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Immigrant Peers in School and Human Capital Development

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Nearly one-quarter of U.S. school-age youth are immigrants or have immigrant parents. The adjustment of immigrant youth to U.S. institutions is well-studied, yet little is known about how immigrant students influence their peers in school. This analysis uses data on seven cohorts of Florida public high school students to estimate the effect of immigrant shares in school on student achievement. Initial results suggest that the effects of immigrant peers depend upon the "quality" of the immigrants. Students who attend schools with higher immigrant shares have lower achievement scores if those immigrants are new entrants- that is, they entered the school system in high school and are likely struggling to learn. Yet when students attend schools with immigrants who have been in the school system longer, a group that typically outperforms observationally-similar native-born, then their performance is higher.

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1 Introduction

In 2008, an estimated 23 percent of children under the age of 18 in the U.S. were either immigrants or children of immigrants.[1] A large literature focuses on how well immigrant youth are adapting to U.S. schools and other institutions (e.g., Kao & Tienda, 1995; Portes & Rumbaut, 2001; Steifel, Schwartz, & Conger, 2009). An equally-abundant literature asks whether immigrants adversely impact the labor market outcomes of native-born (Friedberg & Hunt, 1995; Card, 2001). Yet very little is known about how the presence of immigrant youth in schools influences the human capital development of the other students. Indeed, the literature on peer effects in U.S. schools, while enormous, is almost exclusively devoted to examining the potential externalities of peer achievement and peer racial composition. This focus results from decades of debate among educators and policymakers about the harms and benefits of grouping students by ability and of permitting racial segregation across schools. The school isolation of immigrant students may also require policy attention if such isolation negatively impacts student achievement. Studying immigrant peer effects also sheds light on the overall impact of immigration on human capital development: immigrants can influence host societies both through their own human capital growth and their impact on the growth of others.

This paper uses data on seven cohorts of public school students in Florida to estimate the effect of immigrant shares in school on student achievement. Specifically, I use least squares and student fixed effects models, along with a large set of covariates, to examine the effect of immigrant peers in the first two years of high school on students' reading and math achievement scores in the 10th grade. I also estimate these effects separately for foreign-born and native-born students.

[1] http://datacenter.kidscount.org/

2 Prior Literature

Achievement and Attainment of Immigrant Students in the U.S.

The research on the performance of immigrant students in the U.S. tells a complex story. On the one hand, most immigrant youth arrive with deficiencies that should get in the way of their schooling. In addition to being less familiar with U.S. norms and institutions, they often lack citizenship and a fluent command of the English language. They are also more likely to be racial minorities, to come from poor families, and to live in large urban areas where school systems are under-resourced and achievement falls below national norms (Hernandez & Charney 1998; Van Hook, Brown, & Kwenda 2004). Naturally, then, when newly-arrived immigrants are compared to white, non-poor, fully English proficient, native-born youth who attend high-performing schools, most earn lower test scores, lower grades, and fewer years of schooling (e.g., Kao & Tienda, 1995; Kao, 1999).

On the other hand, several studies show that immigrant youth fare relatively well when compared to native-born who have similar racial/ethnic and socioeconomic profiles (Kao & Tienda, 1995; Fuligni, 1997; Portes & Rumbaut, 2001; Glick & White, 2003; Perreira, Harris, & Lee 2006; Schwartz & Stiefel 2006; Steifel et al., 2009). Nativity gaps in performance often vary by origin country, race, and gender (e.g. Hirschman, 2001; Gonzalez, 2003; Chiswick & DebBurman, 2004; Perreira et al. 2006); however, many children of immigrants outperform what would be predicted based on their observed socio-demographic characteristics. Immigration scholars attribute this finding to selective migration on unobserved attitudinal and, possibility, intellectual abilities – that is, though many immigrants are non-white and have low initial human capital (characteristics that inhibit their upward mobility), they hold a unique set of aspirations and values that put them ahead of native-born, low-income, minorities. When these values

translate to the next generation, resulting in strong attachments to schooling and the co-ethnic immigrant community, immigrant youth outperform both their parents' and their native-born peers in school (Caplan, Whitmore, & Choy, 1989; Zhou & Bankston, 1998; Portes & Rumbaut, 2001; Perriera et al, 2006). For some immigrant youth, however, the attachments to their co-ethnic communities may weaken, leading to a downward trajectory. In fact, the immigrant assimilation literature is hugely concerned with the risks of "becoming American" or "downward assimilation"– a process whereby some children of immigrants are exposed to conditions in their U.S. schools and communities that change the course their parents initially set them on (Gans, 1992; Zhou 1997; Portes & Rumbaut 2001; García Coll & Marks, forthcoming). Stepick et al. (2001), for instance, describe an identity crisis experienced by Haitian-American students in Miami who have high aspirations resembling those of their parents that are eroded by the discrimination they face in their schools and communities. Studies that compare students from three generations at a single point in time often find the first and second generation students outperforming the third, evidence of downward assimilation across generations (e.g., Kao & Tienda, 1995; Glick & White, 2003; Perreira et al., 2006).

Yet the empirical work on whether foreign-born youth upwardly or downwardly assimilate as they age is limited because most of the available data is cross-sectional and the effect of length of residency in the U.S. cannot be distinguished from the effect of age of entry. The handful of studies that examine the academic performance of foreign-born by age of entry/length of residency often find that children who immigrate when they are younger have the same and often better educational outcomes than those who emigrate when they are older (e.g., Cortes, 2006; Perreira et al., 2006; Chiswick & DebBurman 2004; Hirchsman, 2001; Stiefel et al., 2009). Thus, either immigrant children's performance improves as they acculturate or entering

the country at late age has a harmful, long-lasting effect on student performance. Chiswick and DebBurman (2004) examine the effect of age of entry among both youth and adult immigrants, and the findings shed some light on the difference between the effects of age of entry and the length of residency. Using Current Population Survey data on 1990 households, the authors find that teenage entrants (ages 13 to 19) obtain the least amount of schooling, while those who emigrate at younger and older ages obtain more years of schooling. Importantly, they conclude that age of immigration may influence schooling independently of the number of years since immigration.

How Immigrant Peers Might Matter

This section summarizes the large body of research aimed at understanding the spillover effects of peer achievement/ability and peer race/ethnicity in order to understand how immigrant students might affect their peers in school.

From the ability grouping and peer achievement literature, we know that students' knowledge and behavior can affect their peers in a number of ways (see, for example, Lazear 2001).[2] Students' decisions may be directly shaped by the behavior of other students, including how much they study, how excited they are about learning, and how well they listen. Spillover effects of peers might also operate indirectly through teachers when, for example, higher-performing peers ask more advanced questions of the teacher which in turn increases the quality and quantity of material provided to the class. At the same time, attending classrooms with high-performing students could disadvantage lower-performing students if teachers favor the more successful students. Similarly, peers that demand extra attention from teachers either because of

[2] Examples of recent empirical studies on the effect of peer achievement include: Hanushek et al. 2001; Hoxby, 2000; Zimmer and Toma 2000; Betts & Zhou, 2002; and Vigdor & Nechyba, 2004. In most cases, peer achievement effects are positive, yet modest.

learning needs (such as language assistance) or general misbehavior could detract from the learning of other students.

The spillover effect of immigrant students will therefore, depend upon the achievement and behavior of the immigrant students in the school relative to the school average. If the immigrant students are relatively new entrants whose English is limited and who require a significant amount of teacher and other resources, then students who do not benefit from these resources might receive a lower quality education. Conversely, if the immigrant students in the school bring a higher work ethic and stronger attachment to schooling, these attitudes may benefit all the students in the school. Of course, both forces could operate leading to null effects of immigrant peers – e.g., the immigrant students have high aspirations and study hard but their limited English proficiency and poverty limits their own achievement, demands more time from teachers, and reduces their potential for positive externalities.

Immigrant students could also affect their peers though more social and psychological mechanisms. Such mechanisms are well-known to those who study racial segregation in the kindergarten-12 system and affirmative action policies in higher education. For instance, Fordham and Ogbu (1986) suggest that high concentrations of black students in a school can lead to lower black achievement among individual black students through peer pressures not to conform to mainstream, white standards. That is, even though the black peers may have an innately high ability to perform, they develop an oppositional attitude that leads to lower achievement simply because they are black in a white-dominated society. An alternative possibility is that a high concentration of black students provides comfort and eliminates the comparative disadvantage that some black students face in schools where they are in the extreme

minority.[3] In fact, this "critical mass" theory that schools must ensure non-token numbers of minority students in order to prevent the minority group members from feeling singled out, forms the basis of some arguments for affirmative action policies in higher education (Gurin, 1999).

One can easily make a case for psychological and social impacts of immigrant peers in school. For immigrant students, having more immigrant peers might prevent them from feeling isolated or different. Relative to schools with largely underperforming native-born students, immigrant parents might also prefer schools with large immigrant shares because they reinforce the cultural norms that many immigrants are known for, including strong attachments to family, community, and school as well as high aspirations to perform well in school. Immigrant students could also suffer in immigrant-rich schools if oppositional cultures arise similar to those that have been observed in some research on black students in U.S. schools. If the primary mechanism through which immigrant peers matter is their achievement, then there might be no reason to expect a differential effect on native-born than on foreign-born students. Yet if immigrants matter because of their status as immigrants, social tensions could arise that harm both groups. In extreme cases, high shares of immigrants in a school could lead to hostility between native-born and immigrant students, and prevent learning for all students (Gibson, 1988; Olsen, 1997).

[3] Some recent studies have tested the effect of peer racial composition by regressing student level outcomes (usually standardized test scores) on variables capturing the racial composition of children's schools (examples include Hoxby, 2000; Rivkin, 2000; Kain, & Rivkin, 2002; Angrist & Lang, 2004; Burke & Sass, 2006; Cooley, 2006; Armor & Duck, 2007). Hanushek et al. (2009), for instance, find that the school percentage black has a negative effect on individual black student achievement (particularly for high achieving blacks), controlling for average students achievement and measures of school quality. On balance, most of the other studies suggest relatively small influences of the racial composition of school peers on individual student test score performance once the bias driven by selection of students into schools is reasonably minimized.

To summarize, immigrant peers may matter to student achievement, but it is currently unclear precisely how and why they matter. Immigrant peers could affect individual students through their academic aspirations and abilities and/or their status as immigrants. The effect of immigrant peers may also depend upon whether the individual student is an immigrant and on the initial share of immigrants in the school.

Empirical Estimates of Immigrant Clustering Effects

There are several studies on the effect of immigrant neighborhood enclaves on immigrant labor market outcomes (e.g., Borjas, 1995; Gonzalez, 1998; Card, 2001; Edin, Fredriksson, & Åslund, 2003; Cutler, Glaeser, & Vigdor, 2007) and to a lesser extent on immigrant children's educational performance (e.g., Pong & Hao, 2007). There are only two studies to my knowledge that explore the effect of immigrant concentrations in school on the human capital development of the students. One of these two studies uses Israeli data to examine the effect of immigrant concentrations in elementary school on the quality of the high school attended, the likelihood of passing high school matriculation exams (prerequisites for college enrollment), and the likelihood of high school dropout among native Israelis (Gould, Lavy, & Paserman, 2009). The study finds that the presence of immigrants in elementary school has small negative effects on the probability that native-born students will pass the matriculation exams. The second study examines the effect of immigrant shares in middle school on the test score performance of immigrant students in Miami and San Diego (Cortes, 2006). Cortes (2006) finds that the percentage immigrant in school has no effect on the reading and math performance of the immigrant students in the school, controlling for observable student- and school-level characteristics. The study did not examine how the percent of immigrants in the school affects the performance of native-born students.

Thus, the one estimate from the U.S. suggests that immigrant concentrations in school do not affect the academic achievement of immigrant students. The only available estimates of the effect of immigrant shares on native-born educational attainment suggests adverse effects of immigrants but the results may be unique to Israel where there is very little racial variation and the immigrants studied comprised a relatively well educated population from the Soviet Union. There are no existing estimates of the effect of immigrant concentrations on U.S. native-born students, a group that currently makes up the majority of school children.

3 Estimation

One of the main difficulties in identifying peer effects is the possible endogeneity of choices: the same characteristics that determine where and with whom children go to school may also determine their achievement in school. Moreover, student and peer achievement occur contemporaneously (for instance, when an individual student convinces his peers to cheat on an exam). Therefore, studies that regress student achievement on a set of peer characteristics without addressing the endogenous choice of school and the simultaneous nature of peer interactions (when the right-hand side variable of interest is peer achievement) may overestimate the effect of peers.

The two previous attempts at estimating the effect of immigrant concentrations in school condition on a large set of relevant observable characteristics of the students and their schools (Cortes, 2006; Gould et al., 2009). The study of Israeli students goes one step further to exploit random variation in the number of immigrants across grades within the same school. Gould and colleagues argue that, independent of the total number of immigrants in a school, the number of immigrants in a specific grade is due to random factors, such that endogeneity is overcome by

examining conditional grade-level effects (a technique that has also been used to study the effects of the racial composition of peers, notably, Hoxby, 2000).

I take a different approach to addressing biases due to self-selection that uses data on students at two points in time. I first estimate models of 10th grade test scores that hold constant 8th grade test scores as follows:

$$(1) \qquad Y_{isc(g+2)} = \beta_0 + \beta_1 I_{s(g+1,g+2)} + \beta_2 X_{ig} + \beta_3 S_{s(g+1,g+2)} + \beta_4 T_c + a_{sg} + \varepsilon_i.$$

where $Y_{isc(g+2)}$ refers to the 10th grade math score or 10th grade reading score for student *i* in school *s*, cohort *c* (1-7), and grade *g+2* (where *g* refers to the 8th grade). The primary variable of interest is $I_{s(g+1,g+2),}$ which is calculated as the mean of the share of immigrant students in the schools attended in the 9th and 10th grades. Thus, $I_{s(g+1,g+2)}$ captures the exposure to immigrants across the first two years of high school and β_1 is the adjusted effect of a one percentage-point increase in the foreign-born population in a school on the test score performance of the students in the school.

Equation (1) also holds constant $X_{ig,}$ a vector of characteristics unique to student *i*, measured in the 8th grade, including nativity, race/ethnicity, gender, eligibility for free or reduced price lunch (FRPL), parents' native language, English Language Learner (ELL) status,[4] disability status, and her reading or math achievement score. $S_{s(g+1,g+2)}$ are other characteristics of the schools attended in the 9th and 10th grades, including the demographics and educational performance of the students (e.g., % FRPL, % of each racial/ethnic group, mean achievement scores) and the resources available to the schools (e.g., per-pupil expenditures, teacher qualifications). T_c is a vector of indicator variables for the year the student enrolled in the 8th

[4] Also known as Limited English Proficient.

grade, allowing for different intercepts for each cohort; and a_{sg} are fixed effects for the schools attended in the 8th grade.

The value-added nature of Equation (1), along with the large set of student and school control variables, should remove many sources of bias on the estimated effect of immigrant peers. For example, to the extent that students' 8th grade test scores are determined by the quality of their early childhood education, the 8th grade scores should hold constant some portion of the effects of early education on 10th grade scores and school peer composition. Yet the prior year scores and the other student-level covariates are likely imperfect proxies for student, family, school, and community inputs to the production of education that are unique to each student. I, therefore, estimate a second model that identifies the effect of immigrant peers off of within-student changes in grade-level immigrant shares, controlling for other time-varying characteristics of the peers in the student's grade. This within-student estimator, with two observations per student, takes the following form:

$$(2) \qquad Y_{isg} = \beta_0 + \beta_1 I_{sg} + \beta_2 S_{sg} + \beta_3 E_g + f_i + \varepsilon_{ig}.$$

where Y_{isg} is the students test score in the 8th or 10th grade, g. I_{sg} refers to the percent of students in grade g and school s who are immigrants. S_{sg} includes a vector of other time-varying characteristics of the school-grade and E_g is an indicator variable identifying the 10th grade (controlling for the average change between the two grades).

Finally, the model includes student fixed effects (f_i) that control for *all* time-constant characteristics of students and their surroundings that influence test scores and that might otherwise bias the estimates of immigrant peer effects. These include characteristics that are recorded in the data but that need not be included in the model (e.g., race, sex) as well as a host

of unobserved inputs to the education production function that are unique to student *i*, such as family structure, quality of early childhood education, attitudes about schooling, and attitudes about immigrants. The remaining limitation of Equation (2) is that it does not control for unobserved time-varying characteristics of students that determine their performance change between the 8th and 10th grades. For instance, if students who are on a downward academic trajectory transfer to a school with a higher share of immigrants between the 8th and the 10th grades, then the estimated effect of immigrant peers will be downwardly biased.[5]

Equations 1 and 2 are estimated separately for foreign-born and native-born students to determine heterogeneity in effects and additional models are estimated with immigrant shares in intervals to identify nonlinearities.

Though Equation (2) is the preferred estimator as it should control for a larger set of unobservables than Equation (1), it also comes with limitations. In order to estimate Equation (2), the sample must be restricted to students who have test scores in both the 8th and 10th grades. This sample restriction is non-trivial – approximately 22% of the students with 10th grade tests scores lack 8th grade scores. Further, a much larger share of foreign-born students than native-born students are missing 8th grade test scores, approximately 37% and 20% respectively. Given that students who enter the school system in high school — both foreign-born and native-born— generally score lower on the 10th grade exams, omitting these students results in a slightly higher-performing sample of students, with a disproportionate share of higher-performing foreign-born students. If the characteristics of the foreign-born students in the schools attended by this sub-sample of students differs from the foreign-born peers in the larger sample, then the

[5] Note that though some of the student attributes that are recorded in the data technically vary over time (e.g. eligibility for free or reduced price lunch, ELL status, and exceptionality), there is such rare variation between the 8th and 10th grades that including these attributes as time varying has no effect on the estimates.

estimated effects of foreign-born peers could be biased (an issue I explain in greater detail in the results section).

For the samples used in the OLS regressions, I impute the missing values on the 8th grade test scores using multiple imputation by chained equations creating five multiply-imputed datasets.[6] The imputed scores are clearly best guesses of what the students test scores would have been had they been enrolled in the 8th grade and, therefore, prone to measurement error. Nevertheless, in order to fully understand immigrant peer effects, high school age entrants must be included in the analysis.

4 Data

The above models are implemented using administrative data from the Florida Department of Education (FLDOE). The FLDOE's PK20 Education Data Warehouse (EDW) is an integrated statewide longitudinal database that tracks students in Florida's public elementary, secondary, and postsecondary schools. I use seven cohorts of students from the 8th grade who are tracked through high school, with test scores at multiple points, demographics, graduation outcomes, and information on the schools. The first cohort entered the 8th grade in 1997-98 and the last cohort entered in 2002-03.[7]

For each student, demographic, socioeconomic, and program participation data are available, including students' race/ethnicity, gender, birthdate, birthplace, language spoken in the home,

[6] I use the same technique to impute school resource variables. Approximately 1.5% of students were missing school expenditures and teacher years of experience.

[7] The cohorts are "progressive" which means that any student who enters the Florida system after the 8th grade and who would be in the same graduating class is included. For instance, a student who entered in the 9th grade in 1999-2000 is appended to the 8th grade 1998-99 cohort.

English proficiency, participation in special education program,[8] and eligibility for the free or reduced-price lunch program. The data also record students' reading and math scores on the Florida Comprehensive Assessment Test (FCAT) in the 8th and 10th grades; the FCAT is Florida's standardized exam, used for accountability purposes since 1998. Students are linked to the schools attended in each year, which permits aggregation from the student to the school level and, correspondingly, measures of the demographic (e.g., percent foreign-born) and performance (e.g., mean FCAT score) of students in the school. Also included are the resources of the students high schools, including expenditures and teacher characteristics.

I created four samples for the analysis corresponding to the two dependent variables of interest- 10th grade math achievement, 10th grade reading achievement-- and the two different estimators (OLS and fixed effects). As explained above, the primary difference between the OLS and within-student samples is that the OLS includes students who do *not* have 8th grade test scores while the within-student estimator omits them: the difference has important implications for the interpretation of results (to be discussed later).

From all four samples, I delete students with missing birthplace data (approximately 0.12% of students in all four samples); students who are not observed in a Florida public school in the 9th or 10th grades or who have no data on the schools attended (approximately 6% of students in the OLS samples and 2% of students in the fixed effects samples) and students who attended schools with fewer than 20 students (approximately 2% of the students in all samples). For the OLS models, the final math sample includes 1,113,299 students and the reading sample includes 1,119,068 students. For the within-student estimation, the final math sample includes 900,925 and the reading sample includes 906,876 students.

[8] Florida supports supplemental or stand-alone exceptional education programs for students who are gifted or who have learning, physical, or mental disabilities.

Table 1 provides descriptive statistics on all four samples. The subsample of students who have test scores at both points in time (Samples 3 and 4) have higher test scores on average than larger population of student. The sub-sample is also slightly more likely to be native-born and English proficient, reflecting the fact that high-school age entrants to the school system are disproportionately foreign-born students with limited English proficiency. Table 1 continues onto the next page and provides summary statistics on the schools attended by students in each of the samples. For samples 1 and 2, the numbers are the mean characteristics of schools attended by students in the 9^{th} and 10^{th} grades. For samples 3 and 4, the numbers are simply the characteristics of students' peers in the tenth grade (8^{th} grade means are omitted to save space but both are used in the fixed effects estimation). Just over half of the students attend schools with fewer than 10% foreign-born peers but non-trivial shares of students attend more immigrant-rich schools, allowing for tests of nonlinear effects of immigrant peers.

5 Results

Table 2 provides the results of the OLS regressions (Equation 1) of 10^{th} grade math test scores. The first three columns present the results with the percent of schoolmates who are foreign-born in linear form on the right-hand side and the second three columns present the results of the nonlinear specification. Column1 (model without controls) suggests that a one percentage-point increase in the foreign-born share associates with a 0.007 decrease in students' math test scores. Column 2 (the adjusted model) reveals that much of the unadjusted correlation between foreign-born share and math test scores shown in Column 1 may have been driven by the unobservables that are held constant in the second model. Column 3 presents the results of a model that does not impute 8^{th} grade test scores (the sample is restricted only to students with

non-missing 8th grade scores). Again, the model suggests a very small (though positive) effect of immigrant shares on student achievement.

Turning to the nonlinear specifications, large negative correlations between immigrant shares and 10th grade test scores are found in the unadjusted model. Relative to attending a school with fewer than 10% foreign-born students (the type of school attended by most students), attending a school with 10% - <20% foreign-born associates with a near 0.07 drop in math test scores (Column 4). Moves from each decile to the next associate with a 0.04 to 0.08 decrease in test scores with slightly smaller decreases occurring with larger initial shares of immigrants (for instance, moving from a school with 30%-<40% foreign-born to one with 40%-50% foreign-born corresponds to a 0.04 lower test score.

Similar to the second model in the linear specification, a large portion of the negative influence of immigrant shares is wiped out in the conditional model. Immigrant peers still have negative associations with math achievement up until a school becomes 40 to 50% foreign-born, at which point, the effect becomes positive; approximately 4% of the students in the sample attend schools with this many foreign-born. The model without imputed 8th grade test scores (Column 6) renders the effects of foreign-born shares less negative at the lower deciles and more positive at the upper deciles; in fact, the model suggests strong positive effects of attending a school with at least 30% foreign-born.

The difference between the models with and without the imputed 8th grade scores reveals the importance of restricting the sample to students with non-missing 8th grade scores. There are two major differences between the larger population of students with 10th grade test scores and the sub-population of students with scores in both grades that influence the results. As shown in Table 1, the sub-sample is a high-performing group, in part because it includes fewer foreign-

born students with limited English ability. Notice also that the positive effect of being foreign-born in Columns 2 and 5 (where test scores are imputed) is lower than the effect of being foreign-born in Columns 3 and 6 (where the test scores are not imputed), approximately 0.045 and 0.072 respectively. This difference reveals that the foreign-born students who enter the school system at earlier ages and who have 8th grade test scores are a higher-performing group than the native-born who enter younger. Put differently, the positive effect of being foreign-born is larger among younger entrants than among older entrants. Restricting the sample, thus, produces an upward bias on the foreign-born coefficient. In addition, the composition of the foreign-born students in the schools attended by the sub-sample of students differs in a way that produces bias on the immigrant peer effects. The mean 10th grade test scores of the immigrant peers in schools attended by students *with* 8th grade math test scores is 0.109 while the mean 10th grade test scores of the immigrant peers in schools attended by students *without* 8th grade scores is -0.263.

Together, these results suggest that attending a school with a large share of immigrants can be harmful if many of those immigrants are relatively new to the U.S. and, quite possibly, struggling to achieve. Yet, if the immigrants in the school arrived when they were younger and likely outperform equivalent native-born (consistent with the larger literature on immigrant performance), then positive spillovers of immigrant peers are likely. The initial share of immigrants in the school also matters; the positive spillovers only begin to occur when the foreign-born make up at least 30% of the school. The effect of foreign-born peers is conditional on the 8th grade mean performance of the students in the school as well, suggesting that foreign-born may matter to students other than through their higher (or lower) achievement. Of course,

the mean 8th grade scores could also be weak proxies for the achievement of foreign-born in particular.

The results for reading test scores tell a similar story (see Table 3). In fact, the immigrant peer effect estimates from the linear specification for reading (Columns 1, 2, and 3) are nearly identical to those for math: a one percentage-point increase in the foreign-born share has a modest effect on individual student reading achievement. The nonlinear specifications, again, suggest large negative adjusted associations between attending a school with a relatively small share of immigrants (20 to 30%) but a positive effect of attending a school that is 40%-<50%. Column 6, the model that includes only those students whose 8th grade scores were observed, again shows large positive correlations between immigrant-dense schools and individual student's reading achievement.

Thus, the same interpretations provided for the math results apply to the reading results. The coefficient on the foreign-born in reading models with imputed test scores suggests no positive effect of being foreign-born but once the sample is restricted to those with 8th grade scores, the foreign-born advantage increases to 0.083. The results, again, indicate that attending a school with large shares of immigrants who entered the U.S. before high school might be good for individual student achievement. The effect of attending a school with immigrants who are new to the school system and probably under-performing may depend -- note, the negative effect at the second decile and the positive effect at the fifth decile.

The results from the sixth column of Tables 2 and 3 suggest, fairly strongly, that some immigrant peers are good for individual students. Other than the bias rendered by the selected sample, however, the OLS regressions likely suffer from some omitted variable biases. To address some of these remaining biases, I turn now to the results of the within-student estimation

(Table 4). The models are necessarily restricted to the sample of students who have test scores recorded in both the 8th and the 10th grades and, thus, are the same as the students used to estimate the OLS regressions presented in Columns 3 and 6 of Tables 2 and 3. The fixed effects models also condition on a slightly smaller set of school characteristics since resources data could not be disaggregated to the grade-level (e.g. per-pupil expenditures is a schoolwide measure). Note, however, that the effects of those variables are small to zero as shown in the bottom of Tables 2 and 3. The advantage of the within-student estimator is that it should hold constant a larger set of time-constant unobservables than the model that simply holds 8th grade test scores constant. The within-student estimator also captures the effect of the immigrant peers in the students grade (not school), thus increasing the probability of contact.

The fixed effects models render the effects of foreign-born peers overwhelmingly positive. In the linear specification, the effect of a one-percentage point increase in the foreign-born share of a student's grade-level peers increases math test scores by 0.006 and reading test scores by 0.007 (in the OLS models, the coefficient was only 0.001 for the restricted sample). The nonlinear specifications show large gains from moving up one decile on the immigrant peer distribution; when an 8th graders peer group moves from 30-<40% foreign-born to 40-<50% foreign-born by the 10th grade, for instance, his math scores increase by 0.06 standard deviation units.

Table 5 asks whether the effects of immigrant shares differ for foreign-born and native-born students. Given the differences presented by including students without 8th grade test scores, the results are presented both using the OLS estimator (with 8th grade scores imputed) and the fixed effects estimator. Just the nonlinear specifications are shown. Somewhat surprisingly, the results are very similar for the two groups. For both groups, the OLS estimator suggests negative

effects of attending schools with immigrant shares of between 10 and 30% relative to schools with smaller shares. The negative effects are slightly larger for foreign-born. The within-student estimator suggests positive effects of foreign-born peers for both groups and the positive effects are slightly larger for foreign-born than for native-born. The differences between the results from the two estimators are similar in reading (negative effects using OLS and positive effects using within-student). Interestingly, however, the positive effect of foreign-born peers from the within-student estimator is slightly larger for foreign-born than for native-born.

6 Preliminary Conclusions

This paper asks whether immigrant peers in high school affect the achievement of individual students and the answer is "yes" but that the direction and magnitude of the effect depends on a number of circumstances. The results suggest that when the entire population of students with 10^{th} grade test scores is examined, attending schools with immigrants can have negative effects on student achievement. Yet, when the sample is restricted to students who were enrolled in the Florida public schools in the 8^{th} grade and who have 8^{th} grade test scores (approximately 78% of all students), the results suggest strong positive spillover effects of immigrant peers. It turns out that the immigrant peers in the schools attended by this sub-population of students are a high performing group – foreign-born students who arrived to the U.S. when they were younger. The larger population of students disproportionately attend schools where the immigrants are likely limited in their English proficiency and struggling to learn. The effect of immigrant peers is also similar for native-born and foreign-born students, suggesting no negative social externalities (for instance, through anti-immigrant hostility) to immigrants and native-born sharing schools. The reader is cautioned that these are the first of several takes on this question – in order to truly

locate the mechanism through which immigrant peers matter, my next step (to be included in the next draft) is to directly model the effect of attending schools with immigrants with different characteristics (e.g., high achievers and low achievers, new entrants and early entrants, English proficient and non-English proficient).

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Table 1: Descriptive Statistics on Florida Students

	Sample 1: Used to Estimate OLS Regressions of 10th Grade Math Scores		Sample 2: Used to Estimate OLS Regression of 10th Grade Reading Scores		Sample 3: Used to Estimate Fixed Effects Regression of 10th Grade Math Scores		Sample 4: Used to Estimate Fixed Effects Regression of 10th Grade Reading Scores	
Number of students	1,113,299		1,119,068		900,925		906,876	
	Mean	sd	Mean	sd	Mean	sd	Mean	sd
Student test scores:								
10th grade math score	0.130	0.927	0.139	0.918	0.186	0.883	0.191	0.877
10th grade reading score	0.136	0.928	0.124	0.939	0.188	0.882	0.179	0.891
8th grade math score	0.215	0.891	0.214	0.891	0.263	0.880	0.267	0.876
8th grade reading score	0.194	0.925	0.191	0.926	0.246	0.910	0.238	0.915
Missing 8th grade math score	0.224	0.417	0.225	0.417	0.000	0.000	0.000	0.000
Missing 8th grade reading score	0.224	0.417	0.224	0.417	0.000	0.000	0.000	0.000
Student attributes:								
Foreign-born	0.129	0.335	0.129	0.335	0.106	0.308	0.106	0.308
Male	0.493	0.500	0.494	0.500	0.487	0.500	0.488	0.500
Age on 7/1 of year should have graduated	18.493	0.548	18.494	0.547	18.437	0.458	18.438	0.458
Asian	0.023	0.150	0.023	0.150	0.022	0.146	0.022	0.146
Black	0.221	0.415	0.221	0.415	0.226	0.419	0.227	0.419
Hispanic	0.205	0.404	0.205	0.404	0.196	0.397	0.196	0.397
White	0.533	0.499	0.532	0.499	0.539	0.498	0.539	0.498
Eligible for free or reduced-price lunch (FRPL)	0.462	0.499	0.171	0.377	0.469	0.499	0.469	0.499
English is parents' native language	0.783	0.412	0.463	0.499	0.795	0.403	0.795	0.404
English Language Learner (ELL)	0.170	0.376	0.783	0.413	0.158	0.365	0.158	0.365
Exceptionality	0.120	0.325	0.120	0.326	0.121	0.326	0.122	0.327
Cohort 1 (8th grader in 1997)	0.136	0.343	0.135	0.342	0.084	0.278	0.084	0.277
Cohort 2 (8th grader in 1998)	0.116	0.320	0.116	0.320	0.116	0.321	0.116	0.321
Cohort 3 (8th grader in 1999)	0.130	0.337	0.131	0.337	0.137	0.344	0.137	0.344
Cohort 4 (8th grader in 2000)	0.141	0.348	0.140	0.347	0.148	0.355	0.148	0.355
Cohort 5 (8th grader in 2001)	0.150	0.357	0.150	0.357	0.161	0.367	0.160	0.367
Cohort 6 (8th grader in 2002)	0.159	0.366	0.159	0.366	0.171	0.377	0.171	0.377
Cohort 7 (8th grader in 2003)	0.168	0.373	0.169	0.375	0.182	0.386	0.184	0.387

Note: Table continues onto the next page.

Table 1 Continued: Descriptive Statistics on Florida Students

	Sample 1: 10th Grade Math Scores, All Students		Sample 2: 10th Grade Reading Scores, All students		Sample 3: 10th Grade Math Scores, Students with 8th Grade Math Scores		Sample 4: 10th Grade Reading Scores, Students with 8th Grade Math Scores	
	Mean	sd	Mean	sd	Mean	sd	Mean	sd
School Attributes:								
Share foreign-born	0.129	0.119	0.129	0.119	0.129	0.118	0.129	0.117
% Foreign born = 0-<10	0.562	0.496	0.562	0.496	0.544	0.498	0.543	0.498
% Foreign-born = 10-<20	0.186	0.389	0.187	0.390	0.224	0.417	0.225	0.418
% Foreign-born = 20-<30	0.141	0.348	0.141	0.349	0.128	0.334	0.128	0.334
% Foreign-born = 30-<40	0.065	0.247	0.065	0.247	0.062	0.241	0.062	0.241
% Foreign-born = 40-<50	0.037	0.189	0.037	0.190	0.035	0.185	0.035	0.185
% Foreign-born = 50<-100	0.007	0.086	0.007	0.086	0.007	0.086	0.007	0.085
Share Asian	0.021	0.018	0.021	0.018	0.021	0.019	0.021	0.019
Share Black	0.226	0.204	0.226	0.204	0.232	0.200	0.232	0.200
Share Hispanic	0.205	0.224	0.205	0.224	0.211	0.223	0.211	0.223
Share White	0.550	0.230	0.550	0.230	0.518	0.263	0.517	0.266
Share FRPL	0.476	0.202	0.476	0.202	0.482	0.196	0.428	0.196
Share ELL	0.171	0.191	0.171	0.191	0.173	0.190	0.174	0.190
Mean 8th grade math score	0.071	0.349	0.071	0.349	0.056	0.344	0.055	0.345
Mean 8th grade reading score	0.062	0.332	0.061	0.332	0.055	0.334	0.054	0.335
Number of students enrolled	2227	913	2227	913				
Per pupil expenditures	$5,141	$1,004	$5,142	$1,009				
Share teachers with advanced degrees	0.390	0.100	0.386	0.095				
Mean years of teacher experience	14	3	14	3				
Number of instructional staff	119	41	119	41				

Notes: i) For samples 1 and 2, the school attributes are means of attributes in schools attended during the 9th and 10th grades. For samples 3 and 4, the school attributes refer to students 10th grade peers in their schools. Resources data (per pupil expenditures & staff) could not be disaggregated to the school-grade and are, therefore, not reported for Samples 3 and 4. ii) For samples 1 and 2, missing test scores and school resources variables were multiply imputed.

Table 2: OLS Regressions of 10th Grade Math Scores

Foreign-born specification	Linear	Linear	Linear	Nonlinear	Nonlinear	Nonlinear
8th Grade Fixed Effects?	No	Yes	Yes	No	Yes	Yes
8th Grade Test Scores Imputed?	Yes	Yes	No	Yes	Yes	No
Column	1	2	3	4	5	6
School % Foreign-born	-0.007***	-0.001**	0.001**			
	(0.001)	(0.001)	(0.000)			
% Foreign-born = 10-<20				-0.068*	-0.027***	0.001
				(0.038)	(0.010)	(0.007)
% Foreign-born = 20-<30				-0.148***	-0.031**	0.013
				(0.039)	(0.015)	(0.009)
% Foreign-born = 30-<40				-0.227***	-0.005	0.030**
				(0.059)	(0.021)	(0.013)
% Foreign-born = 40-<50				-0.267***	0.054**	0.064***
				(0.050)	(0.026)	(0.020)
% Foreign-born = 50<-100				-0.325***	0.028	0.063***
				(0.059)	(0.032)	(0.023)
Foreign-born		0.045***	0.072***		0.044***	0.072***
		(0.005)	(0.003)		(0.005)	(0.003)
Male		0.103***	0.095***		0.103***	0.095***
		(0.002)	(0.001)		(0.002)	(0.001)
Age		-0.167***	-0.120***		-0.167***	-0.120***
		(0.003)	(0.002)		(0.003)	(0.002)
Asian		0.078***	0.051***		0.078***	0.051***
		(0.008)	(0.006)		(0.008)	(0.006)
Black		-0.207***	-0.094***		-0.207***	-0.094***
		(0.005)	(0.004)		(0.005)	(0.004)
Hispanic		-0.119***	-0.061***		-0.118***	-0.061***
		(0.005)	(0.004)		(0.005)	(0.004)
FRPL		-0.088***	-0.059***		-0.088***	-0.059***
		(0.003)	(0.002)		(0.003)	(0.002)
English is parents' native language		-0.009**	-0.010***		-0.010***	-0.010***
		(0.004)	(0.003)		(0.004)	(0.003)
ELL		-0.064***	0.008**		-0.064***	0.008**
		(0.005)	(0.003)		(0.005)	(0.003)
Exceptionality		-0.345***	-0.144***		-0.345***	-0.144***
		(0.009)	(0.007)		(0.009)	(0.007)
8th grade math score		0.568***	0.736***		0.568***	0.736***
		(0.005)	(0.006)		(0.005)	(0.006)

Notes: Regression output continued onto the next page.

Table 2 Continued: OLS Regressions of 10th Grade Math Scores

Foreign-born specification	Linear	Linear	Linear	Nonlinear	Nonlinear	Nonlinear
8th Grade Fixed Effects?	No	Yes	Yes	No	Yes	Yes
8th Grade Test Scores Imputed?	Yes	Yes	No	Yes	Yes	No
Column	1	2	3	4	5	6
School mean 8th grade score		0.049	0.167***		0.042	0.164***
		(0.031)	(0.020)		(0.031)	(0.019)
School % Asian		0.014***	0.004**		0.016***	0.005***
		(0.003)	(0.002)		(0.003)	(0.002)
School % black		0.001***	0.002***		0.001***	0.002***
		(0.000)	(0.000)		(0.000)	(0.000)
School % Hispanic		-0.001***	-0.001**		-0.001**	-0.001*
		(0.001)	(0.000)		(0.000)	(0.000)
School % FRPL		-0.002***	0.000		-0.002***	-0.001
		(0.000)	(0.000)		(0.000)	(0.000)
School % ELL		0.004***	0.003***		0.002***	0.002***
		(0.001)	(0.001)		(0.001)	(0.001)
School enrollment		-0.000***	-0.000***		-0.000***	-0.000***
		(0.000)	(0.000)		(0.000)	(0.000)
School per pupil expenditures		0.000	0.000		0.000	0.000
		(0.000)	(0.000)		(0.000)	(0.000)
School % teachers with advanced degrees		0.001***	0.000		0.001***	0.000
		(0.000)	(0.000)		(0.000)	(0.000)
School mean years of teacher experience		-0.001	0.001		0.000	0.001
		(0.001)	(0.001)		(0.001)	(0.001)
School number of instructional staff		0.001***	0.000***		0.001***	0.000***
		(0.000)	(0.000)		(0.000)	(0.000)
Constant	0.234***	3.243***	2.176***	0.210***	3.227***	2.179***
	(0.018)	(0.049)	(0.042)	(0.016)	(0.050)	(0.043)
Number of Observations	1,113,299	1,113,299	863,441	1,113,299	1,113,299	863,441

Notes: i) Robust standard errors in parentheses. ii) FRPL refers to Free or reduced price lunch. ELL refers to English Language Learner. iii) Models shown in Columns 2,3, 5, and 6 also include cohort indicators. iv) * p< 0.10; ** p<0.05; *** p<0.01.

Table 3: OLS Regressions of 10th Grade Reading Scores

Foreign-born specification	Linear	Linear	Linear	Nonlinear	Nonlinear	Nonlinear
8th Grade Fixed Effects?	No	Yes	Yes	No	Yes	Yes
8th Grade Test Scores Imputed?	Yes	Yes	No	Yes	Yes	No
Column	1	2	3	4	5	6
School % Foreign-born	-0.007***	-0.002*	0.001**			
	(0.001)	(0.001)	(0.001)			
% Foreign-born = 10-<20				-0.086**	-0.020**	0.004
				(0.036)	(0.010)	(0.007)
% Foreign-born = 20-<30				-0.163***	-0.015	0.026**
				(0.035)	(0.015)	(0.010)
% Foreign-born = 30-<40				-0.230***	0.013	0.044***
				(0.054)	(0.019)	(0.013)
% Foreign-born = 40-<50				-0.309***	0.046*	0.062***
				(0.052)	(0.027)	(0.017)
% Foreign-born = 50<-100				-0.358***	0.043	0.110***
				(0.068)	(0.033)	(0.019)
Foreign-born		0.002	0.083***		0.000	0.083***
		(0.007)	(0.003)		(0.007)	(0.003)
Male		0.013***	0.031***		0.013***	0.031***
		(0.002)	(0.001)		(0.002)	(0.001)
Age		-0.180***	-0.146***		-0.180***	-0.146***
		(0.002)	(0.002)		(0.002)	(0.002)
Asian		0.000	0.003		0.000	0.003
		(0.008)	(0.006)		(0.008)	(0.006)
Black		-0.205***	-0.118***		-0.204***	-0.118***
		(0.005)	(0.004)		(0.005)	(0.004)
Hispanic		-0.092***	-0.049***		-0.091***	-0.048***
		(0.005)	(0.003)		(0.005)	(0.003)
FRPL		-0.115***	-0.083***		-0.115***	-0.083***
		(0.003)	(0.002)		(0.003)	(0.002)
English is parents' native language		-0.004	-0.016***		-0.004	-0.016***
		(0.005)	(0.003)		(0.005)	(0.004)
ELL		-0.130***	-0.007**		-0.129***	-0.007**
		(0.006)	(0.004)		(0.006)	(0.004)
Exceptionality		-0.393***	-0.226***		-0.393***	-0.226***
		(0.009)	(0.007)		(0.009)	(0.007)
8th grade reading score		0.488***	0.629***		0.488***	0.629***
		(0.004)	(0.004)		(0.004)	(0.004)

Notes: Regression output continued onto the next page.

Table 3 Continued: OLS Regressions of 10th Grade Reading Scores

Foreign-born specification	Linear	Linear	Linear	Nonlinear	Nonlinear	Nonlinear
8th Grade Fixed Effects?	No	Yes	Yes	No	Yes	Yes
8th Grade Test Scores Imputed?	Yes	Yes	No	Yes	Yes	No
Column	1	2	3	4	5	6
School mean 8th grade score		0.143***	0.273***		0.136***	0.273***
		(0.029)	(0.019)		(0.030)	(0.019)
School % Asian		0.014***	0.003**		0.015***	0.004**
		(0.003)	(0.002)		(0.003)	(0.002)
School % black		0.002***	0.002***		0.002***	0.002***
		(0.000)	(0.000)		(0.000)	(0.000)
School % Hispanic		0.000	0.000		0.000	0.000
		(0.000)	(0.000)		(0.000)	(0.000)
School % FRPL		-0.002***	0.000		-0.002***	0.000
		(0.000)	(0.000)		(0.000)	(0.000)
School % ELL		0.002***	0.002***		0.001	0.002***
		(0.001)	(0.001)		(0.001)	(0.000)
School enrollment		-0.000***	-0.000**		-0.000***	-0.000**
		(0.000)	(0.000)		(0.000)	(0.000)
School per pupil expenditures		-0.000**	-0.000***		-0.000**	-0.000**
		(0.000)	(0.000)		(0.000)	(0.000)
School % teachers with advanced degrees		0.001**	0.000		0.001**	0.000
		(0.000)	(0.000)		(0.000)	(0.000)
School mean years of teacher experience		0.001	0.002*		0.001	0.002**
		(0.001)	(0.001)		(0.001)	(0.001)
School number of instructional staff		0.001***	0.000		0.001***	0.000
		(0.000)	(0.000)		(0.000)	(0.000)
Constant	0.236***	3.603***	2.738***	0.210***	3.590***	2.741***
	(0.017)	(0.051)	(0.048)	(0.015)	(0.051)	(0.048)
Number of Observations	1,119,068	1,119,068	868,008	1,119,068	1,119,068	868,008

Notes: i) Robust standard errors in parentheses. ii) FRPL refers to Free or reduced price lunch. ELL refers to English Language Learner. iii) Models shown in Columns 2,3, 5, and 6 also include cohort indicators. iv) * p< 0.10; ** p<0.05; *** p<0.01.

Table 4: Within Student Estimators, 10th Grade Math and Reading Test Scores

Dependent Variable	Math	Math	Reading	Reading
Specification	Linear	Nonlinear	Linear	Nonlinear
School % Foreign-born	0.006***		0.007***	
	(0.000)		(0.000)	
% Foreign-born = 10-<20		0.031***		0.039***
		(0.002)		(0.002)
% Foreign-born = 20-<30		0.037***		0.044***
		(0.003)		(0.003)
% Foreign-born = 30-<40		0.086***		0.096***
		(0.004)		(0.005)
% Foreign-born = 40-<50		0.146***		0.156***
		(0.006)		(0.007)
% Foreign-born = 50<-100		0.154***		0.209***
		(0.008)		(0.010)
School mean 8th grade score	0.257***	0.253***	0.295***	0.293***
	(0.002)	(0.002)	(0.003)	(0.003)
School % Asian	0.003***	0.002***	0.003***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)
School % black	-0.003***	-0.001***	-0.003***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
School % Hispanic	-0.000*	-0.000**	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
School % FRPL	-0.010***	-0.009***	-0.011***	-0.009***
	(0.000)	(0.000)	(0.000)	(0.000)
School % ELL	0.001***	0.001***	0.001***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
10th grade indicator	-0.064***	-0.061***	-0.047***	-0.043***
	(0.001)	(0.001)	(0.001)	(0.001)
Contant	0.084***	0.114***	0.037***	0.070***
	(0.003)	(0.003)	(0.004)	(0.004)
Number of Students	900,925	900,925	906,876	906,876
Number of Observations	1,801,850	1,801,850	1,813,752	1,813,752

Notes: i) Models include student fixed effects. ii) "School" refers to the "school-grade". iii) * p<.10; ** p<

Table 5: Effect of Foreign-born School Share on Foreign-born and Native-born Students

Dependent Variable	Math	Math	Math	Math	Reading	Reading	Reading	Reading
Estimator	OLS	OLS	Within-Student	Within-Student	OLS	OLS	Within-Student	Within-Student
Student is:	Foreign-born	Native-born	Foreign-born	Native-born	Foreign-born	Native-born	Foreign-born	Native-born
% Foreign-born = 10-<20	-0.047***	-0.024**	0.034***	0.025***	-0.034*	-0.017*	0.016**	0.032***
	(0.016)	(0.010)	(0.007)	(0.002)	(0.018)	(0.010)	(0.008)	(0.002)
% Foreign-born = 20-<30	-0.066***	-0.025	0.029***	0.025***	-0.050**	-0.005	-0.01	0.031***
	(0.023)	(0.015)	(0.010)	(0.003)	(0.025)	(0.014)	(0.011)	(0.004)
% Foreign-born = 30-<40	-0.023	-0.002	0.086***	0.060***	-0.01	0.023	0.024	0.069***
	(0.038)	(0.020)	(0.013)	(0.005)	(0.033)	(0.020)	(0.015)	(0.005)
% Foreign-born = 40-<50	0.059	0.042	0.159***	0.102***	0.027	0.068**	0.073***	0.108***
	(0.038)	(0.026)	(0.016)	(0.006)	(0.036)	(0.026)	(0.018)	(0.007)
% Foreign-born = 50<-100	0.021	0.028	0.162***	0.115***	0.018	0.090***	0.140***	0.149***
	(0.049)	(0.037)	(0.019)	(0.010)	(0.059)	(0.029)	(0.022)	(0.012)
Number of students	142,196	971,103	95,944	804,981	143,184	975,884	96,410	810,466
Number of observations	142,196	971,103	191,888	1,609,962	143,184	975,884	192820	1620932

Notes: i) Robust standard errors in parentheses. ii) OLS Estimator also includes all variables shown in Column 5 of Tables 2 and 3. iii) Within-Student estimator also includes all control variables shown in Table 4. iv) * p< 0.10; ** p<0.05; *** p<0.01.