66	0.92
	SD	0.39	0.35	0.48	0.50	0.46	0.42	0.48	0.27
	N	4335	178	578	45	472	308	61	208
Single-parent	Mean	0.10	0.11	0.48	0.38	0.19	0.16	0.08	0.06
	SD	0.31	0.32	0.50	0.49	0.39	0.37	0.28	0.24
	N	4335	178	578	45	472	308	61	208
Other family types	Mean	0.08	0.03	0.16	0.04	0.12	0.07	0.26	0.01
	SD	0.27	0.17	0.37	0.21	0.33	0.26	0.44	0.12
	N	4335	178	578	45	472	308	61	208

Appendix C. Summary statistics on reading Theta scores for the reading score-based sample (N=6,311)

		White		Black		Hispanic		Asian	
		Native	Immigrant	Native	Immigrant	Native	Immigrant	Native	Immigrant
Fall 1998	Mean	-1.151	-1.156	-1.431	-1.252	-1.323	-1.492	-1.066	-0.983
(Kindergarten)	SD	0.473	0.518	0.461	0.460	0.485	0.461	0.528	0.664
	N	4380	182	611	45	488	316	63	226
Spring 1999	Mean	-0.591	-0.581	-0.861	-0.683	-0.691	-0.802	-0.491	-0.359
(Kindergarten)	SD	0.441	0.464	0.496	0.458	0.435	0.465	0.406	0.537
	N	4380	182	611	45	488	316	63	226
Fall 1999	Mean	-0.331	-0.442	-0.637	-0.285	-0.480	-0.521	-0.389	-0.057
(First grade)	SD	0.432	0.415	0.479	0.482	0.466	0.509	0.402	0.575
	N	1318	64	182	16	147	84	12	59
Spring 2000	Mean	0.252	0.263	-0.002	0.087	0.144	0.084	0.340	0.396
(First grade)	SD	0.372	0.344	0.451	0.435	0.393	0.397	0.392	0.398
	N	4380	182	611	45	488	316	63	226
Spring 2002	Mean	0.909	0.935	0.644	0.753	0.805	0.776	0.929	0.924
(Third grade)	SD	0.259	0.246	0.295	0.239	0.274	0.274	0.255	0.237
	N	4380	182	611	45	488	316	63	226
Spring 2004	Mean	1.158	1.173	0.896	0.992	1.056	1.029	1.171	1.169
(Fifth grade)	SD	0.256	0.257	0.268	0.259	0.249	0.254	0.220	0.257
	N	4380	182	611	45	488	316	63	226
Spring 2007	Mean	1.446	1.498	1.067	1.244	1.284	1.295	1.506	1.511
(Eighth grade)	SD	0.342	0.335	0.346	0.373	0.361	0.337	0.349	0.334
	N	4380	182	611	45	488	316	63	226

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