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ON RURAL-URBAN DIFFERENCES IN HUMAN CAPITAL FORMATION: FINDING THE 'BOTTLENECKS'*

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ABSTRACT

Studies have found lower levels of educational achievement for students in rural areas focusing mostly on cross-sectional data. Using the 1997 National Longitudinal Survey of Youth, we follow the same youth cohort to examine whether there are metro-nonmetro gaps in high cognitive achievement, high school graduation, college readiness, degree attainment, and earnings. We find that gaps emerge early in life and they remain constant through high school. In addition, results suggest that rural students graduate from high school at the same rate as their urban counterparts, but they fall behind when it comes to college graduation rates. Growing up in a rural area does not seem to impose a wage penalty beyond the lower earnings operating through cognitive test performance and college degree attainment.

Whether nonmetro youth face unique disadvantages in terms of human capital formation remains open to discussion (e.g., Reeves 2012). Recent estimates on adults residing in nonmetro areas show a clear gap in formal education. From 2006 to 2010, 17.5 percent of nonmetro adults had no high school diploma (compared with 14.4 percent of metro adults) and 17.5 percent had at least a college degree (compared with 30 percent of metro adults) (USDA 2012).[1] Overall, nonmetro human capital gaps can persist either through disproportionate migration of more

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[1]The report used data from the Census Bureau's American Community Survey (ACS) (2006-2010).

productive youth or lower human capital formation among incumbent nonmetro youth, accrued at any point in their lives.[2]

This study focuses on the timing of metro-nonmetro differences in human capital within the life of a nationally representative cohort of youth followed from age 12 to 30, using long-term panel data from the National Longitudinal Survey of Youth (1997) (NLSY97; Bureau of Labor Statistics 2012). We track the size of metro-nonmetro gaps in several educational outcomes among youth as they go through important life stages, examine how accumulated education and cognitive skill relate to migration decisions, and explore the labor market consequences of nonmetro human capital gaps. Specifically, we ask: 1) At which point in their lives do nonmetro and metro youth start to look statistically different in terms of cognitive skills and completed schooling?; 2) What happens to gaps in these outcomes as youth go through important life stages (before and during high school, college, and work force)?; 3) How do migration choices of nonmetro youth relate to education and cognitive skill?; and 4) What is the net effect that educational outcome gaps have on adult wages?

We use the conceptual framework of Roscigno and Crowley (2001) as a starting point, and extend it to highlight the temporal aspects of human capital formation. Roscigno and Crowley (2001) pointed out that the interaction of labor markets, family resources, and migration patterns may result not only in a concentration of resource-constrained households in nonmetro areas, but also a lower propensity to invest out of a given resource base. This highlights the importance of distinguishing between resources and investments, in both the private and public sectors, when considering metro-nonmetro human capital gaps.

Empirically, many studies have used the framework of Roscigno and Crowley (2001) with cross-sectional or short panel data on youth of different ages to examine the relative role of resources and investments (public and private) in explaining metro-nonmetro gaps in educational outcomes at a given point in time (e.g., Byun, Meece, and Irvin 2012; Durham and Smith 2006).

We complement the current literature by exploiting long-term panel data to pinpoint *when* metro-nonmetro differences start emerging, how these gaps evolve over time, and their relationship to migration decisions and adult wages. Our

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[2]Human capital is a person's productive capacity in a labor market context. This productive capacity is influenced by many factors, such as the quantity and quality of formal education; innate or acquired cognitive ability; and non-cognitive attributes such as patience, impulsivity, interpersonal skills, ambition, etc. In this paper we proxy human capital through several measures of formal education and cognitive skills (AFQT test, SAT/ACT test, high school and college diplomas).

approach will provide information on the relative merits of age-specific interventions focusing less on *explaining* metro-nonmetro educational gaps for any particular age group and more on *measuring* their progression over the lives of a nationally representative cohort of youth as they age from 12 to 30 years old.

LITERATURE REVIEW ON METRO-NONMETRO GAPS IN EDUCATIONAL OUTCOMES

Many studies have examined metro-nonmetro achievement gaps over several educational outcomes. Primarily, they have used short term data to identify gaps and factors that underlie them, such as family background, private resources and investments, and place-specific attributes ranging from public investments to social capital, and more. A full review of this literature is not within the scope of our study, however, we highlight recent studies that have identified metro-nonmetro achievement gaps during important life stages of youth focusing specifically on their findings, data, controls for youth's past, and implications for the timing of metro-nonmetro gaps.

Kindergarten

Several important studies have examined the determinants of cognitive achievement in children (e.g., Blau and Grossberg 1992; Todd and Wolpin 2007). These studies have found that school, home inputs, mother's ability (as measured by Armed Forces Qualification Test (AFQT) score), and social resources are among the main factors that influence children's cognitive achievement. An important finding of this literature is that, besides quantities, the timing of resources invested in youth matters substantially.

Concerning metro-nonmetro gaps, Durham and Smith (2006) examined literacy gaps in kindergarten and found a negative association between early literacy ability and rurality. Their findings reveal that literacy gaps emerge quite early and the relationship between nonmetro status and educational deficiencies depends on the structural characteristics of the community (e.g., poverty, work instability), individual ethnicity, and socioeconomic status (e.g., family income, alternative family arrangements).

1st through 8th Grade

Summary statistics in a report by the National Center for Educational Statistics (Provasnik et al. 2007) showed that nonmetro youth in 4th and 8th grade trailed their suburban peers in math, reading, and science tests, but did better than youth in inner cities.

Fan and Chen (1999), in an earlier study, used data from the National Education Longitudinal Study of 1988 (NELS88) to perform, among other things, comparisons for 8^{th} graders, and found no gaps in achievement across four subjects (reading, mathematics, science, and social studies). That study, however, provides estimates adjusted for socioeconomic characteristics (SES) for each grade level, and does not use the panel nature of the data to decompose raw gaps temporally (i.e., into disparities that exist before 8^{th} grade and generated during high school). Lee and Mcintire (2000) compared mathematics scores for metro and nonmetro 8^{th} graders and reported no significant differences nationally, but state variation in gaps. However, that study did not hold constant race, ethnicity, and other SES.

A few studies have used data from particular states. For example, Beck and Shoffstall's (2005) school-level analysis found that nonmetro schools show no significant differences from suburban schools but they outperform their peers in inner city schools in Illinois' standardized tests of 7^{th} and 8^{th} graders; after controlling for (among others) income, parent involvement, school size, and student turnover. However, these findings are difficult to interpret regarding timing for similar reasons. No results that only held constant race and ethnicity were provided, and the ones that held background constant did not lend themselves to a clear temporal interpretation.

High School

There is a large body of literature regarding high school student achievement and dropout rates among metro and nonmetro areas. In a review of this literature from the 1990s and before; Khattri, Riley, and Kane (1997) found no clear answer regarding the relative performance of nonmetro schooling.

Using data on 10^{th} and 12^{th} graders from the NELS88, Fan and Chen (1999) concluded that "rural students performed as well, if not better, than their peers in metropolitan schools" (Fan and Chen 1999:31). All estimates control for SES and an area's SES composition is not random, but a result of deliberate location choices by parents, which may have been made with educational investments in mind. So only controlling for SES masks important temporal dynamics in metro-nonmetro achievement.

Roscigno and Crowley (2001) also employed NELS88 data and the Common Core of Data (CCD), and they found that students living in nonmetro areas exhibit lower levels of educational achievement, explained largely by factoring resources and investments among families and schools.

Some studies have used data from individual states; for instance Reeves and Bylund (2005) and Reeves (2003) found that nonmetro Kentucky students trail their metro counterparts; in Reeves and Bylund's (2005) study, findings suggested that they do so even after controls for various resources and investments. Year-to-year growth in nonmetro schools, however, exceeds that of metro. While interesting, their use of data over time does not inform gaps by age group; as school type (elementary, secondary, or mixed) was simply used as a control variable. No analysis was undertaken to compare scores or growth by age-group.

A recent study by Reeves (2012) used data from the 2002-2004 cohorts of the Educational Longitudinal Study to report no math achievement gaps in 10th grade. However, this is strictly based on descriptive statistics; no results were provided for 10th grade math gaps within race and ethnicity. The study also found that 10th to 12th grade growth in rural areas is about 0.1 standard deviations lower, even after controlling for several individual and school attributes and baseline 10th grade scores. The authors found that the rural disadvantage operates largely through peer influences and motivation to take more advanced math classes. This study comes closest to addressing some of the questions on timing that we are posing, and it did find that growth during high school is lower in nonmetro areas.

College

The decision to attend college is perhaps one of the most important and most widely studied, empirically. Surprisingly, few studies have examined metro-nonmetro differences in college attendance. As for college matriculation and completion, most studies have found a nonmetro disadvantage. Smith, Beaulieu, and Seraphine (1995); using data from The High School and Beyond (1980); found that nonmetro students were much less likely to attend college, with parents' expectations and encouragement on educational attainment being the most powerful predictor. Gibbs (1998), using data from the NLSY79, also found that nonmetro youth trail their metro counterparts in the pursuit of higher education, and that family and SES only explain a small portion of this disadvantage. Both studies reflect college attendance in the 1980s. Byun et al. (2012) also examined college attendance decisions made in the early 1990s and they find that nonmetro adults attend college at a much lower rate. Once SES was controlled for, differences were no longer statistically significant. Finally, Provansik et al. (2007), using several data sets, presented evidence (mainly descriptive) that college enrollment rates and the percentage of rural adults with a bachelor's degree were lower in rural areas compared with the national average in 2004, and a larger percentage of rural teenagers were neither employed nor in school.

LITERATURE REVIEW ON METRO-NONMETRO MIGRATION

Many studies have focused on nonmetro-metro migration (e.g., Domina 2006; Goetz and Debertin 1996; Winters 2011). Generally, studies have found that during the second half of the last century and the early 2000s, nonmetropolitan America has experienced an out-migration with most nonmetro areas experiencing a population loss (Johnson 2006). As noted, economic theory looks at migration as an investment in human capital where individuals evaluate their expected long-term benefits and choose to migrate if such benefits outweigh costs of moving (e.g., Mills and Hazarika 2001; Sjaastad 1962). Consistently, studies of nonmetropolitan out-migration have shown that leaving a nonmetropolitan county reduces time spent in poverty and unemployment spells; and increases wages and overall income (Mills and Hazarika 2001).

Our interpretation of the overall literature on metro-nonmetro education gaps is that it has generally provided evidence that nonmetro schools are at a disadvantage, and that this disadvantage can be observed in many outcomes and over several life stages. Studies have found gaps in kindergarten, 7th-8th grade, 10th-12th grade, college, etc. Researchers have also made significant progress in addressing how human capital gaps observable at any given age relate to the interplay of public as opposed to private resources and the role of ensuing investments in each domain. What is less clear is when these gaps emerge; how they evolve; how they influence subsequent skills; and how important they are, compared with one another, for adult outcomes.

DATA

The primary source of data is the NLSY97, administered by the Bureau of Labor Statistics. The NLSY97 is a nationally representative sample of approximately 9,000 youths who were 12 to 16 years old as of December 31, 1996. The first round of the survey started in 1997 and youths have been interviewed annually thereafter. The 1997 survey collected data on respondents' age, gender, race, and ethnicity. Family information includes household size and composition; number of adults; relationship of youth to each adult at home; the number and ages of siblings; education of biological parents, despite whether they lived at home; education of household members; household's income and wealth; whether the household went through hard times at any point before 1997; and mother's age when she had her first child; among others.

The survey reports progress in school each year, including grades completed and degrees obtained, and whether the school attended was a public school. The attainment of high school diplomas, college attendance, and college graduation are reported each year; making it possible to record whether and when each degree was completed. Additionally, all respondents are asked if they took a college admissions test and, if so, which one. Further they are asked to report the range wherein their score fell among six different categories.

The vast majority of survey respondents were also administered the Armed Services Vocational Aptitude Battery tests (ASVAB) in 1998. The ASVAB is a battery of tests intended to assess multiple dimensions of one's ability for the predominant purpose of assessing their likely fit in the military. Several test components are used to compute the Armed Forces Qualifying Test (AFQT), which provides a composite score for word knowledge, paragraph comprehension, arithmetic reasoning, and mathematical knowledge. The NLSY97 reports the AFQT score as a percentile ranking of each youth within their age group; so the AFQT is already age adjusted. In multiple previous studies, the AFQT has been a very good measure of cognitive skill affected by formal schooling (Cascio and Lewis 2006). The AFQT is an excellent predictor of school and labor market performance; this test score, in conjunction with the NLSY79 (the predecessor of the dataset used here), has underscored much of the debate on group cognitive abilities and earnings gaps, especially in the context of race and ethnicity (e.g., Neal and Johnson 1996).

The survey also reports employment and wages in each survey round, making it possible to examine whether adult wages are affected by early life experiences in rural areas. Additionally, the proprietary geocoded version of the dataset reports the county and state that the youth lived in during each survey round between 1997 and 2009. This makes it possible to attach rural-urban continuum codes to each individual's location in their teens and as adults.

Based on the 1993 ERS's Rural-Urban Continuum Codes, we grouped individuals into four categories, those living in: metro areas with an urban population of one million or more, that is counties with a rural-urban continuum code that is equal to 0 or 1 (we label these as *cities*); metro areas with an urban population of less than one million and a rural-urban continuum code of 2 or 3 (we label these counties as *smaller metro*); nonmetro counties with urban populations of 20,000 or more, or with urban populations that are less than 20,000 but that are adjacent to a metro area (i.e., rural-urban codes 4, 5, or 6; we label these as *rural*);

and *remote nonmetro*, which consists of all remaining counties (i.e., rural-urban codes of 7, 8, or 9.

In sum, NLSY97 also has several desirable features for our purposes. It follows youth over important life stages, starting before high school and following through labor force entry. The data are recent; although most of the literature on metro-nonmetro gaps has used data from past decades, nonmetro education levels have evolved, even since 2000. Our data reflects pre-high school conditions in the late 1990s, high school and college decisions made in the 2000s, and 2009 labor market conditions. County geocodes are used to account for heterogeneity within nonmetro areas, by using rural-urban continuum codes (a classification scheme published by USDA's Economic Research Service to classify nonmetro counties by rurality). Finally, the survey has collected an extensive array of family and background information. Summary statistics for the variables are presented in Table 1 for each of the four categories of rurality.

EMPIRICAL STRATEGY

We began by examining how nonmetropolitan youth compare with their metropolitan counterparts in terms of achievement in the AFQT. We first examined whether achievement gaps arise before high school and whether they widen or narrow during high school. The natural logarithm of the AFQT is used to measure achievement.[3] We used multilevel mixed-effects linear models since, in our case, individuals are clustered within counties (e.g., Bryk and Raudenbush 1992).

We estimated random intercept models that relate the natural logarithm of the AFQT score to rurality measured by categorical variables in the fixed component. We provide three different specifications of the model. The first includes only the indicators of residence in a smaller metro area, a rural area (code 4, 5, or 6), or a remote rural area (code 7, 8, or 9) in the first survey round. The coefficients are to be interpreted relative to being in a city (codes of 0 or 1). This specification also includes race, ethnicity, and gender; we control for these throughout the analysis for reasons specified above. This specification estimates average percentage point gaps by rurality for all youth (who were between the ages of 13 and 18 when the test was administered in 1998).

[3]The natural logarithm is chosen for empirical reasons, as it appears to resemble a normal distribution more closely than untransformed percentile scores. Models using percentile scores were also estimated and the results are very similar. (Results are available from the authors upon request.)

TABLE 1. SUMMARY STATISTICS.

VARIABLE	METRO AREA		SMALLER METRO AREA		RURAL		REMOTE	
	MEAN	STD. DEV.	MEAN	STD. DEV.	MEAN	STD. DEV.	MEAN	STD. DEV.
AFQT	46.84	29.74	45.82	29.00	41.99	28.18	39.54	27.77
Took SAT or ACT	0.50	0.50	0.46	0.50	0.43	0.50	0.40	0.49
High School	0.81	0.39	0.79	0.41	0.77	0.42	0.75	0.43
Bachelor's degree	0.29	0.45	0.22	0.41	0.18	0.38	0.16	0.37
White female	0.23	0.42	0.27	0.44	0.35	0.48	0.31	0.46
Hispanic male	0.12	0.33	0.10	0.30	0.04	0.19	0.04	0.20
Hispanic female	0.12	0.33	0.09	0.28	0.05	0.22	0.01	0.12
Black male	0.13	0.33	0.12	0.32	0.12	0.33	0.16	0.37
Black female	0.14	0.35	0.14	0.35	0.12	0.33	0.09	0.28
Household size	4.58	1.53	4.53	1.50	4.46	1.55	4.48	1.48
# Kids younger than 18	2.45	1.24	2.45	1.24	2.48	1.35	2.41	1.32
# Kids younger than 6	0.20	0.51	0.21	0.53	0.23	0.57	0.17	0.45
Two adults, one biological parent	0.04	0.21	0.05	0.21	0.05	0.21	0.07	0.26
One biological parent	0.38	0.48	0.39	0.49	0.40	0.49	0.36	0.48
Other family arrangement at age of 12	0.05	0.22	0.06	0.24	0.06	0.24	0.06	0.25
Mother's years of education	12.31	4.46	12.31	4.20	12.28	3.08	11.87	3.16
Mother's age when had the first child	22.70	5.24	22.24	4.68	21.87	4.60	21.83	4.86
Father's years of education	12.33	5.32	12.20	4.38	12.09	3.45	11.77	3.35
Poverty ratio	2.35	3.05	2.17	2.44	2.03	2.05	1.84	2.04
Net worth	7.67	13.89	7.33	12.36	6.93	12.33	5.24	9.54
Hard times	0.04	0.21	0.04	0.21	0.08	0.27	0.03	0.17
Attended public school	0.88	0.33	0.93	0.25	0.93	0.25	0.95	0.22
Observations	2974		2323		718		405	

The second specification classifies individuals into three age groups: those born after September 1983, who would not be of high school age by the first survey round; those born after September 1981 but before September 1983 (mid high school); and those born before September 1981 (who would be in the last two years of high school or shortly past at the time of the test). Interactions among these age groups and rurality categories estimate age-group specific gaps.

The third specification adds several variables that reflect background conditions at or before 8th grade within the household. Specifically, control variables include indicators of family size and composition, including whether the youth lived in a nontraditional home (with two adults but one biological parent, only one adult, or another arrangement; compared with living with two biological parents). Family size, the number of siblings, and age of siblings are controlled for as theories of educational investment have long postulated a tradeoff between number of children and investment in each child (e.g., Hanushek 1992; Moav 2004).

Baseline household assets are measured by net income normalized by the household-size-adjusted poverty line and normalized net worth, including the value of the home and all other liquid or non-liquid assets. Studies have shown that events occurring early in childhood have longer lasting effects, thus an indicator of whether the household suffered hardship in the past is included, as well as the mother's age at the time of first birth (to control for birth to a teenage or young mother). Attendance of private school before the first survey wave is also held constant. Finally, parental education is controlled for as a myriad of studies have shown that it has important implications for a child's achievement.

These are all variables that in the framework of Roscigno and Crowley (2001) would be classified as family resources and, as the authors pointed out, simply accounting for these prior resources likely overstates their effects since these are correlated with subsequent private investments, as well as public resources and investments. However, we interpret the remaining gap after controlling for family resources as a lower-bound estimate of how much can be addressed by eliminating institutional differences across regions.

We next turned to the question of persistence in high school by estimating multilevel mixed-effects logistic regressions to examine whether rural youth are at greater or lesser risk of dropping out compared with their urban counterparts. Three specifications are presented here as well: one that simply shows graduation propensities over rurality, holding constant race, ethnicity, and gender; a second one that adds achievement; and the third one adds the background variables.

Next we estimated multilevel mixed-effects logistic regressions with the same three specifications but with the dependent variable being an indicator of whether the respondent has ever reported taking either the SAT or the ACT test. Taking one of these tests is a prerequisite to admission in nearly all four-year colleges. Thus, it is a strong indicator of intent to go to college.

We then turned our attention to performance on the ACT or SAT test. Performance on these tests is not only indicative of cognitive ability, but also an institutional prerequisite to admission in most four-year colleges; and thus, likely highly correlated with the likelihood of admission into and financial aid offered by desired colleges. Each respondent who reported taking either test reported where their scores fell among six ordinal categories. However, not every student took a test. We set the scores of the non-takers to zero and estimated random-effects tobit regressions with the outcome bottom censored at zero and with the same sets of controls as above.[4]

We also examined rural-urban differences in college degree attainment. Specifically, we estimated multilevel mixed-effects logistic regression models where the outcome variable was an indicator of having earned a bachelor's degree at some point before the last survey round. Three specifications are presented here: one that simply shows college completion propensities over rurality, holding constant race, ethnicity, and gender; one that adds dummy variables for whether youth took ACT or SAT, measures of performance on these tests (if taken), and the natural logarithm of the AFQT score; and the third specification that adds background variables.

Next, we examined migration differences in rural and urban areas using mixed-effects logistic models. For this we split the sample into youth born in metro and nonmetro areas and we ran separate mixed-effects logistic regression models on whether nonmetro youth moved to a metro area; controlling (in the first specification) for whether they graduated from high school and whether they have a bachelor's degree, as well as for race and gender. In the second specification we added ability (logarithm of AFQT). The same model is applied to youth in metro areas with the outcome variable being moving from a metro to a nonmetro area.

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[4]Typically, normal linear regression assumes a random sample. In instances where the outcome of interest is only observed conditional on an individual choice (e.g., taking the test), the missing values are nonrandom, and, in our case, they form a disproportionate concentration of observations with a value of zero. Tobit models, developed in Tobin (1969), account for this censoring in the conditional mean function.

Finally, we examined adult wage determinants as well as wage differences among metro, smaller metro, rural, and remote areas. A mixed-effects model was used, where the outcome variable was the logarithm of wages. Five different specifications were estimated; adding additional controls for rurality, cognitive skills, high school completion, completion of a bachelor's degree, and place where they live later during their adulthood.

RESULTS

Results from the multilevel mixed-effects linear model on cognitive ability measured by the natural logarithm of the AFQT score, an age-adjusted cognitive test score that reflects math and language skills, are presented in Table 2. After adjusting for gender, race, and ethnicity; youth in smaller metro areas have statistically identical results to those in cities (omitted category); but youth in rural counties scored 18.6 percentage points lower and those in remote areas scored 17.6 percentage points lower (table 2, specification A). The deficit is statistically identical in rural and remote areas, and it is equal to approximately one sixth of a standard deviation.

We next investigated when this disadvantage arises, whether it emerged before high school or rather is associated with going to high school in a rural area. As noted, we took advantage of the fact that the ASVAB test battery was administered to all youth in the same year; however, some respondents were not yet in high school, others were in the first two years, while others were in the last two years when the test was administered.

Specification B in Table 2 adds interactions between rurality and age group. Estimates associated with residence in a rural area are still negative, while interactions of living in rural counties with age group 2 (1^{st} or 2^{nd} year in high school) and interactions with group 3 (last two years of high school) are small and statistically indistinguishable from zero. This implies that cognitive gaps already existed in 8^{th} grade and that attending high school in a rural area does not widen or close these gaps. For remote areas, evidence of a gap as of 8^{th} grade is still present, but the interaction of living in a remote county with age group 3 is positive and significant. Taken together the estimates imply that remote youth start at about a 25 percentage point disadvantage in 8^{th} grade, but that by the end of high school the disadvantage has been reduced to just 6-7 percentage points, and nearly all the reduction occurs during the last two years in high school. Clustering of individuals into counties also appears to matter, as in specifications A and B, more

TABLE 2. NONMETRO GAPS IN COGNITIVE ABILITY MEASURED BY LOG OF AFQT SCORES (MIXED-EFFECTS LINEAR MODEL).

	(A)		(B)		(C)	
	PARAM	S.E.	PARAM	S.E.	PARAM	S.E.
Smaller metro area.	-0.0405	(0.0516)	-0.0462	(0.0652)	-0.0044	(0.0580)
Rural.	-0.1860***	(0.0718)	-0.2043**	(0.0930)	-0.0913	(0.0874)
Remote.	-0.1755*	(0.1102)	-0.2450*	(0.1419)	-0.2158*	(0.1256)
1st -2nd year in high school x Smaller metro area.			-0.0243	(0.0607)	-0.0429	(0.0564)
1st -2nd year in high school x Rural.			0.1174	(0.0849)	0.0948	(0.0831)
1st -2nd year in high school x Remote.			-0.0212	(0.1279)	0.0563	(0.1191)
3rd-4th year in high school x Smaller metro area.			0.0342	(0.0600)	0.0281	(0.0558)
3rd-4th year in high x Rural.			-0.0380	(0.0855)	-0.0340	(0.0755)
3rd-4th year in high x Remote.			0.1839*	(0.1077)	0.2149**	(0.1014)
1st -2nd year in high school	0.0127	(0.0283)	0.0088	(0.0418)	0.0144	(0.0385)
3rd-4th year in high school.	0.0078	(0.0272)	-0.0198	(0.0406)	-0.0112	(0.0384)
White female.	0.0931***	(0.0260)	0.0928***	(0.0262)	0.1035***	(0.0260)
Hispanic male.	-0.4771***	(0.0585)	-0.4746***	(0.0589)	-0.2679***	(0.0566)
Hispanic female.	-0.4000***	(0.0583)	-0.4005***	(0.0583)	-0.2051***	(0.0510)
Black male.	-0.8530***	(0.0682)	-0.8523***	(0.0682)	-0.6614***	(0.0632)
Black female.	-0.6074***	(0.0606)	-0.6080***	(0.0607)	-0.4125***	(0.0545)
Household size.					-0.0376**	(0.0160)
# Kids younger than 18.					0.0047	(0.0204)
# Kids younger than 6.					0.0127	(0.0315)
Two adults - one bio. parent.					-0.1275**	(0.0611)
Raised by one biological parent.					-0.1865***	(0.0274)
Other family arrangement at age 12.					-0.1670***	(0.0587)
Household size.					-0.0740	(0.0463)
Mother's years of education.					0.0322***	(0.0080)

TABLE 2. NONMETRO GAPS IN COGNITIVE ABILITY MEASURED BY LOG OF AFQT SCORES (MIXED-EFFECTS LINEAR MODEL) (*continued*).

	(A)		(B)		(C)	
	PARAM	S.E.	PARAM	S.E.	PARAM	S.E.
Father's years of education.					0.0126**	(0.0058)
Mothers age when had first child.					0.0205***	(0.0027)
Poverty ratio.					0.0150***	(0.0048)
Net worth.					0.0029***	(0.0008)
Hard times.					-0.1486**	(0.0726)
Attended public school.					-0.1105***	(0.0352)
Constant.	10.6750***	(0.0477)	10.6873***	(0.0513)	9.8472***	(0.1181)
Between-place variation.	0.1911		0.1911		0.1419	
% Explained.	20.34		20.49		17.37	
Observations.	7,057	7,057	7,057	7,057	7,057	7,057
Number of groups.	330	330	330	330	330	330

NOTES: Standard errors in parentheses, ***$p \leq 0.01$, **$p \leq 0.05$, *$p \leq 0.1$, all models include age effect.

than one fifth of the total variation is between counties. This share drops to 17 percent after background variables are included.

Table 3 presents the marginal effects (mfx) of high school graduation using multilevel mixed-effects logistic regressions (Rabe-Hesketh, Skrondal, and Pickles 2005). Estimates in specification A indicate that high school graduation rates among youth in small metro, rural, and remote rural areas are not statistically different from urban youth. The result persists after controlling for the natural logarithm of AFQT in specification B where one log point increase in AFQT (equivalent to doubling the average score) is associated with a 5.6 percentage point higher likelihood of graduation from high school. After controlling for background variables in specification C, there is still no difference in the likelihood of graduation among urban and small metro, rural, and remote rural areas. Several background variables; namely the number of kids younger than 18 years old in the family, living with just one biological parent, alternative non-traditional family arrangements, household size, and hard times are negatively associated with the likelihood of graduation, while mother's years of education and mother's age when her first child was born increase the likelihood of graduation. Overall, it appears that rural youth have no disadvantage in high school graduation. Our findings with respect to dropout rates are different from those provided in Roscigno and Crowley (2001), who after controlling for family/school investments found that rural youth are much less likely to drop out than their urban counterparts. The reason could be that we are examining late 1990s cohorts, whereas Roscigno and Crowley (2001) examined late 1980s cohorts.

Next we estimated multilevel mixed-effects logistic regressions (specifications A, B, and C) to uncover the determinants of whether youth took a college admission test and random effects tobit to examine differences in how youth scored in the SAT or ACT in Table 4. Results from the first two specifications (A and B) indicate that there is no difference between rural and urban youth when it comes to the propensity to take SAT or ACT; even after controlling for gender, race, ethnicity, and background characteristics. Next we turn to the results on the actual SAT or ACT scores, with specification C indicating that rural areas are disadvantaged compared with urban, showing a gap of 0.5 points in scores (amounting to one fourth of a standard deviation). The disadvantage is, however, fully explained by the logarithm of the AFQT score added in specification D, indicating that any differences in college preparatory test performance have their roots in the pre-high school cognitive gap. Our results with respect to achievement are similar to those of Roscigno and Crowley (2001) who, after adding controls, found no difference in

TABLE 3. HIGH SCHOOL GRADUATION (MIXED-EFFECTS LOGISTIC REGRESSION MODEL)

	(A)		(B)		(C)	
	MFX.	S.E.	MFX.	S.E.	MFX.	S.E.
Smaller metro area.	-0.0034	(0.0068)	-0.0029	(0.0070)	-0.0016	(0.0072)
Rural .	-0.0111	(0.0105)	-0.0019	(0.0106)	-0.0038	(0.0108)
Remote.	0.0010	(0.0123)	0.0129	(0.0125)	0.0123	(0.0127)
White female.	0.0103*	(0.0058)	0.0051	(0.0064)	0.0170**	(0.0068)
Hispanic male.	-0.0467***	(0.0090)	-0.0183**	(0.0086)	-0.0055	(0.0088)
Hispanic female.	-0.0216***	(0.0083)	0.0057	(0.0088)	0.0213**	(0.0094)
Black male.	-0.0585***	(0.0094)	-0.0096	(0.0079)	-0.0154*	(0.0080)
Black female.	-0.0124*	(0.0075)	0.0336***	(0.0089)	0.0395***	(0.0091)
Household size.					0.0018	(0.0028)
# Kids younger than 18.					-0.0068**	(0.0034)
# Kids younger than 6.					-0.0013	(0.0047)
Two adults - one bio. parent.					-0.0513***	(0.0122)
Raised by one biological parent.					-0.0585***	(0.0085)
Other family arrangement at age of 12.					-0.0582***	(0.0115)
Household size.					-0.0365***	(0.0094)
Mother's years of education.					0.0038***	(0.0010)
Mother's age when she had first child.					0.0028***	(0.0006)
Father's years of education.					0.0034***	(0.0010)
Poverty ratio.					0.0060***	(0.0016)
Net worth.					0.0015***	(0.0003)
Hard times.					-0.0233**	(0.0096)
Attended public school.					-0.0027	(0.0086)
Born in 1981.	-0.0104	(0.0065)	-0.0135*	(0.0073)	-0.0161**	(0.0074)
Born in 1982.	-0.0068	(0.0065)	-0.0095	(0.0073)	-0.0110	(0.0074)
Born in 1983.	-0.0084	(0.0065)	-0.0107	(0.0073)	-0.0117	(0.0074)
Born in 1984.	-0.0022	(0.0065)	-0.0032	(0.0073)	-0.0021	(0.0075)
Log. of AFQT.			0.0562***	(0.0061)		
Between-place variation.	0.5233		0.4611		0.4564	
% Explained.	34.35		31.56		31.34	
Observations.	7,057		7,057		7,057	
Groups.	330		330		330	

NOTES: Standard errors in parentheses, $^{***}p\leq0.01$, $^{**}p\leq0.05$, $^{*}p\leq0.1$, all models include age effects, marginal effects reported.

TABLE 4. COLLEGE READINESS GAPS (TAKING SAT OR SAT) AND SCORE GAPS IN SAT/ACT (MIXED-EFFECTS LOGISTIC REGRESSION MODEL)

	TOOK SAT OR ACT (A)		TOOK SAT OR ACT (B)		SAT/ACT SCORE (C)		SAT/ACT SCORE (D)		SAT/ACT SCORE (E)	
OUTCOME	MFX.	S.E.	MFX.	S.E.	MFX.	S.E.	MFX.	S.E.	MFX.	S.E.
Smaller metro area.	-0.0028	(0.0078)	0.0048	(0.0084)	-0.0671	(0.1798)	-0.0441	(0.1442)	0.0498	(0.1332)
Rural.	-0.0179	(0.0123)	-0.0046	(0.0129)	-0.4992*	(0.2840)	-0.1219	(0.2259)	0.0272	(0.2069)
Remote.	-0.0192	(0.0143)	-0.0000	(0.0148)	-0.4160	(0.3277)	-0.0404	(0.2586)	0.1561	(0.2357)
White female. . . .	0.0286***	(0.0064)	0.0412***	(0.0080)	0.5373***	(0.1288)	0.3334***	(0.1121)	0.4101***	(0.1086)
Hispanic male. . . .	-0.0921***	(0.0132)	-0.0456***	(0.0123)	-2.4628***	(0.2168)	-1.2132***	(0.1906)	-0.6431***	(0.1864)
Hispanic female.	-0.0618***	(0.0112)	-0.0105	(0.0112)	-1.7923***	(0.2116)	-0.6732***	(0.1852)	-0.1605	(0.1812)
Black male..	-0.0801***	(0.0111)	-0.0247**	(0.0103)	-2.2839***	(0.1933)	-0.1921	(0.1752)	0.3480**	(0.1723)
Black female.	-0.0176**	(0.0080)	0.0538***	(0.0113)	-0.8118***	(0.1803)	0.8056***	(0.1621)	1.4026***	(0.1607)
Household size. . .			-0.0009	(0.0035)					-0.0160	(0.0574)
# Kids younger than 18.			-0.0056	(0.0042)					-0.0518	(0.0685)
# Kids younger than 6.			-0.0064	(0.0064)					-0.0871	(0.1042)
Other family arrangement at age of 12. . .			-0.0528***	(0.0135)					-0.5848***	(0.2079)
Two adults - one bio. parent.. . .			-0.0585***	(0.0143)					-0.8557***	(0.2166)
Raised by one biological parent.			-0.0569***	(0.0087)					-0.6758***	(0.1098)
Household size. . .			-0.0284***	(0.0109)					-0.4149**	(0.1716)
Mother's years of education. . . .			0.0083***	(0.0013)					0.0667***	(0.0141)
Father's years of education. . . .			0.0025***	(0.0009)					0.0319**	(0.0127)

TABLE 4. COLLEGE READINESS GAPS (TAKING SAT OR SAT) AND SCORE GAPS IN SAT/ACT (MIXED-EFFECTS LOGISTIC REGRESSION MODEL) (*continued*)

	TOOK SAT OR ACT (A)		TOOK SAT OR ACT (B)		SAT/ACT SCORE (C)		SAT/ACT SCORE (D)		SAT/ACT SCORE (E)	
OUTCOME	MFX.	S.E.	MFX.	S.E.	MFX.	S.E.	MFX.	S.E.	MFX.	S.E.
Mother's age when she had first child.			0.0050***	(0.0008)					0.0541***	(0.0096)
Poverty ratio. . . .			0.0062***	(0.0015)					0.0432**	(0.0184)
Net worth.			0.0016***	(0.0003)					0.0169***	(0.0037)
Hard times.			-0.0473***	(0.0150)					-0.7241***	(0.2368)
Attended public school.			-0.0446***	(0.0106)					-0.4763***	(0.1407)
Born in 1981.	-0.0018	(0.0070)	-0.0065	(0.0085)	0.0664	(0.1585)	-0.0393	(0.1393)	-0.0801	(0.1350)
Born in 1982.	-0.0118	(0.0072)	-0.0198**	(0.0088)	-0.2092	(0.1604)	-0.3098**	(0.1410)	-0.3564***	(0.1369)
Born in 1983.	-0.0065	(0.0071)	-0.0119	(0.0087)	-0.0915	(0.1603)	-0.1571	(0.1408)	-0.1913	(0.1371)
Born in 1984.	0.0043	(0.0071)	0.0046	(0.0087)	0.1616	(0.1601)	0.0869	(0.1406)	0.0571	(0.1376)
Log. of AFQT. . .							2.3573***	(0.0647)	1.9873***	(0.0633)
Between-place variation.	0.477		0.3902		0.9722		0.7086		0.6105	
% Explained.	32.29		28.07		21.16		18.41		16.77	
Observations. . . .	7,057		7,057		7,057		7,057		7,057	
Number of groups.	330		330		330		330		330	

NOTES:Standard errors in parentheses, *** p≤0.01, ** p≤0.05, * p≤0.1, all models include age effects, marginal effects reported.

the math/reading achievement test between rural and urban students. Background variables in specification E indicate that nontraditional family arrangements and family hard times are negatively associated with test scores; while mother's education, father's education, mother's age when she had the first child, and net worth, are positively associated with test performance.

Thus far we have found disadvantages on pre-high school cognitive test scores, no disadvantage associated with attending a rural high school and no *unexplained* disadvantages associated in the propensity to take a college admissions test or the score achieved on one. Scores on ACT/SAT tests are indeed lower in rural areas, but these only reflect the pre-high school test score gap. We next examined how these achievement and college preparation patterns translate into college degrees.

Table 5 presents estimates of the mixed-effects logistic model on the propensity to obtain a bachelor's degree or higher. On average, after adjusting for gender and race (specification A), youth in rural and remote areas are approximately 8.8 percentage points less likely to graduate from college. After adjusting for whether they took the ACT or SAT, actual score on the test, and the logarithm of their AFQT score (specification B); the disadvantage decreases to 4.9 percentage points (amounting to nearly 17 and 14 percent of the average share of rural adults with degrees). Even after holding constant all background variables in specification C, youth in rural and remote areas are more than 3 percentage points less likely to obtain a college degree. Scores on both the AFQT and SAT/ACT are strong predictors of higher educational attainment, but the rural gap in cognitive scores is only responsible for a small share of the rural disadvantage in college completion. It is also important to note that intent to pursue a higher education in four-year colleges (proxied by taking a college admissions test) is also a strong predictor of a bachelor's degree, but it does not affect the rural college gap, since intent was similar across the rural-urban continuum. The fact that; net of background, cognitive achievement in low and high stakes tests, and revealed intent to pursue admission at a four-year college; rural youth are still less likely to graduate with a bachelor's degree may indicate greater institutional barriers to college attendance.

We also examined how these human capital disadvantages reflect upon youths' decision to stay or migrate to another area. Table 6 presents results from mixed-effects logit models that relate migration status to educational attainment and

TABLE 5. ATTAINMENT OF AT LEAST A BACHELOR'S DEGREE (MIXED-EFFECTS MODEL)

	(A)		(B)		(C)	
	MFX.	S.E.	MFX.	S.E.	MFX.	S.E.
Smaller metro area.	-0.0318*	(0.0174)	-0.0222*	(0.0118)	-0.0109	(0.0111)
Rural.	-0.0879***	(0.0283)	-0.0493***	(0.0186)	-0.0353**	(0.0174)
Remote.	-0.0887***	(0.0326)	-0.0492**	(0.0208)	-0.0306	(0.0195)
White female.	0.0745***	(0.0117)	0.0477***	(0.0099)	0.0538***	(0.0097)
Hispanic male.	-0.2084***	(0.0241)	-0.0412**	(0.0194)	-0.0122	(0.0191)
Hispanic female.	-0.1059***	(0.0207)	0.0260	(0.0174)	0.0538***	(0.0170)
Black male.	-0.2103***	(0.0226)	-0.0148	(0.0183)	0.0263	(0.0181)
Black female.	-0.0780***	(0.0181)	0.0311**	(0.0151)	0.0783***	(0.0150)
Took SAT or ACT.			0.1145***	(0.0246)	0.1046***	(0.0239)
SAT or ACT score.			0.0436***	(0.0055)	0.0388***	(0.0055)
Log. of AFQT.			0.1183***	(0.0085)	0.1016***	(0.0084)
Household size.					0.0184***	(0.0055)
# Kids younger than 18.					-0.0133**	(0.0066)
# Kids younger than 6.					-0.0213*	(0.0111)
Other family arrangement at age of 12.					-0.0423**	(0.0214)
Two adults - one bio. parent.					-0.0454**	(0.0212)
Raised by one biological parent.					-0.0317***	(0.0103)
Household size.					0.0317**	(0.0160)
Mother's years of education.					0.0007	(0.0014)
Father's years of education.					0.0026**	(0.0012)
Mother's age when first child born.					0.0043***	(0.0009)
Poverty ratio.					0.0048***	(0.0016)
Net worth.					0.0012***	(0.0003)
Hard times.					-0.0487*	(0.0278)

TABLE 5. ATTAINMENT OF AT LEAST A BACHELOR'S DEGREE (MIXED-EFFECTS MODEL) (*continued*)

	(A)		(B)		(C)	
	MFX.	S.E.	MFX.	S.E.	MFX.	S.E.
Attended public school					-0.0171	(0.0124)
Born in 1981	0.0218	(0.0153)	0.0125	(0.0129)		
Born in 1982	0.0184	(0.0154)	0.0193	(0.0130)		
Born in 1983	0.0081	(0.0156)	0.0055	(0.0131)		
Born in 1984	-0.0319**	(0.0161)	-0.0415***	(0.0133)		
Between-place variation	0.5822		0.4265		0.3836	
% Explained	37.04		29.90		27.72	
Observations	7,057		7,057		7,057	
Number of groups	330		330		330	

NOTES:Standard errors in parentheses, *** $p \leq 0.01$, ** $p \leq 0.05$, * $p \leq 0.1$, all models include age effects, marginal effects reported

TABLE 6. DETERMINANTS OF MIGRATION (MIXED-EFFECTS LOGISTIC MODEL)

	NONMETRO TO METRO		METRO TO NONMETRO	
OUTCOME	(A)	(B)	(C)	(D)
No high school.	-0.0858**	-0.0458	0.0159**	0.0135*
	(0.0337)	(0.0347)	(0.0071)	(0.0074)
Bachelor's degree.	0.2161***	0.1769***	0.0034	0.0053
	(0.0287)	(0.0300)	(0.0070)	(0.0072)
Log of AFQT.		0.0649***		-0.0035
		(0.0155)		(0.0031)
White female.	-0.0210	-0.0208	0.0045	0.0045
	(0.0290)	(0.0287)	(0.0072)	(0.0072)
Hispanic male.	0.1570**	0.1788***	-0.0256**	-0.0271**
	(0.0689)	(0.0689)	(0.0117)	(0.0118)
Hispanic female.	-0.1531*	-0.1222	-0.0367***	-0.0382***
	(0.0921)	(0.0908)	(0.0131)	(0.0132)
Black male..	0.0181	0.0747	0.0027	-0.0001
	(0.0452)	(0.0468)	(0.0092)	(0.0096)
Black female.	0.0154	0.0624	-0.0339***	-0.0367***
	(0.0449)	(0.0458)	(0.0117)	(0.0120)
Between-place variation	0.3614	0.3358	0.5498	0.5450
% Explained.	26.55	25.14	35.48	35.28
Observations.	1,324	1,324	5,096	5,096
Number of groups.	330	330	330	330

NOTES:Standard errors in parentheses, *** $p \leq 0.01$, ** $p \leq 0.05$, * $p \leq 0.1$. Marginal effects are reported.

ability for metro and nonmetro youth separately. The first two specifications (A and B) use only youth in nonmetro areas during high school and examine the determinants of migrating from a nonmetro to a metro area by 2009. The next two specifications (C and D) do the opposite; they estimate the predictors of having migrated to a nonmetro area for all metro youth. Results suggest that high school dropouts are 8.6 percentage points less likely to move to a metro area than youth with a high school diploma, and those with a bachelor's degree are 21.6 percentage points more likely to move to a metro area. When we add the AFQT score, the difference in those with no high school diploma goes away and still, those with a bachelor's degree are 17.7 percentage points more likely to move than those with just a high school diploma. A different picture is portrayed when we do the same exercise, but on the status of those that were in a metro area. We find that youth with no high school diploma that resided in a metro area are more likely (by 1.6 percentage points) to move to a nonmetro area than those with a high school diploma; and there are no differences in the propensity to move among those with both a high school diploma and a bachelor's degree.

Table 7 paints an overall picture regarding the relative role of educational disparities among incumbent youth and disproportionate migration. College completion and dropout rates are presented by location of origin (at age 16 or earlier) and location where youth were last observed earning wages (at age 29, on average). The figures under the heading at age 16 represent the percentage of college graduates and high school dropouts that each category of locations would have if there were no migration of any kind. The figures under the age 29 column represent the actual makeup of each group of counties. The first thing to notice is that, in terms of both college degrees and dropouts, cities are better off with migration than they would be without; whereas all other areas would have been better off without migration. The migration penalty (the difference between the share with degrees or without high school diplomas by county of origin and that of adult residence) is higher for rural and remote areas. In terms of adult college degrees, the percentage point difference between those residing in metro and nonmetro areas is 12 percentage points (closely resembling estimates from the Census Bureau's American Community Survey (ACS)). Disproportionate migration thus accounts for one fourth of this gap, and nearly three fourths is explained by disproportionate degree attainment. This is also confirmed by marginal effects for the degree attainment models, which show rural and remote youth at an 8-9 percentage point disadvantage from their counterparts in cities.

Do these human capital disadvantages translate into lower wages for youth raised in rural and remote areas, and what is the relative damage? Table 8 presents estimates of the determinants of adult wages. Unadjusted wages are 13.4, 14.9, and 18.2 percent lower in smaller metro, rural, and remote areas; respectively (specification A). The wage disadvantages in smaller metro areas remain virtually unchanged when we control for cognitive tests (specification B); this is not surprising since there are no human capital differences between metro and smaller metro areas. For rural and remote areas, the wage gap after controlling for cognitive tests is reduced by approximately two percentage points (to 12.7 percent in rural and to 16.1 percent in remote rural areas).

Controlling for lack of a high school diploma (specification C) does not affect rurality estimates; but those estimates decrease by almost 1, 2, and 3 percentage points in smaller metro areas, rural, and remote rural areas, respectively; once we control for bachelor's degree holder status (specification D).

Most other parameter estimates show the expected associations with wages. It appears that youth with no high school diploma earn 15 percent less than those with one, and youth with a bachelor's degree earn almost 30 percent more than

TABLE 7. COLLEGE COMPLETION AND HIGH SCHOOL DROPOUT RATES BY METRO STATUS AT AGE 16 AND 29.

AREA	CITY		SMALLER METRO		RURAL		REMOTE		ALL NONMETRO		ALL METRO	
Status at age	16	29	16	29	16	29	16	29	16	29	16	29
						College Completion						
Mean	0.33	0.36	0.28	0.26	0.24	0.20	0.21	0.18	0.23	0.20	0.31	0.32
Std. Dev.	0.47	0.48	0.45	0.44	0.43	0.40	0.40	0.39	0.42	0.40	0.46	0.46
Observations	2588	2747	2137	2140	684	680	567	380	1251	1060	4725	4887
						High School Dropout						
Mean	0.16	0.15	0.19	0.19	0.18	0.20	0.19	0.24	0.18	0.21	0.17	0.17
Std. Dev.	0.37	0.36	0.39	0.39	0.38	0.40	0.39	0.43	0.39	0.41	0.38	0.37
Observations	2588	2747	2137	2140	684	680	567	380	1251	1060	4725	4887

Table 8. Labor Market Productivity Measured by Log Wages (Mixed-effects Model)

	(A)	(B)	(C)	(D)	(E)
Smaller metro area	-0.1338***	-0.1304***	-0.1286***	-0.1177***	-0.0269
	(0.0240)	(0.0228)	(0.0224)	(0.0219)	(0.0280)
Rural	-0.1490***	-0.1274***	-0.1254***	-0.1035***	-0.0247
	(0.0364)	(0.0345)	(0.0339)	(0.0331)	(0.0406)
Remote	-0.1823***	-0.1605***	-0.1636***	-0.1336***	-0.0438
	(0.0408)	(0.0385)	(0.0378)	(0.0367)	(0.0434)
Log of AFQT		0.1267***	0.1050***	0.0709***	0.0691***
		(0.0089)	(0.0095)	(0.0097)	(0.0097)
No high school			-0.1501***	-0.0975***	-0.0967***
			(0.0231)	(0.0231)	(0.0231)
Bachelor's degree				0.2978***	0.2886***
				(0.0216)	(0.0216)
As adults live in smaller metro					-0.1322***
					(0.0261)
As adults live in rural area					-0.1036***
					(0.0376)
As adults live in remote rural					-0.1394***
					(0.0460)
White female	-0.1434***	-0.1556***	-0.1572***	-0.1827***	-0.1823***
	(0.0234)	(0.0231)	(0.0230)	(0.0227)	(0.0227)
Hispanic male	-0.0917***	-0.0135	-0.0046	0.0269	0.0213
	(0.0337)	(0.0334)	(0.0333)	(0.0328)	(0.0327)
Hispanic female	-0.2121***	-0.1446***	-0.1473***	-0.1308***	-0.1388***
	(0.0340)	(0.0336)	(0.0334)	(0.0329)	(0.0328)
Black male	-0.2138***	-0.0871***	-0.0854***	-0.0719**	-0.0751**
	(0.0312)	(0.0318)	(0.0316)	(0.0311)	(0.0311)
Black female	-0.2949***	-0.1971***	-0.2088***	-0.2081***	-0.2108***
	(0.0301)	(0.0302)	(0.0301)	(0.0296)	(0.0295)
Constant	7.3838***	6.0243***	6.2806***	6.5409***	6.5811***
	(0.0217)	(0.0980)	(0.1054)	(0.1055)	(0.1057)
Between-place variation	0.0078	0.0058	0.0052	0.0046	0.0043
% Explained	1.66	1.28	1.16	1.06	0.99
Observations	6,203	6,203	6,203	6,203	6,203
Number of groups	328	328	328	328	328

NOTES:Standard errors in parentheses, $^{***}p \leq 0.01$, $^{**}p \leq 0.05$, $^{*}p \leq 0.10$.

those with only a high school diploma. Interestingly, specifications A and B resemble the basic models presented by Neal and Johnson (1996), who found that the inclusion of the AFQT score as a teen accounted for all wage gaps between white and Hispanic males as adults and reduced wage gaps between black and white males by two thirds; using data from the NLSY79, the predecessor to this dataset. We have found the same with this more recent cohort by comparing estimates of wage differences for Hispanic and black males (compared with white males) between specifications A and B.

In the next specifications (D and E) we included indicators of the rurality of the area in which respondents lived at the time when adult wages were observed. With the inclusion of these indicators, all parameter estimates on the rurality of the area in which one attended high school are statistically nonsignificant and very small in magnitude. This implies that growing up in a rural area does not impose a wage penalty on top of the cumulative 5 percent operating through cognitive test performance and college degree attainment. Living in a nonmetro area as an adult does come at a wage cost.

CONCLUSION

We have investigated several important questions regarding rural-urban differences in human capital. Using the NLSY97 we examined whether there are metro-nonmetro gaps in cognitive achievement, high school graduation, college readiness, and degree attainment. We have focused on pinpointing the time-path of these gaps, starting by isolating any gaps that have accrued before 8^{th} grade, and following achievement and formal education gaps forward.

We found that gaps emerge early in life, before high school, as they are reflected in cognitive test scores. These gaps then remain constant through high school, and youth graduate high school at the same rate. Other important steps to prepare for college taken during high school, such as taking a college admission test, are also no different by rurality. Performance on these tests is lower, but only to the extent that would be predicted by the pre-existing achievement gap measured at 8^{th} grade. We thus found nonmetro high schools to be performing on par with their metro counterparts, at least insofar as cognitive scores, graduations, and inducing students to take the necessary steps for a college career are concerned. This is in contrast to other studies that have found either an ameliorative effect of rural high schools (e.g., Reeves and Bylund 2005) or a rural achievement gap due to the effects of family socioeconomic status and peer effects (e.g., Reeves 2012).

The emergence of this early gap, on the other hand, is consistent with descriptive statistics from Provasnik et al. (2007), and the findings of Reeves and Bylund (2005) and Reeves (2003) using school data from Kentucky, although the studies cannot be compared directly as we used a different conditioning strategy from these previous studies. This early gap may in fact emerge far sooner than age 12 (the earliest age we examined in this study), as Durham and Smith (2006) found that some gaps in cognitive achievement and school readiness between nonmetro and metro youth are evident as early as in kindergarten. Also, despite strong evidence that quality preschool attendance can have large positive effects that persist even into adulthood, rural children are far less likely to participate in preschool (Temple 2009). Further inquiry into early rural-urban achievement gaps is warranted.

The second major bottleneck comes in the form of a college degree gap. Nonmetro youth are far less likely to obtain a college degree, despite the fact that they show similar rates of college prep test taking. Additionally, half the disadvantage in degree attainment is explained by prior cognitive achievement gaps. A 3.5 percentage point gap remains, even after controlling for background. As noted, this is interpreted as the minimal college degree gap that college access policies and other interventions intended for 17 year olds can address.

We must note that there is one additional channel to a four-year degree that may not require college admission tests. Individuals may start at a two-year college and transfer. Previous evidence has shown, however, that rural high school graduates are not more likely to pursue this path. Mykerezi, Kostandini, and Mills (2009) found that rural community colleges do serve as a pathway to a bachelor's degree, but that they do so at the same rate as urban community colleges. We thus propose that the role that differentials in enrollment costs and availability of pathways to college for rural youth play in influencing outcomes merits further investigation. This assessment is consistent with previous evidence as well; several studies have documented the important role that geographic proximity to colleges has on college attendance (e.g., Card 1993; Mykerezi and Mills 2004), and rural youth are further from four-year colleges than their urban counterparts (Mykerezi et al. 2009).

Our migration models also confirm theoretical predictions and previous results in Mills and Hazarika (2001) and others that nonmetro youth with a college degree are far more likely to head for metro labor markets, while those with no high school diploma are less likely to do so, compared with those with just a high school degree.

Taken together, college education disparities between incumbent nonmetro youth and metro youth explain nearly three fourths of the adult gap in degrees, with migration patterns explaining the remaining one fourth.

Finally, we used wage equation estimates to tally the consequences. The independent variation in early achievement gaps and college completion gaps each cost 2 and 3 percentage point penalties in adult wages, respectively. These are thus of approximately equal consequence to individuals. Additionally, after factoring in the decision to migrate, those who grew up in nonmetro areas see no disadvantage on wages. Migration explains all of the remaining gap in adult wages between youth who attended school in nonmetro areas and those in metro schools.

Overall this study implies that investments in early education and improved college access would be the two most promising strategies for increasing the educational attainment of youth born and raised in nonmetro areas. However, educational investments are not sufficient to close metro-nonmetro adult education gaps, as migration plays an important role. Strategies to attract and retain educated adults need to be part of the policy equation.

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REFERENCES

Beck, Frank D. and Grant W. Shoffstall. 2005. "How Do Rural Schools Fare Under a High-Stakes Testing Regime?" *Journal of Research in Rural Education* 20(14):1–12.

Blau, Francine D. and Adam J. Grossberg. 1992. "Maternal Labor Supply and Children's Cognitive Development." *Review of Economics and Statistics* 74(3):474–81.

Bryk, Anthony, S. and Stephen W. Raudenbush. 1992. *Hierarchical Linear Models: Applications and Data Analysis Methods.* Newbury Park, CA: Sage.

Bureau of Labor Statistics, U.S. Department of Labor. National Longitudinal Survey of Youth 1997 cohort, 1997-2010 (rounds 1-14) [computer file]. Produced by the National Opinion Research Center, the University of Chicago and distributed by the Center for Human Resource Research, The Ohio State University. Columbus, OH: 2012.

Byun, Soo-yong, Judith L. Meece, and Mathew J. Irvin. 2012. "Rural-Nonrural Disparities in Postsecondary Educational Attainment Revisited." *American Educational Research Journal* 49(3):412–37.

Card, David. 1993. "Using Geographic Variation in College Proximity to Estimate the Return to Schooling: Progress on Some Persistent Econometric Problems." *Econometrica* 69(5):1127–60.

Cascio, Elizabeth U. and Ethan G. Lewis. 2006. "Schooling and the Armed Forces Qualifying Test: Evidence from School-entry Laws." *Journal of Human Resources* 41(2):294–318.

Domina, Thurston. 2006. "What Clean Break?: Education and Nonmetropolitan Migration Patterns, 1989-2004." *Rural Sociology* 71(3):373–98.

Durham, Rachel E. and Johnelle P. Smith. 2006. "Nonmetropolitan Status and Kindergarteners' Early Literacy Skills: Is There a Rural Disadvantage?" *Rural Sociology* 71(4):625–61.

Fan, Xitao and Michael J.Chen. 1999. "Academic Achievement of Rural School Students: A Multi-year Comparison with Their Peers in Suburban and Urban Schools." *Journal of Research in Rural Education* 15(1):31–46.

Gibbs, Robert M. 1998. "College Completion and Return Migration among Rural Youth." Pp. 61–80 in *Rural Education and Training in the New Economy: The Myth of the Rural Skills Gap,* edited by R. M. Gibbs, P. L. Swaim, and R. A. Teixeira. Ames, IA: Iowa State University Press.

Goetz, Stephan J. and David L. Debertin. 1996. "Rural Population Decline in the 1980s: Impacts of Farm Structure and Federal Farm Programs." *American Journal of Agricultural Economics* 78(3):517–29.

Hanushek, Eric A. 1992. "The Trade-off between Child Quantity and Quality." *Journal of Political Economy* 100(1):84–117.

Johnson, Kenneth M. 2006. *Demographic Trends in Rural and Small Town America.* Durham, NH: Carsey Institute, University of New Hampshire.

Khattri, Nidhi, Kevin W. Riley, and Michael B. Kane. 1997. "Students at Risk in Poor, Rural Areas: A Review of the Research." *Journal of Research in Rural Education* 13(2):79–100.

Lee, Jaekyung and Walter G. Mcintire. 2000. "Interstate Variation in the Mathematics Achievement of Rural and Nonrural Students." *Journal of Research in Rural Education* 16(3):168–81.

Mills, Bradford F. and Gautam Hazarika. 2001. "The Migration of Young Adults from Nonmetropolitan Counties." *American Journal of Agricultural Economics* 3(2):329–40.

Moav, Omer. 2004. "Cheap Children and the Persistence of Poverty." *The Economic Journal* 115(500):88–110.

Mykerezi, Elton, Genti Kostandini, and Bradford F. Mills. 2009. "Do Rural Community Colleges Supply Unique Educational Benefits?" *Journal of Agricultural and Applied Economics* 41(2):411–7.

Mykerezi, Elton and Bradford F. Mills 2004. "Education and Economic Wellbeing in Racially Diverse Rural Counties: The Role of Historically Black Colleges and Universities." *Review of Regional Studies* 34(3):303–19.

Neal Derek A. and William R. Johnson. 1996. "The Role of Premarket Factors in Black-White Wage Differences." *Journal of Political Economy* 104(5):869–95.

Provasnik, Stephen, Angelina KewalRamani, Mary M. Coleman, Lauren Gilbertson, Will Herring, and Qingshu Xie. 2007. "Status of Education in Rural America." (NCES 2007-040). Washington, DC: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education.

Rabe-Hesketh, Sophia, Anders Skrondal, and Andrew Pickles. 2005. "Maximum Likelihood Estimation of Limited and Discrete Dependent Variable Models with Nested Random Effects." *Journal of Econometrics* 128(2):301–23.

Reeves, Edward B. 2003. "Disentangling the Effects of Nonmetro Location and Student Poverty on School Performance/Improvement: Implications for Equitable Excellence in Kentucky Pubic Schools." *Journal of Research on Rural Education* 18(1):17–30.

_______. 2012. "The Effects of Opportunity to Learn, Family Socioeconomic Status, and Friends on the Rural Math Achievement Gap in High School." *American Behavioral Scientist* 56(7):887–907.

Reeves, Edward B. and Robert A. Bylund. 2005. "Are Rural Schools Inferior to Urban Schools? A Multilevel Analysis of School Accountability Trends in Kentucky." *Rural Sociology* 70(3):360–86.

Rosicgno, Vincent, J. and Martha L. Crowley. 2001. "Rurality, Institutional Disadvantage, and Achievement/Attainment." *Rural Sociology* 66(2):268–92.

Sjaastad, Larry. 1962. "The Costs and Returns of Human Migration." *Journal of Political Economy* 70(5):80–93.

Smith, Mark H., Lionel J. Beaulieu, and Ann Seraphine. 1995. "Social Capital, Place of Residence, and College Attendance." *Rural Sociology* 60(3):363–80.

Temple, Judy A. 2009. "Rural gaps in early education." *Journal of Agricultural and Applied Economics*, 41(2):403–10.

Tobin, James. 1969. "A General Equilibrium Approach to Monetary Theory." *Journal of Money, Credit, and Banking* 1.1(1):15–29.

Todd, Petra E. and Kenneth I. Wolpin. 2007. "The Production of Cognitive Achievement in Children: Home, School, and Racial Test Score Gaps." *Journal of Human Capital* 1(1): 91–136.

United States Department of Agriculture, Economic Research Service. 2012."Employment & Education: Rural Education." Retrieved January 30, 2013(www.ers.usda.gov/topcis/rural-economy-population/employment-education/rural-education.aspx.)

Winters, John V. 2011. "Human Capital and Population Growth in Nonmetropolitan U.S. Counties: The Importance of College Student Migration." *Economic Development Quarterly* 25(4):353–65.