Making Connections

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College enrollment patterns for rural Indiana high school graduates

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In collaboration with the Midwest Rural Research Alliance

Key findings

- A similar proportion of 2010 Indiana graduates of rural and of nonrural public high schools enrolled in college, but the proportion that enrolled in a two-year college was higher for graduates of rural schools.
- Rural graduates had academic preparation similar to that of nonrural graduates and were less likely to be eligible for the school lunch program.
- Rural graduates travelled farther than nonrural graduates to attend two-year colleges and less selective four-year colleges.
- About a third of rural graduates and a quarter of nonrural graduates who enrolled in college chose a college that was less selective than colleges for which they were presumptively eligible.

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Summary

Research has shown a gap in college enrollment and degree attainment between students in rural and nonrural high schools. In Indiana, where 31 percent of high school students attend rural schools, increasing postsecondary educational attainment requires understanding and addressing the needs and challenges of rural students. This descriptive study supports the state's efforts to improve college readiness by offering a better understanding of the processes that advance the educational success of rural students and by providing a foundation for future research on these processes and potential interventions.

Using data from the Indiana state longitudinal data system, this study examined rural–nonrural differences in college enrollment patterns among Indiana's 2010 public high school graduates enrolling in Indiana public colleges.

The study examined whether there were differences in the proportion of graduates of rural and nonrural high schools enrolling in Indiana state colleges of various selectivity and, if so, whether the differences were affected by economic factors, academic achievement, or the distance to colleges. It also looked for any rural–nonrural differences in whether graduates enrolled in a college that matched their academic qualifications (that is, for which they were "presumptively eligible") or in a college less selective than their academic qualifications would predict.

The study found that a similar proportion of 2010 graduates of rural and nonrural public high schools enrolled in Indiana colleges. However, rural graduates enrolled more frequently than nonrural graduates in two-year colleges and less frequently in very selective colleges. Rural high school graduates had slightly lower levels of eligibility for the school lunch program (a proxy for low-income status), which differed from findings based on national data. Graduates of rural and nonrural high schools had similar academic preparation and similar levels of presumptive eligibility for colleges based on their academic qualifications. Yet, after controlling for student and school characteristics, the study found that rural high school graduates were more likely to enroll in two-year colleges and colleges that were "undermatched" with their level of presumptive eligibility. Distance may have been a factor: the farther rural graduates' high schools were from colleges, the more likely rural graduates were to enroll in a two-year college or to undermatch with a college.

Indiana data differed from national data in some areas, emphasizing the importance of relying on state data in making education policy decisions.

Contents

Figures

Maps

Tables

Why this study?

Postsecondary education is a fundamental tool for achieving upward mobility and economic growth. Students with an associate's or bachelor's degree earn substantially more in a lifetime and experience better working conditions and job benefits than students with only a high school diploma. Researchers have estimated that by 2018, 63 percent of job openings will require some postsecondary education and that the country will have 3 million fewer college graduates than the job market will demand (Carnevale, Smith, & Strohl, 2010). Faced with this projected demand for college-educated workers, most states in the Regional Educational Laboratory (REL) Midwest Region have committed to increasing the number of students who acquire college credentials (Lumina Foundation, 2013).

Achieving this goal requires understanding students' college enrollment patterns and the factors that influence different types of students. Indiana has taken multiple steps to improve the college readiness of students across the state by introducing initiatives aimed at raising students' expectations and high school achievement (Indiana Code 20–30–10–1, 2005; Indiana Code 20-30-10-4, 2006), by aligning high school standards with college and workplace expectations (Plucker, Wongsarnpigoon, & Houser, 2006), and by adopting new graduation requirements (Indiana Department of Education, 2011). Although these changes allow for greater access to a more rigorous high school curriculum, rural and nonrural students may use these resources in different ways.[1] For instance, rural schools may not be able to offer the same advanced math, world language, Advanced Placement, International Baccalaureate, or dual-credit options as nonrural schools, and rural students may not take advantage of honors diploma offerings at the same rate as nonrural students.

Nationally, college enrollment rates are lower for students from rural areas (27 percent) than for students from cities (37 percent), suburbs (37 percent), and towns (32 percent)

A gap exists between rural and nonrural students in college enrollment and degree attainment

Research on college choices and postsecondary educational attainment for students from rural areas is limited (see appendix A for a comprehensive review of the literature). Nationally, college enrollment rates are lower for students from rural areas (27 percent) than for students from cities (37 percent), suburbs (37 percent), and towns (32 percent). Smaller percentages of rural adults than urban adults earn a bachelor's degree (13 percent versus 17 percent) or a graduate or professional degree (7 percent versus 10 percent; Provasnik et al., 2007). Despite these discrepancies, research examining college enrollment or attainment often does not account for students' geographic context, nor has previous research used geographic information system data in the analyses (Byun, Meece, & Irvin, 2012; Turley, 2009). In addition, studies that do examine rural–nonrural disparities in college enrollment and attainment often use national datasets, making it difficult to apply findings to a specific state (for example, Byun et al., 2012; Hu, 2003). In fact, some research has suggested that studies of rural–nonrural differences should be conducted at a regional level by identifying clusters of rural districts sharing similar economic, historic, and demographic characteristics (Johnson & Strange, 2009).

Students attending four-year and more selective colleges attain degrees at higher rates and earn higher salaries, on average, than students attending two-year colleges

On the whole, high school graduates who attend four-year colleges attain degrees at a higher rate and earn more than students who attend two-year colleges, and students who attend more selective four-year colleges attain degrees at the highest rate (Brand &

Halaby, 2006; Hoekstra, 2009; Mullen, Goyette, & Soares, 2003; Pascarella & Terenzini, 2005; Reynolds, 2012). However, previous research has found some overlap in the earnings distribution of students who graduate with an associate's degree and those who graduate with a bachelor's degree because certain technical programs at two-year colleges can have higher associated earnings than some liberal arts programs at four-year colleges (Jacobson & Mokher, 2009; Rosenbaum, Stephan, & Rosenbaum, 2010). Overall, though, the selectivity of the college predicts the earnings of its graduates even after accounting for many student characteristics (Brand & Halaby, 2006; Dougherty, 1994; Hoekstra, 2009; Stephan, Rosenbaum, & Person, 2009). It is important, therefore, to understand how students access different postsecondary pathways.

Not all students who qualify for a four-year college or a more selective college actually attend one. Studies have found that some high school graduates enter less selective colleges than the presumptive level of eligibility (see box 1) suggested by their academic qualifications (they are undermatched with their college; Bowen, Chingos, & McPherson, 2009; Roderick, Nagaoka, Coca, & Moeller, 2008; Smith, Pender, & Howell, 2013). No study has examined whether or to what extent rural–nonrural differences exist in college enrollment patterns related to presumptive eligibility.

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Midwest school leaders want to know more about the differences in postsecondary pathways between rural and nonrural students

Policymakers and school leaders in many REL Midwest Region states have committed to increasing the number of students with postsecondary credentials (Board of Regents, State of Iowa, 2010; Illinois Board of Higher Education, 2009; Indiana Department of Education, 2013; Lumina Foundation, 2013; White House Initiative on Increasing College Completion Rates, 2009). Rural students make up a substantial proportion of high school students in Indiana (31 percent) and in the Midwest Region more generally (23 percent; U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, 2010). Increasing postsecondary educational attainment for all students requires understanding and addressing the pathways of rural students.

Box 1. Presumptive eligibility

Presumptive eligibility is the highest level of college selectivity for which a student is presumed eligible for admission, as determined by academic qualifications. In this study, grade point average (GPA) and ACT/SAT scores were used to determine presumptive eligibility by examining the actual college-going patterns of the analytic sample of graduates with valid or nonmissing GPAs enrolling in Indiana public colleges (see appendix B).

Presumptive eligibility is an important component of understanding college pathways and postsecondary academic success; students are more likely to complete their degree if they enroll in a college that matches their academic qualifications (Bowen et al., 2009). Bowen et al. use the term *undermatching* to refer to students who ultimately attend institutions that are less selective than the ones for which they seem to qualify.

Several studies that examined presumptive eligibility and undermatching among national, state, and urban populations found differences by race/ethnicity and socioeconomic status in the rate at which graduates enroll in a college that matches their presumptive eligibility (Bowen et al., 2009; Roderick et al., 2008). The current study expands on this research by examining rural–nonrural differences in presumptive eligibility and undermatching.

In addition to supporting the work of the Indiana Commission for Higher Education, this study takes an initial step toward supporting the work of the Rural Research Alliance and the College and Career Success Research Alliance, two groups convened by REL Midwest. This study supports the work of the Rural Research Alliance by providing descriptive information on the processes that enhance the educational success of rural students. Members of the alliance can use the study results to inform policy decisions in their own state and to support their own rural and nonrural student populations.

To support the work of the College and Career Success Research Alliance, the study examines differences in public college enrollment rates as well as the usefulness of previously identified early college success predictors in predicting presumptive college eligibility for 2010 graduates of Indiana public rural and nonrural high schools. Results from this study will help Indiana educators, policymakers, and others represented by this alliance allocate resources to students of rural and nonrural high schools who are most in need of support for enrolling in the colleges most appropriate for their level of academic preparation.

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Finally, this report presents methodologies that could be useful for examining rural–nonrural college enrollment patterns outside Indiana.

What the study examined

This study used student data on 2010 Indiana public high school graduates who enrolled in Indiana public colleges in the fall after high school graduation to compare enrollment patterns of students from rural and nonrural high schools (see box 2 for a description of Indiana's public college system). The data were obtained from the Indiana state longitudinal data system and the Indiana Commission for Higher Education. Geographic information system software (ArcMap 10.2; Environmental Systems Research Institute [Esri], 2013), descriptive statistics, and statistical models were used in the analyses.

Box 2. Public colleges in Indiana

Indiana has 16 degree-granting public colleges, according to the National Center for Education Statistics: 14 four-year institutions and 2 two-year institutions (U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, n.d. a). The two-year colleges are Vincennes University and the Ivy Tech system, which has 31 degree-granting locations statewide. These two-year colleges have open-admissions policies. Although Vincennes University does award some bachelor's degrees, it is listed in the Integrated Postsecondary Education Data System as a four-year, mostly associate's degree–granting public institution. It is grouped with two-year colleges by the Indiana Commission for Higher Education and is not rated by Barron's. Thus, for the purposes of this study, Vincennes University is considered a two-year college.

According to Barron's rankings of college selectivity (Barron's Educational Series, 2010), Indiana's four-year public colleges consist of 1 highly competitive institution, 1 very competitive institution, 3 competitive institutions, and 8 less competitive institutions. One four-year, degree-granting public college in Indiana is not ranked by Barron's; it has a similar profile of average SAT scores and acceptance rates as colleges ranked by Barron's as less competitive, so for the purposes of this study, this college was rated as less competitive. In addition, the highly competitive and very competitive institutions were combined into one category (very selective; see appendix B for a detailed discussion of college selectivity and table B2 in appendix B for a list of Indiana public four-year colleges by selectivity level).

The study explored five research questions on 2010 graduates of Indiana public rural and nonrural high schools who enrolled in Indiana public colleges:

1. What proportion of graduates of rural and nonrural high schools enrolled in college, enrolled in different types of colleges (two- or four-year colleges of varying selectivity), and enrolled full-time?

2. Did graduates of rural and nonrural high schools differ in their academic preparation or eligibility for the school lunch program (a proxy for low-income status)?

3. Where are two- and four-year colleges located, and how does distance from high schools to colleges vary for graduates of rural and nonrural high schools who enrolled in Indiana public colleges?

4. What proportion of rural and nonrural high school graduates who enrolled in college had academic characteristics that made them "presumptively eligible" (see box 1) for two- or four-year public colleges of varying selectivity? What proportion who enrolled in a college undermatched with their level of presumptive eligibility?

5. After student- and school-level characteristics were controlled for among high school graduates who enrolled in a public college, did any rural–nonrural differences remain with respect to enrolling in a two- versus four-year college or undermatching with the college of enrollment?

This study used student data on 2010 Indiana public high school graduates who enrolled in Indiana public colleges in the fall after high school graduation to compare enrollment patterns of students from rural and nonrural high schools

Research question 1 asks about differences in the postsecondary pathways of rural and nonrural students. Research questions 2 and 3 examine three potential explanations for rural–nonrural disparities raised in the literature: differences in academic preparation, differences in school lunch program eligibility, and differences in proximity to colleges. Research question 4 asks about differences in presumptive eligibility and the extent to which rural and nonrural graduates enroll in colleges less selective than their level of presumptive eligibility. Research question 5 considers the extent to which rural–nonrural differences remain after student and school academic, demographic, and geographic characteristics are controlled for. Box 3 briefly describes the analytic samples and research approach.

This report presents results in tabular and graphic formats. Supplemental maps are also used to display average differences between rural and nonrural high schools on a variety of variables and to illustrate the distribution of outcomes. The maps allow for the identification and discussion of any geographic differences found in the analyses.

A literature review in appendix A describes differences in college enrollment and completion, academic preparation, poverty, and distance traveled to attend college for rural and nonrural students. A detailed explanation of the data, sample, and study methodology is in appendix B. Detailed findings, some of which are not discussed in the main report, are discussed in appendix C. Finally, detailed findings of the regression analyses not discussed in the main report are shown in appendix D.

Box 3. Analytic samples and research approach

This study uses three analytic samples to address the research questions. Research questions 1 and 2, which seek general information on differences among 2010 graduates of Indiana public high schools in rural and nonrural locales, use the high school graduates sample of 64,534 students (see figure B1 in appendix B for details on the creation of the analytic sample). These students are primarily White (81 percent), with smaller percentages of Black (10 percent), Hispanic (5 percent), and Asian (1 percent) students. Slightly more than half (51 percent) the students are female, and almost a third (29 percent) are eligible for the school lunch program. Because a high school's geographic locale was a key variable in the study, graduates from high schools for which latitude and longitude data were missing were excluded from all analytic samples.

The remaining questions focus on the subgroup of students who enrolled in Indiana public colleges in fall 2010, which represents the majority (78 percent) of Indiana public high school graduates (U.S. Department of Education, 2012). The analytic sample of graduates enrolling in Indiana public colleges (30,624 students) was used to examine research question 3 on travel distance to college and question 5 on any rural–nonrural differences in enrollment in two- versus four-year colleges remaining after student and school characteristics were controlled for. The analytic sample for research question 4 on presumptive eligibility and question 5 on any remaining undermatching with students' college of enrollment after student and school characteristics were controlled for was limited to the subsample of graduates with valid grade point averages (GPAs; 24,810 students). This further limitation was required because GPA is used to determine a student's presumptive eligibility (see box 1).

To answer research question 1, the percentage of Indiana high school graduates not attending any college and the percentages attending two- and four-year colleges in the fall after 2010 high school graduation were computed and compared for rural and nonrural high school students.

For research question 2, academic characteristics and the percentage of students eligible for the school lunch program were computed and presented in a table comparing graduates of rural and nonrural high schools. In addition, several maps displaying average academic characteristics in rural and nonrural schools were created to facilitate comparison (see appendix C).

For research question 3, geographic information system software (ArcMap 10.2; Esri, 2013) was used to create maps depicting the locations of colleges in Indiana, student enrollment in various types of colleges, and geographic proximity of postsecondary institutions to high schools. Geographic proximity analyses differed at the student and school levels. At the student level average distance traveled was calculated from high schools of graduation to colleges of enrollment. At the school level straight line distances were calculated between high schools and the nearest two- and four-year colleges of varying selectivity (see appendix B for a detailed description of how distances were calculated).

For research question 4, a qualifications rubric based on GPA and ACT/SAT scores was created to determine the category of selectivity for which a student was presumptively eligible (see appendix B for a detailed description of the construction of the qualifications rubric and presumptive eligibility analysis). The selectivity ratings of the colleges of enrollment were compared with the presumptive eligibility ratings to show rural–nonrural differences for students enrolling in a college less selective than their presumptive eligibility suggested.

Finally, for research question 5, two regression models were estimated to show whether—after this study's control for student and school characteristics—rural or nonrural high school locale predicts enrollment in a two-year versus a four-year college and enrollment in a college less selective than the level for which a student is presumptively eligible (see appendix B).

What the study found

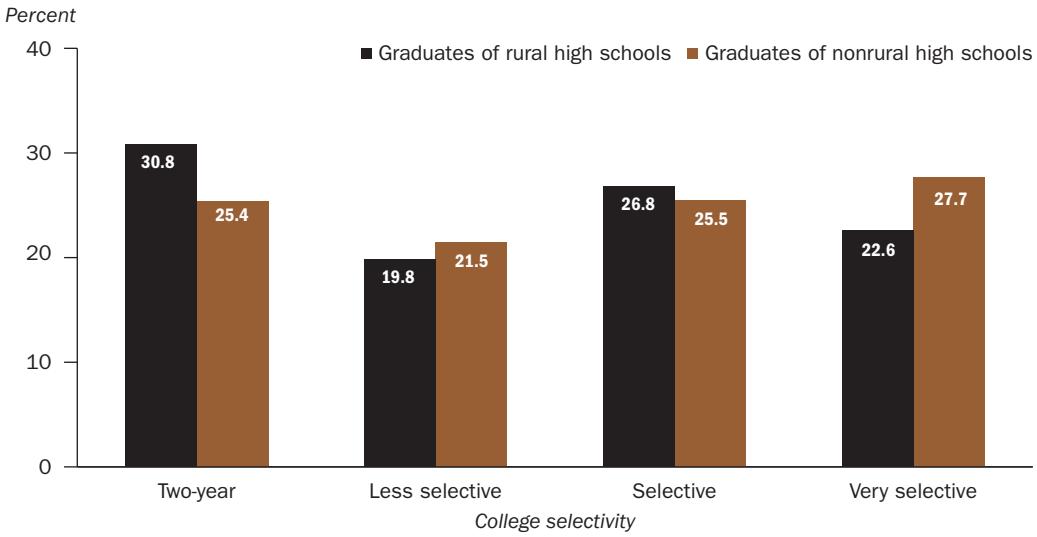
A similar proportion of graduates of rural and nonrural Indiana public high schools enrolled in college. However, rural graduates were more likely than nonrural graduates to enroll in a two-year college and less likely to enroll in a very selective four-year college. Rural high school graduates had slightly lower eligibility for the school lunch program (a proxy for low-income status). Rural and nonrural graduates had similar academic preparation and similar levels of presumptive eligibility for colleges according to their academic qualifications. Yet, after controlling for student and school characteristics, the study found that rural high school graduates were more likely to enroll in two-year colleges and colleges undermatched with their level of presumptive eligibility. Distance may have been a factor: the farther rural graduates' high schools were from colleges, the more likely graduates were to enroll in a two-year college or to undermatch with a college.

Rural graduates were more likely than nonrural graduates to enroll in a two-year college and less likely to enroll in a very selective four-year college

A similar proportion of graduates of rural and nonrural high schools enrolled in college, with rural graduates enrolling at a slightly higher rate than nonrural graduates

Student enrollment in two-year colleges and four-year colleges of varying selectivity. A similar proportion of graduates of rural and nonrural high schools enrolled in college, with rural graduates enrolling at a slightly higher rate than nonrural graduates (62.1 percent versus 60.6 percent). Differences emerged, however, in the type and selectivity level (less selective, selective, and very selective colleges; see appendix B for how selectivity levels were defined) of colleges in which these graduates enrolled. Among students who enrolled in any college in fall 2010, rural graduates were more likely than nonrural graduates to enroll in a two-year college (30.8 percent versus 25.4 percent) and less likely to enroll in a very selective four-year college (22.6 percent versus 27.7 percent; see figure 1).

Figure 1. Graduates of rural high schools in Indiana in 2010 were more likely than graduates of nonrural high schools to enroll in a two-year college and less likely to enroll in a very selective college



Note: Two-year colleges include Vincennes University, which is a four-year college with an open-admissions policy that grants primarily associate's degrees. Less selective, selective, and very selective colleges include four-year colleges only.

Source: Authors' calculations based on data from the Indiana state longitudinal data system and Barron's Educational Series (2010).

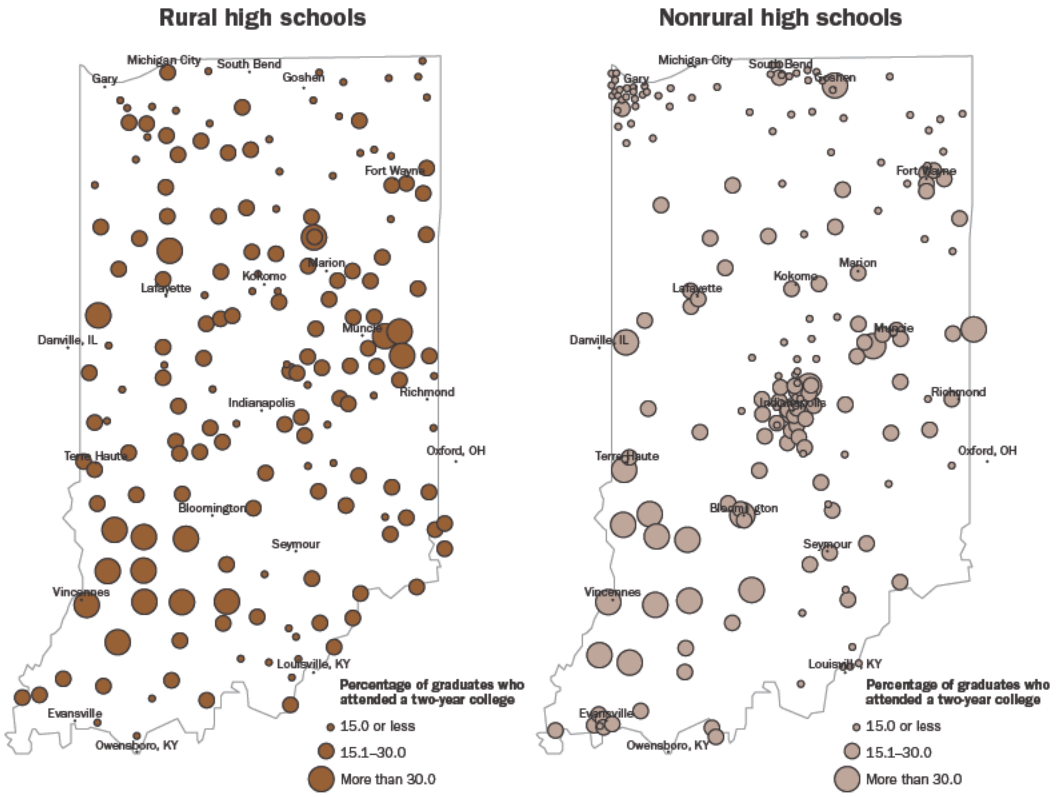
School-level enrollment in two- and four-year colleges of varying selectivity. School-level analysis supported findings from the student analysis showing a higher percentage of rural schools than nonrural schools sending a higher percentage of students to two-year colleges (map 1). Almost three-fourths of rural schools (69 percent) and half of nonrural schools (50 percent) sent more than 15 percent of their students to a two-year college. Both rural and nonrural high schools with the highest percentages of students attending a two-year college were concentrated largely in the southwestern portion of the state (see map 3 later in the report for the locations of Indiana public two- and four-year colleges of varying selectivity).

Map 2 displays percentages of students from rural and nonrural high schools attending four-year colleges of varying selectivity. Less selective colleges are symbolized by circles, selective colleges by squares, and very selective colleges by triangles.

Almost three-fourths of rural schools (69 percent) and half of nonrural schools (50 percent) sent more than 15 percent of their students to a two-year college

Some 42 percent of rural schools and 38 percent of nonrural schools sent the largest percentage of their four-year-college-bound graduates to selective colleges. In contrast,

Map 1. Rural Indiana high schools sent a higher percentage of their 2010 graduates to two-year colleges than did nonrural schools



Note: Each circle represents the location of a high school. The size of the circle indicates the percentage of each high school's 2010 graduates who enrolled in a two-year college; smaller circles indicate a lower percentage. There are more medium-size and large circles on the rural map and more small circles on the nonrural map, supporting the student-level finding that students from rural high schools were more likely than students from nonrural high schools to enroll in a two-year college. Two-year colleges include Vincennes University, which is a four-year college with an open-admissions policy that grants primarily associate's degrees.

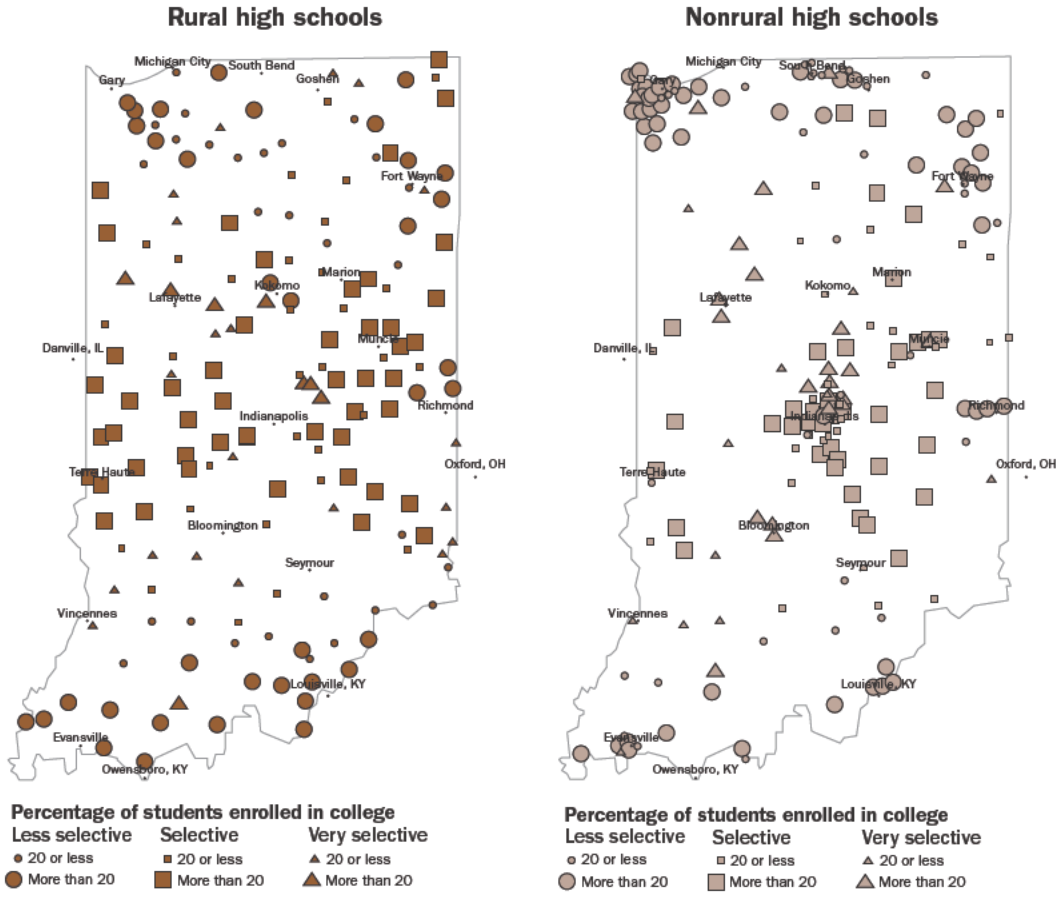
Source: Authors' calculations based on data from the Indiana state longitudinal data system and latitude and longitude coordinates of high schools (U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, n.d. b).

21 percent of nonrural schools and 17 percent of rural schools sent the largest percentage of their four-year-college-bound graduates to very selective colleges. Of these, 16 nonrural schools (8 percent) and five rural schools (3 percent) sent more than 20 percent of their four-year college-bound graduates to very selective colleges (see map 3 for the locations of Indiana public two- and four-year colleges of varying selectivity).

Rural high schools sent more of their four-year college-bound graduates to selective colleges than did nonrural schools, whereas nonrural schools sent a higher percentage of their four-year college-bound graduates to very selective colleges than did rural schools.

Map 2. Rural Indiana high schools sent a higher percentage of their 2010 four-year college-bound graduates to less selective and selective colleges than did nonrural schools, and nonrural schools sent a higher percentage of their four-year college-bound graduates to very selective colleges than did rural schools

Some 42 percent of rural schools and 38 percent of nonrural schools sent the largest percentage of their four-year-college-bound graduates to selective colleges



Note: Each shape represents the location of a high school. In high schools represented by circles, the largest percentage of 2010 four-year college-bound graduates from that high school enrolled in a less selective college. In high schools represented by squares, the majority of 2010 graduates from that high school enrolled in a selective college. In high schools represented by triangles, the majority of graduates from that high school enrolled in a very selective college. The size of the shape indicates the percentage of the high school's graduates who enrolled in a college at that selectivity level; smaller shapes indicate that 20 percent or less of a high school's graduates enrolled in a college at that selectivity level. There are more circles and squares of both sizes on the rural map and more triangles of both sizes on the nonrural high school map.

Source: Authors' calculations based on data from the Indiana state longitudinal data system, latitude and longitude coordinates of high schools (U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics n.d. b), and Barron's Educational Series (2010).

Because there are more smaller shapes on the left side of map 2, it may appear that more rural schools had less than 20 percent of their graduates attending colleges of any selectivity level. However, the reason that the percentages of four-year enrollment appear lower overall for rural schools than for nonrural schools is because many rural schools sent a high percentage of their students to two-year colleges.

In terms of geography, most nonrural high schools sending more than 20 percent of their students to four-year colleges of any selectivity level appear to be in major cities (Indianapolis area, Gary area, and so on; see footnote 1 for how rural and nonrural are defined), whereas rural schools sending more than 20 percent of their students to four-year colleges of any selectivity level are more dispersed, with a higher concentration in central and southern Indiana.

Rural graduates had academic preparation similar to that of nonrural graduates and were less often eligible for the school lunch program

Rural and nonrural graduates showed similar patterns of academic preparation in their scores on the Indiana Statewide Testing for Educational Progress—Plus, ACT, and SAT and in their rates of taking either the ACT or SAT

Academic preparation. Graduates of rural and nonrural high schools took Advanced Placement exams at similar rates (27.2 percent versus 28.2 percent). This similarity may be explained partly by a 2006 Indiana law requiring high schools to offer a minimum of two dual-credit courses and two Advanced Placement courses for students who qualify (Indiana Code 20-30-10-4, 2006). However, a lower percentage of rural graduates than nonrural graduates took and passed at least one Advanced Placement exam (9.9 percent versus 12.7 percent; table 1). In addition, rural and nonrural graduates showed similar patterns of academic preparation in their scores on the Indiana Statewide Testing for Educational Progress—Plus (ISTEP+),[2] ACT, and SAT and in their rates of taking either the ACT or SAT (see table 1).

School lunch program eligibility. Previous studies have found that poverty is negatively correlated with postsecondary educational attainment, and national samples have found that rural students have higher rates of poverty, on average, than nonrural students (Byun et al., 2012; Hill, 2008; Lichter & Johnson, 2007; O'Hare & Savage, 2006; Plank & Jordan, 2001; Roscigno & Crowley, 2001; Roscigno, Tomascovic-Devey, & Crowley, 2006). In addition, some evidence suggests that the determinants of the likelihood of graduation are similar for rural and urban high school students (Jordan, Kostandini, & Mykerezi, 2012). In the sample of all Indiana high school graduates for the current study, however, rural graduates were less likely than nonrural graduates to be eligible for the school lunch program (23.5 percent versus 31.2 percent; see table 1). Since the current study considered only graduates, it is possible that a disproportionate number of rural high school students eligible for the school lunch program dropped out of high school before graduation, but this possibility was not investigated.

Rural high school graduates traveled farther than nonrural graduates to two-year colleges and to less selective four-year colleges

Previous research has reported that students are less likely to attend colleges that are farther from their homes (Rouse, 1995) and more likely to apply to college when there are a greater number of colleges close to home (Turley, 2009). Rural students consider living near their families while attending college to be very important (Johnson, Elder, & Stern, 2005). Familial responsibilities, school and community environments, the availability

Table 1. Number and percentage of 2010 graduates of Indiana rural and nonrural high schools, by student academic and socioeconomic subgroup

Student academic subgroup	Rural high school graduates		Nonrural high school graduates	
	Number	Percent	Number	Percent
Total	20,817	100.0	43,717	100.0
Grade 10 ISTEP+ math and English language arts composite				
Lower third of ISTEP+ composite	6,032	30.2	14,155	34.4
Middle third of ISTEP+ composite	7,120	35.7	13,060	31.7
Upper third of ISTEP+ composite	6,803	34.1	13,998	34.0
ACT score				
Lower third of ACT scores	1,467	36.6	4,359	40.6
Middle third of ACT scores	1,022	25.5	2,327	21.7
Upper third of ACT scores	1,524	38.0	4,056	37.8
SAT score				
Lower third of SAT scores	3,724	32.4	7,922	33.4
Middle third of SAT scores	3,957	34.4	7,329	30.9
Upper third of SAT scores	3,819	33.2	8,488	35.8
ACT or SAT score				
Has a score	12,433	59.7	26,737	61.2
Does not have a score	8,384	40.3	16,980	38.8
Advanced Placement exam				
Took and passed at least one exam	2,055	9.9	5,520	12.7
Took at least one exam but did not pass any	3,596	17.3	6,733	15.5
Did not take any exams	15,120	72.8	31,333	71.9
Eligibility for school lunch program				
Eligible	4,871	23.5	13,578	31.2
Not eligible	15,900	76.6	30,008	68.9

ISTEP+ is the Indiana Statewide Testing for Educational Progress—Plus.

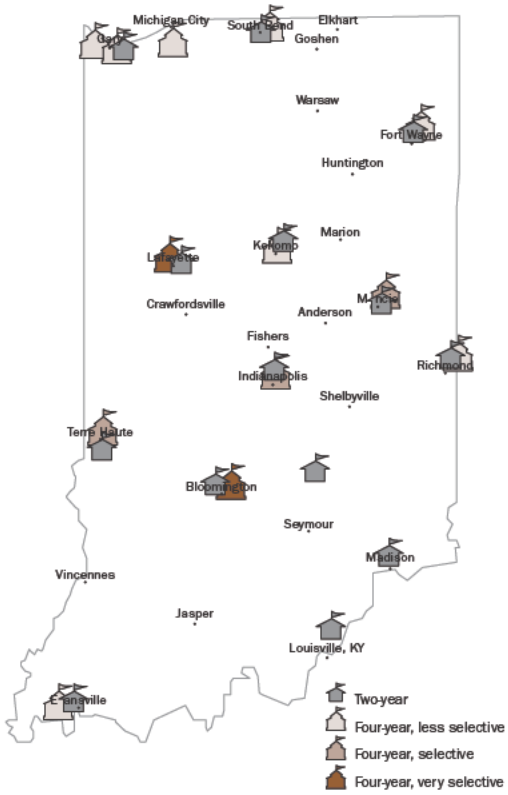
Note: Lower, middle, and upper thirds of ISTEP+, ACT, and SAT scores are based on scores of students in the high school graduates analytic sample. Numbers within subgroups may not sum to total number of graduates because of missing data. Percentages may not sum to 100 because of rounding.

Source: Authors' calculations based on data from the Indiana state longitudinal data system.

of social resources, and local agricultural or industrial job opportunities can all present unique pressures, incentives, and influences on rural students (Byun et al., 2012; Gillie, Isenhour, & Rasmussen, 2006; Johnson et al., 2005; Roscigno & Crowley, 2001; Turley, 2009). In addition, living on campus can be costly, as can commuting long distances to attend college. The considerable financial benefits of living at home during college (saving money on housing, food, and other expenses associated with living on campus) can be a powerful incentive for students in choosing which college to attend. To better understand whether distance affects which college rural and nonrural graduates attend, the study examined the location of Indiana public colleges and the distance that rural and nonrural students traveled to them.

Overall, both two- and four-year colleges in Indiana are located primarily in cities and more urban areas (map 3). Two-year colleges are generally located close to four-year colleges; only three two-year colleges do not have a four-year college nearby.

Map 3. Indiana public two- and four-year colleges are concentrated largely around nonrural areas of the state, such as near cities and towns



Note: There are 31 Ivy Tech (two-year college) campuses throughout Indiana. In some cases, the unique identification number for these colleges represents more than one campus, and the flags on the map may represent more than one physical campus clustered within the same area.

Source: Latitude and longitude coordinates for all Indiana colleges provided by the Indiana Commission for Higher Education.

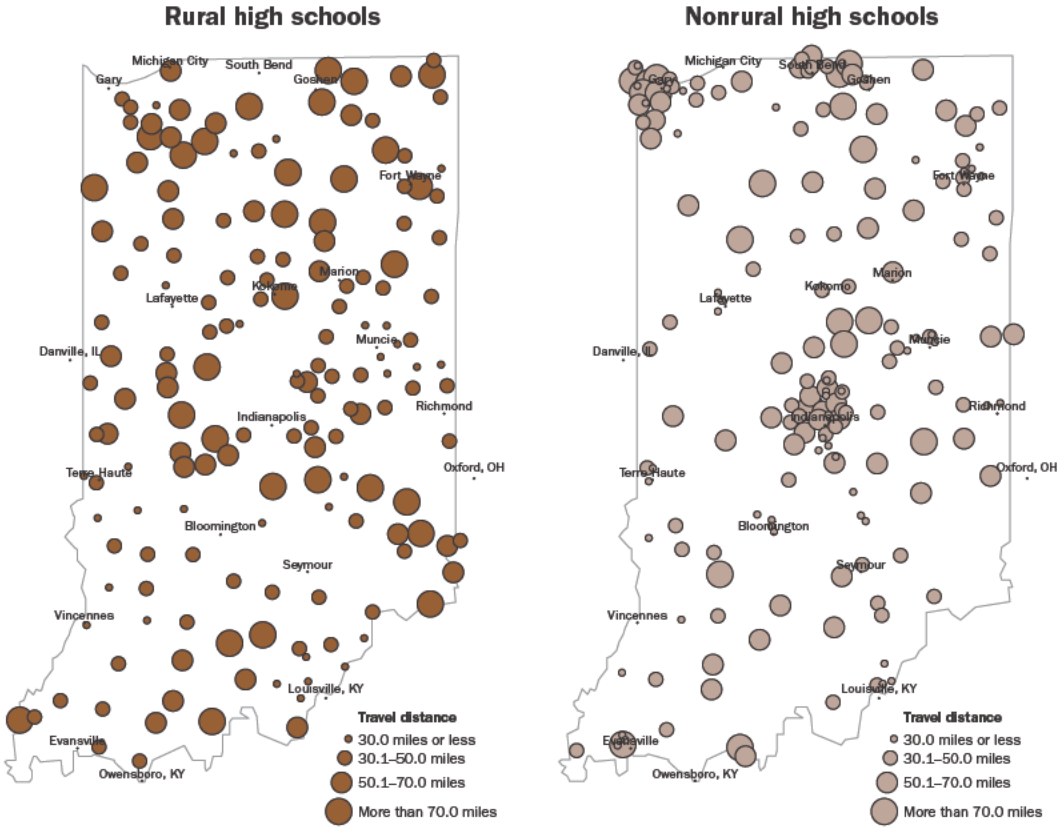
Rural graduates traveled slightly shorter distances on average than nonrural graduates to selective colleges and very selective colleges

The average distance students traveled between their high school of graduation and college of enrollment varied by college type and selectivity level for both rural and nonrural high school graduates. Average distances traveled to attend college increased in parallel with the selectivity level of the college. Indiana has only two very selective public colleges, and thus most students who attend these colleges will travel farther than they would to less selective schools, which can be found in greater numbers across the state in both rural and nonrural locales. Rural graduates traveled farther on average, however, than nonrural graduates to two-year colleges (44.5 miles versus 38.9 miles; map 4; see also table C3 in appendix C) and to less selective four-year colleges (53.5 miles versus 45.3 miles; see table C3 and map C8 in appendix C). But rural graduates traveled slightly shorter distances on average than nonrural graduates to selective colleges (72.5 miles versus 75.8 miles; see table C3 and map C9 in appendix C) and very selective colleges (88.8 miles versus 94.0 miles; see table C3 and map C10 in appendix C).

Rural and nonrural graduates had similar levels of presumptive eligibility according to their academic qualifications

Previous research on presumptive eligibility (see box 1) demonstrates that students who enroll in colleges that match their level of academic qualifications have a greater probability of academic success (Bowen et al., 2009; Roderick et al., 2008). Thus, the study

Map 4. Rural high school graduates in Indiana in 2010 traveled farther, on average, than nonrural graduates to attend two-year colleges



Note: Each circle represents the location of a high school. The size of the circle indicates the average distance that graduates of each high school who enrolled in a two-year college traveled to college; smaller circles indicate a shorter distance. There are more medium-size and large circles on the rural map, suggesting that more rural high schools had graduates traveling longer distances to attend a two-year college. Two-year colleges include Vincennes University, which is a four-year college with an open-admissions policy that grants primarily associate's degrees.

Source: Authors' calculations based on latitude and longitude coordinates of high schools (U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics n.d. b), latitude and longitude coordinates of colleges provided by the Indiana Commission for Higher Education, and aggregated travel distances from students' high schools of graduation to colleges of enrollment (Esri, 2013).

examined differences in the presumptive eligibility for colleges of various selectivity levels based on high school academic qualifications of rural and nonrural graduates. Because GPA was needed to calculate graduates' presumptive eligibility, the analytic sample of graduates with valid GPAs entering Indiana public colleges was used for this analysis.

Rural high school graduates were presumptively eligible to attend colleges that were similar to those for which nonrural graduates were presumptively eligible (for example, 23.9 percent of rural graduates and 25.8 percent of nonrural graduates were presumptively eligible to attend very selective colleges; table 2).

Rural graduates were more likely to enroll in a college undermatched with their level of presumptive eligibility

Of the 2010 high school graduates enrolled in Indiana public colleges, the 8,074 rural graduates and 16,736 nonrural graduates had similar levels of presumptive eligibility (see table 2).

Table 2. Presumptive eligibility for colleges for 2010 graduates of Indiana rural and nonrural high schools, by college selectivity level

College selectivity level	Rural (*n* = 8,074)		Nonrural (*n* = 16,736)		Total (*n* = 24,810)	
	Number	Percent	Number	Percent	Number	Percent
Two-year	1,465	18.1	2,789	16.7	4,254	17.2
Less selective four-year	1,907	23.6	4,296	25.7	6,203	25.0
Selective four-year	2,773	34.3	5,327	31.8	8,100	32.7
Very selective four-year	1,929	23.9	4,324	25.8	6,253	25.2

Note: Presumptive eligibility was based on the ACT/SAT scores and grade point average of the actual college-going population of high school graduates. Because two-year colleges do not require ACT/SAT for admission, those missing ACT/SAT were presumed eligible for two-year colleges, but calculating presumptive eligibility required a valid grade point average. Thus graduates missing grade point averages were excluded from the analysis. Percentages may not sum to 100 because of rounding.

Source: Authors' calculations based on data from the Indiana state longitudinal data system and Barron's Educational Series (2010).

In general, the higher students' presumptive eligibility, the more frequently they enrolled in a college undermatched with their level of presumptive eligibility

However, rural graduates were more likely than their nonrural counterparts to enroll in a college undermatched with their level of presumptive eligibility (2,317 rural graduates, or 28.7 percent, compared with 4,082 nonrural graduates, or 24.4 percent, were undermatched with their college; tables 3 and 4). Indeed, for each level of presumptive eligibility, rural graduates had higher rates of undermatching (see table C1 in appendix C for overall rates of undermatching). For example, among graduates presumed eligible to attend very selective colleges, rural graduates had higher rates than nonrural graduates of actual enrollment in selective colleges (26.0 percent and 20.6 percent), in less selective colleges (13.8 percent and 11.5 percent), and in two-year colleges (2.4 percent and 1.0 percent; see tables 3 and 4).

In general, the higher students' presumptive eligibility, the more frequently they enrolled in a college undermatched with their level of presumptive eligibility. One possible explanation for this finding is that the higher a student's level of presumptive eligibility, the fewer

Table 3. Enrollment versus selectivity of colleges for which 2010 graduates of Indiana rural high schools were presumptively eligible

		Presumptive eligibility			
		Two-year (*n* = 1,465) Percent (number)	Less selective four-year (*n* = 1,907) Percent (number)	Selective four-year (*n* = 2,773) Percent (number)	Very selective four-year (*n* = 1,929) Percent (number)
Actual enrollment	Two-year	55.2 (809)	26.5 (505)	9.0 (250)	2.4 (47)
	Less selective four-year	19.7 (288)	39.5 (754)	26.9 (746)	13.8 (267)
	Selective four-year	16.3 (239)	31.0 (591)	39.2 (1,086)	26.0 (502)
	Very selective four-year	8.8 (129)	3.0 (57)	24.9 (691)	57.7 (1,113)

Note: Percentages are based on 8,074 rural graduates with valid grade point averages who enrolled in Indiana public colleges. Cells shaded in gray indicate graduates whose presumptive eligibility ranking was higher than the college in which they actually enrolled, and cells shaded in brown indicate graduates whose actual enrollment matched with or was higher than their presumptive eligibility ranking. Percentages may not sum to 100 because of rounding. Taken together, tables 3 and 4 show that rural high school graduates are more likely than nonrural high school graduates to enroll in a college undermatched with their academic qualifications.

Source: Authors' calculations based on data from the Indiana state longitudinal data system and Barron's Educational Series (2010).

Table 4. Enrollment versus selectivity of college for which 2010 graduates of Indiana nonrural high schools were presumptively eligible

		Presumptive eligibility			
		Two-year college (*n* = 2,789) Percent (number)	Less selective college (*n* = 4,296) Percent (number)	Selective college (*n* = 5,327) Percent (number)	Very selective college (*n* = 4,324) Percent (number)
Actual enrollment	Two-year	49.0 (1,366)	20.1 (862)	6.4 (343)	1.0 (41)
	Less selective four-year	25.8 (720)	45.7 (1,964)	27.1 (1,446)	11.5 (499)
	Selective four-year	14.9 (416)	29.8 (1,278)	37.3 (1,987)	20.6 (891)
	Very selective four-year	10.3 (287)	4.5 (192)	29.1 (1,551)	66.9 (2,893)

Note: Percentages are based on 16,736 nonrural graduates with valid grade point averages who enrolled in Indiana public colleges. Cells shaded in gray indicate graduates whose presumptive eligibility ranking was higher than the college in which they actually enrolled, and cells shaded in tan indicate graduates whose actual enrollment matched with or was higher than their presumptive eligibility ranking. Percentages may not sum to 100 because of rounding. Taken together, tables 3 and 4 show that rural high school graduates are more likely than nonrural high school graduates to enroll in a college undermatched with their academic qualifications.

Source: Authors' calculations based on data from the Indiana state longitudinal data system and Barron's Educational Series (2010).

Among high school graduates presumptively eligible for very selective colleges, rural graduates were more likely than nonrural graduates to enroll in a selective, less selective, or two-year college

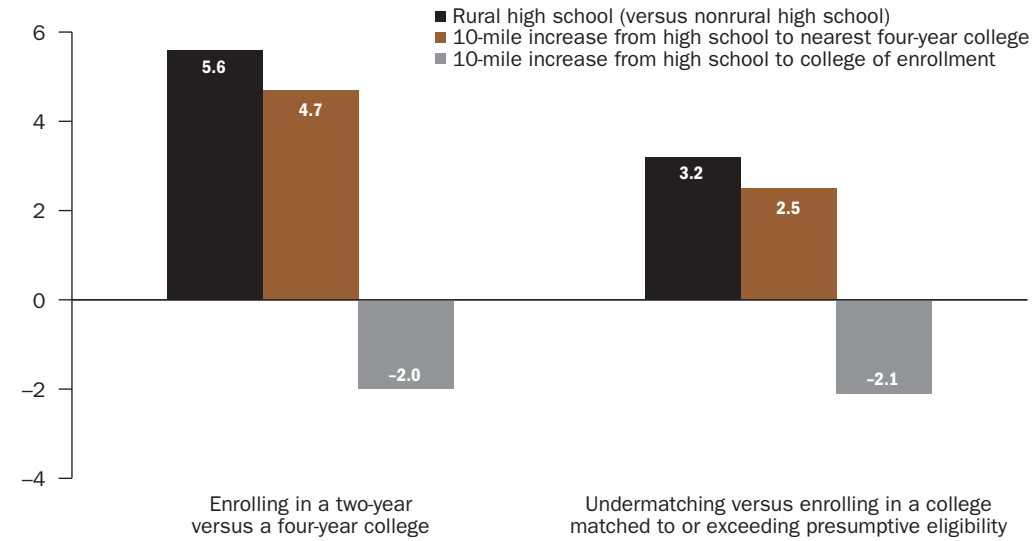
the options are for enrolling in a college that matches the student's academic qualifications and the more opportunity there is to undermatch. This phenomenon, however, was more pronounced among rural graduates than among nonrural graduates. Among high school graduates presumptively eligible for very selective colleges, rural graduates were more likely than nonrural graduates to enroll in a selective, less selective, or two-year college (42.2 percent versus 33.1 percent; see figure C1 in appendix C). Among high school graduates presumptively eligible for less selective four-year colleges, rural graduates were more likely to enroll in a two-year college (26.5 percent versus 20.1 percent). In addition, among graduates presumed eligible for two-year colleges, rural graduates' college enrollment less frequently matched a college more selective than one for which they were presumed eligible (that is, less selective four-year, selective four-year, or very selective four-year colleges) than did nonrural graduates' enrollment (44.8 percent versus 51.0 percent).

Even after differences in academic achievement, poverty, and distance between high schools and colleges (at the student and high school levels) were controlled for, graduates of rural high schools were still more likely than graduates of nonrural high schools to enroll in a two-year rather than a four-year college. And they were also still more likely to enroll in a college undermatched with their level of presumptive eligibility.

For the typical student,[3] graduating from a rural high school was associated with a 5.6 percentage point increase in the probability of enrolling in a two-year rather than a four-year college and a 3.2 percentage point increase in the probability of undermatching with their college (figure 2).

The distances between rural high schools and both the nearest four-year college (at the school level) and the college of actual enrollment (at the student level) were also significant predictors of college enrollment patterns among rural graduates. At the school level, for the typical high school graduate, a 10-mile increase in the distance between the high school

Figure 2. Graduating from an Indiana rural high school in 2010 and distance to the nearest college significantly predicted the likelihood of enrolling in a two-year rather than a four-year college and the likelihood of undermatching



Note: Predicted probabilities of enrolling in a two-year versus a four-year college and undermatching are based on the "typical" high school graduate, or a graduate from a high school with average academic and socio-demographic characteristics.

Source: Authors' calculations based on regression models using data from the Indiana state longitudinal data system, distance analyses (Esri, 2013), and U.S. Department of Education (2010).

The farther a student's high school is from the nearest four-year college, the more likely the student is to enroll in a two-year college rather than a four-year college and to undermatch

and the nearest four-year college was associated with a 4.7 percentage point increase in the probability of enrolling in a two-year rather than a four-year college and a 2.5 percentage point increase in the probability of undermatching rather than enrolling in a college that matched or exceeded the student's presumptive eligibility. These findings suggest that the farther a student's high school is from the nearest four-year college, the more likely the student is to enroll in a two-year college rather than a four-year college and to undermatch.

At the student level, regression analyses showed that, for the typical high school graduate, a 10-mile increase in the distance from the student's high school of graduation to the college of enrollment was associated with a 2.0 percentage point decrease in the probability of the student enrolling in a two-year rather than a four-year college and a 2.1 percentage point decrease in the probability of undermatching. This finding suggests that the greater the distance between a student's high school and the college he or she enrolls in, the less likely the student is to enroll in a two-year college or to undermatch. One possible reason for this finding may be related to the average distance traveled to enroll in colleges of varying levels of selectivity, as graduates of both rural and nonrural high schools travel farther on average to colleges of higher selectivity.

Implications of the study findings and next steps

This study examined differences in college enrollment patterns, academic preparation, poverty, and distance traveled to college between graduates of high schools in rural locales and graduates of high schools in nonrural locales for Indiana's class of 2010. The results raise three considerations for educators and policymakers about rural–nonrural differences in Indiana.

Rural and nonrural students may have different college choice processes

Graduates of Indiana rural public high schools in 2010 were more likely than graduates of nonrural high schools to enroll in two-year colleges and colleges undermatched with their level of presumptive eligibility. Differences in academic achievement, poverty, and proximity to college do not completely account for these differences.

Several possible reasons that graduates of rural and nonrural high schools in Indiana enroll in different types of colleges could be examined in greater detail. Previous research has emphasized the importance for rural high school graduates of living near parents or relatives (Johnson et al., 2005). Rural students come from environments with specific pressures (such as community and school influences, availability of social resources and social capital), familial factors (such as income level, parental educational expectations, parental education levels, family structure), responsibilities (such as helping the family earn an income, employment in agricultural or industrial positions), and incentives (such as local well paying job opportunities not requiring a four-year degree) that could influence them to make college choices that differ from those of their nonrural counterparts (Byun et al., 2012; Gillie et al., 2006; Johnson et al., 2005; Roscigno & Crowley, 2001; Turley, 2009).

The greater likelihood of undermatching among rural graduates may be explained partly by the information available to them and by the culture of their high schools

Two-year colleges in Indiana are located largely in cities and nonrural areas and are often close to four-year colleges. Coupled with the unique circumstances of rural high school graduates just mentioned, this fact may help explain why rural students travel farther on average than nonrural students to attend two-year colleges. With the exception of Vincennes University, all Indiana two-year public colleges are Ivy Tech Community College campuses. According to the Ivy Tech website, "most students attending Ivy Tech Community College commute daily from their homes …; that is why Ivy Tech does not operate its own residence halls."[4] Thus it is safe to conclude that the majority of students enrolling in two-year colleges commute to school each day, and rural students face longer commuting distances as a result of the concentration of two-year colleges in more urban areas. Rural students have rated living near their families while attending college as "very important," and relocating to live near a nonresidential college is a costly endeavor that is likely to be avoided in favor of commuting longer distances to attend college.

The greater likelihood of undermatching among rural graduates may be explained partly by the information available to them and by the culture of their high schools. Previous research has suggested that students may enroll in colleges undermatched with their levels of presumptive eligibility partly because they are unaware of the opportunities their academic qualifications may afford them (Bowen et al., 2009). More selective colleges may focus recruitment in urban and suburban areas with a higher volume of students and may not recruit as heavily in rural areas with fewer students and historically higher rates of two-year college enrollment. Providing tailored information about opportunities at more selective colleges to groups of students prone to undermatching may help these students enroll in colleges matched to their academic qualifications (Hoxby & Turner, 2013); however, other research has found an overall shortage of college counselors nationally, with the greatest shortages in rural and urban high schools (McDonough, 2005). Research on presumptive eligibility suggests that students' college choice may be influenced by the culture of their high school (Roderick et al., 2008). Rural–nonrural differences in college enrollment patterns may be explained by a culture in rural high schools that supports enrolling in a two-year college after graduation as the more common postsecondary pathway. Previous

national research has examined the aspirations of rural high school students (Meece & Farmer, 2008), but no studies have examined this issue with a state or regional scope.

Future research could attempt to determine how students learn about their college options, what support structures are in place to help them enroll in college, and how these processes and supports differ between rural and nonrural schools. In addition, future work could examine rural and nonrural student aspirations in Indiana in addition to enrollment patterns to identify differences in the reasons students choose to attend various types of colleges.

More research is needed to examine the types of programs in which rural and nonrural graduates enroll

Future research could examine not only the types of colleges in which students enroll, but also the types of programs. A study aimed at understanding rural Indiana students' reasons for deciding to enroll in a two-year college may help explain the differences found in college enrollment patterns between rural and nonrural high school graduates. Previous research has demonstrated that some technical programs at two-year colleges have higher associated earnings than some liberal arts programs at four-year colleges (Jacobson & Mokher, 2009; Rosenbaum et al., 2010). If rural students (especially those who are presumptively eligible to attend four-year colleges) are enrolling in two-year colleges primarily for high-payoff technical programs or in programs that are supported by a local employer, the finding that rural students are more likely to enroll in two-year colleges and less selective colleges may not be as much of a concern as it would otherwise be (say, when other student groups such as racial/ethnic minority students and students of lower socioeconomic status in nationally representative and urban populations are found to be at risk of enrolling in a college less selective than their presumptive eligibility; Roderick et al., 2008; Smith, Howell, Pender, & Hurwitz, 2012).

If rural students are enrolling in two-year colleges primarily for high-payoff technical programs or in programs that are supported by a local employer, the finding that rural students are more likely to enroll in two-year colleges and less selective colleges may not be as much of a concern as it would otherwise be

State policymakers may want to consider their own rural populations and not make generalizations from national research

Indiana may present a unique relationship between urbanicity and poverty that differs from the nation as a whole. Previous studies using national samples have shown that rural areas tend to have more students of a lower socioeconomic status (Roscigno & Crowley, 2001; Roscigno et al., 2006) and with higher poverty rates (Lichter & Johnson, 2007; O'Hare & Savage, 2006) than nonrural areas do and have attributed the lower rates of rural students' bachelor's degree completion to lower socioeconomic status (Byun et al., 2012). Unlike studies using national samples, this study for Indiana found that, although rural high school graduates were enrolling in two-year colleges at a higher rate than nonrural graduates, rural graduates were less likely than nonrural graduates to be eligible for the school lunch program, suggesting that rural graduates in Indiana do not necessarily have higher poverty rates than their nonrural counterparts. This finding aligns with data from the 2007–11 U.S. Census Bureau's American Community Survey, which indicated that urban and rural areas in Indiana had comparable rates of employment.[5]

Finally, this finding suggests that there are factors influencing the two-year college enrollment rate of rural Indiana high school graduates that are unrelated to poverty and socioeconomic status. Because these results are counter to the results of studies using national

data, state policymakers may want to examine the unique characteristics of their own rural populations whenever possible and act cautiously when using information from studies of nationally representative samples of students. The work of the Rural School and Community Trust supports the ideas that national analyses do not account for the variation in rural regions across the country and that the most appropriate analyses are specific to states and regions (Johnson & Strange, 2009).

Limitations of the study

There are six limitations to the work described here. First, this analysis could not consider all factors related to the enrollment patterns of rural and nonrural public high school graduates, but it did consider student-level academic preparation, eligibility for the school lunch program, distance traveled to college, and school-level academic preparation—factors that the literature has indicated are important (see appendix A).

This analysis could not consider all factors related to the enrollment patterns of rural and nonrural public high school graduates, but it did consider factors that the literature has indicated are important

Second, rural–nonrural distinctions are not always clearly defined. Although the urban-centric locale code classification system of the National Center for Education Statistics categorizes schools on the basis of proximity to an urban area, it may not adequately identify all rural schools (U.S. Department of Education, n.d. b). In addition, not all rural communities are equal in their composition or resources, and this study did not attempt to control for these variations. For the purposes of this study, examining differences between schools outside an urban area (rural) and schools within an urban area (nonrural) was sufficient to address the research questions. Future work may attempt to isolate differences between subclassifications of rural and nonrural students.

Third, only college enrollments for Indiana public colleges were included in these analyses. Although this limits the generalizability of the findings, the majority of the 2010 cohort of high school graduates who continued on to college enrolled in an Indiana public college (U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, 2012), which is the most relevant subgroup of students for the Indiana Commission for Higher Education (one requestor of this study). This cohort of students also had additional data available, such as high school GPA and award of dual credit. These data were not available for students attending private Indiana colleges and out-of-state colleges because the National Student Clearinghouse, which provides data to the commission, does not include high school GPA or award of dual credit data.

Fourth, because the presumptive eligibility analysis is the first step in determining whether students enrolled in colleges less selective than those for which they were academically qualified, this analysis includes only graduates in the analytic sample who continued on to an Indiana public college in the fall immediately after graduation from high school. Thus, the results cannot be generalized to students who may have been presumptively eligible to attend colleges of varying selectivity but who either were not observed to enroll in any college or delayed their enrollment; nor can the results be generalized to all students who attend these colleges.

Fifth, the data provided by the Indiana Commission for Higher Education on high school GPAs are self-reported by the students, and the commission is not able to verify the accuracy of these data. Previous studies, however, have found that self-reported GPAs produce predictions of outcomes similar to those of school-reported GPAs (Kuncel, Credé, &

Thomas, 2005) and have been found among undergraduates to be similar to GPAs in official school records (Cassady, 2001).

Finally, this study is descriptive and cannot examine causality. It does, however, provide information about rural Indiana students that can be useful to policymakers in understanding what rural–nonrural differences in college enrollment exist and how differences may relate to academic characteristics, household income, and distance to college. Such information can be useful in Indiana and other states to inform the decisions of policymakers in targeting resources and designing improvement in policies, programs, and initiatives to support college and career success.

Appendix A. Literature review

Whether and where students attend college relates to their future educational attainment and earnings. Attaining an associate's degree returns 24 percent more in lifetime earnings than a high school diploma alone, and attaining a bachelor's degree returns 66 percent more (Baum, Ma, & Payea, 2010). Students with a college degree (associate's or bachelor's) have better job benefits and work conditions than those with only a high school diploma (Baum et al., 2010). High school graduates who enter a four-year college attain degrees at a higher rate and earn more than students who enter a two-year college, and students at more selective four-year colleges do so at the highest rates (Brand & Halaby, 2006; Hoekstra, 2009; Mullen et al., 2003; Pascarella & Terenzini, 2005; Reynolds, 2012). Although the diverse types of students who follow these varied postsecondary pathways explain some of the differences in outcomes, college selectivity predicts degree attainment and earnings even after many student characteristics are accounted for (Brand & Halaby, 2006; Dougherty, 1994; Hoekstra, 2009; Stephan et al., 2009). It is important, therefore, to understand how students access different postsecondary pathways.

The following sections describe what is known from the literature on rural–nonrural differences in college enrollment patterns and on three potential correlates of these differences: academic preparation, household income, and distance to college. The appendix also briefly describes college readiness initiatives in Indiana.

Differences in college enrollment and completion between rural and nonrural students

Using national data, studies have shown differences between rural and nonrural students in whether students enroll in college, the types of colleges that students attend, and students' likelihood of completing a college degree. For example, Hu (2003), using data from the National Education Longitudinal Study of 1988 (U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, n.d. c), found that rural students aspired to four-year colleges, enrolled in any college, and enrolled in four-year colleges at lower rates than their urban counterparts. Specifically, 61 percent of students from urban schools enrolled in a four-year college, compared with 56 percent of rural students. For two-year colleges, rural students enrolled at a higher rate (44 percent) than their urban counterparts (39 percent; Hu, 2003). Byun et al. (2012), also using National Education Longitudinal Study data to examine factors related to college enrollment and degree completion, found that urban students nationally were 74 percent more likely to enroll in college and 106 percent more likely than rural students to attain a bachelor's degree.

Although national studies have shown rural–nonrural differences in college choice and attainment (Byun et al., 2012; Hu, 2003), these studies have relied on older data (U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, n.d. c) and have not examined information specific to rural Indiana students. Data from the 2000 decennial census indicate that rural Indiana residents completed college at a lower rate than their urban counterparts—12 percent compared with 22 percent that year (Gillie et al., 2006). A review of the literature did not yield any rural–nonrural comparisons of college enrollment by college type or selectivity for Indiana students, nor did the review identify any studies examining the extent to which other factors may account for differences in college enrollment or outcomes. These differences

could be due to any number of factors, including potential "pull" factors, such as rural communities that influence students to pursue well paying jobs that do not require a college degree. Because college enrollment patterns relate to college attainment (Brand & Halaby, 2006; Dougherty, 1994; Hoekstra, 2009; Stephan et al., 2009), understanding differences in enrollment patterns is important.

Academic preparation and college enrollment patterns

Academic preparation is a potential barrier for rural students to enrolling in a four-year or more selective college. One study using national data found that rural high school students have lower standardized test scores than suburban students and take less rigorous courses than urban or suburban students (Byun et al., 2012). Previous research using national data has indicated that rural students have less access to college preparatory programs (Griffin, Hutchins, & Meece, 2011) and have a narrower school curriculum (Graham, 2009), which could explain some of the difference in academic preparation.

Students who attend a high school with higher mean achievement, as defined by measures related to test scores or grade point average (GPA), enroll in four-year colleges, expect to complete a four-year degree, and attain a college degree at a higher rate than students who attend a high school with lower mean achievement (Bowen et al., 2009; Engberg & Wolniak, 2010; Frost, 2007; Hill, 2008).

Academic preparation, however, does not completely account for differences in college choice. Even students who qualify for four-year colleges or more selective colleges do not always enroll in one. In Chicago Public Schools, approximately two-thirds of 2005 high school graduates enrolled in a college with a selectivity level below the types of colleges that would likely have accepted them on their qualifications (Roderick et al., 2008).[6] Bowen et al. (2009), who build on the work of Roderick et al., use the term "undermatch" to refer to well qualified students who ultimately attend institutions that are less selective than the ones for which they likely qualify. Undermatch rates are higher for Black students, students from low-income backgrounds, and students whose parents have lower levels of educational attainment (Bowen et al., 2009; Roderick, Coca, & Nagaoka, 2011). But previous literature has not examined the relationship between students' locale and undermatch rates.

Poverty and college enrollment patterns

In their study of rural–nonrural differences in college attainment, Byun et al. (2012) concluded that the lower bachelor's degree completion rate that they found for rural students was largely attributable to lower socioeconomic status among rural students (Byun et al., 2012). Family income predicts college enrollment or completion (Adelman, 2006; Adelman, Daniel, Berkovits, & Owings, 2003; Bozick, 2007; Goldrick-Rab & Pfeffer, 2009), and at all levels of academic achievement, lower socioeconomic students enroll in college and in four-year colleges at lower rates (Plank & Jordan, 2001). Some research has also found that students attending a higher socioeconomic status high school are more likely to enroll in college (Hill, 2008), to enroll in a four-year or a more selective college (Engberg & Wolniak, 2010; Klugman, 2012; McDonough, 1997; see Hill, 2008, for the opposite), or to expect to attain a bachelor's degree (Frost, 2007). Rural areas tend to have lower socioeconomic status (Roscigno & Crowley, 2001; Roscigno et al., 2006) and higher poverty

rates (Lichter & Johnson, 2007; O'Hare & Savage, 2006). High school socioeconomic status in these studies is measured by parental educational attainment (Frost, 2007), a combination of parental educational attainment and occupational status (McDonough, 1997), a combination of parental educational attainment and family income (Hill, 2008), or a combination of parental educational attainment, parental occupational status, and family income (Engberg & Wolniak, 2010).

Little is known about the extent to which differences in socioeconomic status explain any discrepancies in college choices between rural and nonrural students in Indiana.

Distance to college and college enrollment patterns

For many students, distance to college matters. For example, in a 1994 survey of Iowa high school seniors from rural communities, nearly 75 percent reported that it was somewhat to very important to live near parents or relatives (Johnson et al., 2005). Distance to college correlates (in national data) with whether and to what colleges students apply and enroll; students are less likely to attend colleges farther from their home (Rouse, 1995) and more likely to apply to college as the number of colleges located nearby increases (Turley, 2009). In a study of college choice, McDonough (1997) found that students from various socioeconomic backgrounds discussed being close to home as a factor in their choice, although the meaning of "close" varied by student socioeconomic status.

Distance to college could influence students' college enrollment patterns in a variety of ways. Students may find it more financially or logistically convenient to enroll in colleges that are closer to home (Gillie et al., 2006; Turley, 2009). Living on campus can be costly, and higher commuting costs from geographically isolated rural communities to postsecondary institutions could prevent students from enrolling in schools farther from home (Gillie et al., 2006; Turley, 2009). With rural communities tending to have lower socioeconomic status and higher poverty rates (Lichter & Johnson, 2007; O'Hare & Savage, 2006), the location of postsecondary institutions could be especially important for rural families because significant financial benefits (for example, saving money on rent, bills, and food) are associated with living at home during college (Turley, 2009). In addition, living close to a college could foster a predisposition to attending college or provide useful social capital and role models to local residents (Gillie et al., 2006; Turley, 2009).

The geographic distribution of college opportunities could explain some differences in rural–nonrural college enrollment patterns. But the extent to which distance between students' high school and college differs for graduates of rural and nonrural high schools has not been examined in published research at the state level.

College readiness initiatives in Indiana

Indiana has worked to align high school standards with college and workplace expectations (Plucker et al., 2006) and has made an effort to expand access to rigorous coursework for students across the state, Specifically, Indiana requires each high school to offer a minimum of two dual-credit and Advanced Placement courses to students who qualify (Indiana Code 20–30–10–4, 2006), and the Indiana General Assembly made completion of a college preparation curriculum (called Core 40) a graduation requirement for all students beginning with those entering high school in fall 2007 (Indiana Code 20–30–10–1,

2005). These requirements involve completion of more academically challenging courses, a specific focus on the development of essential workplace skills (for example, clear communication in speech and writing; ability to analyze data, conduct research, solve complex problems), and a focus on college preparation and success throughout a student's high school education (Indiana Department of Education, 2013). Although these changes allow for greater access to a more rigorous high school curriculum, there may be differences in how rural and nonrural students utilize these resources.

In addition, the state has taken multiple steps to improve the college readiness of students across the state, one of which has been joining the American Diploma Project, an effort to raise high school students' expectations and achievement. States in the project commit to align assessments and standards with the knowledge and skills required for the demands of college, require all high school graduates to complete a college- and career-ready curriculum, align high school assessment systems with college- and career-ready expectations, and create comprehensive accountability and reporting systems that promote college and career readiness (Achieve, Inc., 2013).

Appendix B. Data and methodology

This appendix describes the study's data sources, data processing, and methodology.

Data sources

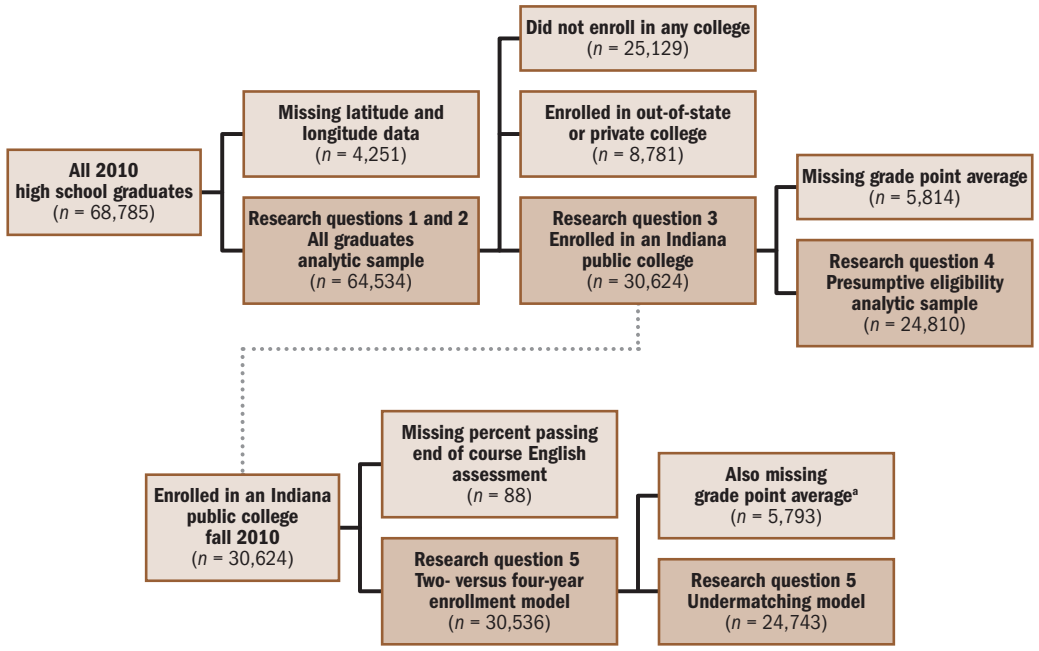
Regional Education Laboratory (REL) Midwest worked directly with the Indiana Commission for Higher Education, which is represented on the College and Career Success Research Alliance, to acquire the student data from the Indiana Student Information System. The data consist of measures collected by the Indiana Department of Education and by the Indiana Commission for Higher Education. The commission collects student college enrollment information from Indiana public colleges and, for private and out-of-state enrollments, from the National Student Clearinghouse. Aggregate high school characteristics (for example, percentage of students eligible for the school lunch program, percentage of grade 10 students taking and passing end-of-course assessments) are publicly available and were downloaded from the department's website (http://www.doe.in.gov/improvement/accountability/find-school-and-corporation-data-reports). Urban-centric locale codes and latitude and longitude coordinates for Indiana high schools were downloaded from the National Center for Education Statistics Elementary and Secondary Information System website (http://nces.ed.gov/ccd/elsi/; U.S. Department of Education, 2010). College-level data came from two sources, publicly available data accessed through the Integrated Postsecondary Education Data System Data Center website (http://nces.ed.gov/ipeds/datacenter/) and selectivity rankings from Barron's Profiles of American Colleges (Barron's Educational Series, 2010).

Routing data used to compute travel distances for students from high schools of graduation to colleges of enrollment was downloaded from the Environmental Systems Research Institute's customer data portal and consisted of U.S. detailed streets, highways, interstates, and local roads, as well as speed limit, directional, access, and toll information collected in 2009 (Esri, 2013).

Data processing

Creation of the analytic samples. REL Midwest received data on all 2010 Indiana high school graduates (68,785 students), with each student identified by an anonymous identification number. For the analytic datasets corresponding to the full sample (for research questions 1 and 2), 6.2 percent of this population (4,251 students) were removed because of missing high school latitude and longitude data (figure B1 and table B1). The final dataset for the full analytic sample has 64,534 students. For the analytic dataset for the remainder of the research questions, the following students were removed from analysis. For research question 3, students who did not enroll in any college in fall 2010 (25,129 students) and students who enrolled in a private Indiana or out-of-state college in fall 2010 (8,781 students) were removed from the sample, leaving 30,624 students. For the remainder of the research questions, different inclusion criteria were used depending on the analysis. For research question 4, graduates who enrolled in an Indiana public college who were missing data on grade point average (GPA; 5,814 students) were removed from the sample, leaving 24,810 students.[7] To create the analytic samples for research question 5, the study team started with the sample of students who enrolled in an Indiana public college (n = 30,624), and removed students based on the needs of the analysis. The analysis of rural–nonrural

Figure B1. Creation of the analytic samples



a. Twenty-one students who enrolled in an Indiana public college were missing data on both end-of-course English assessment and grade point average.

Source: Authors' creation.

differences with respect to enrolling in a two- versus four-year college included multilevel modeling, which did not allow for variables missing data at the school level. Students missing the school-level variable, percentage of students passing the end-of-course English assessment were removed (n = 88), and the final analytic sample for that part of research question 5 included 30,536 students. The analysis of rural–nonrural differences with respect to undermatching with the college of enrollment included multilevel modeling but also required data on GPA to calculate presumptive eligibility. Students missing data on the percentage of students passing the end-of-course English assessment (n = 88) and on GPA (n = 5,814) were removed (21 students were missing data on both end-of-course English assessment and GPA), leaving 24,743 students for that part of research question 5.

Variable creation. The following paragraphs describe variables that were created from the raw data. Variables that did not require extensive manipulation (for example, gender, race/ethnicity) are not described.

College enrollment data. The full analytic sample consisted of Indiana high school students who graduated in spring 2010. College enrollment was based on multiple data sources. College enrollment data for graduates who enrolled in an Indiana public two- or four-year college in fall 2010 were based on enrollment data collected by the Indiana Commission for Higher Education. For graduates who enrolled in a private Indiana two- or four-year college, or in an out-of-state college, college enrollment data were based on data collected by the National Student Clearinghouse. The remaining group of graduates are those for whom there are no records of enrollment in a degree-granting two- or four-year college: specifically, students who did not enroll in any college, students who enrolled in a less-than-two-year college (such as a beauty school) that does not grant degrees, or students

Table B1. Analytic samples for the study and the research questions associated with each

Research questions	Analytic sample	Description of analytic sample	Sample size
1 and 2	High school graduates	All 2010 graduates of Indiana high schools regardless of postsecondary plans	64,534
3	Graduates entering Indiana public colleges	Graduates of Indiana high schools in 2010 who enrolled in a two- or four-year Indiana public college in fall 2010	30,624
4	Graduates with a valid grade point average entering an Indiana public college	Graduates of Indiana high schools in 2010 with a valid grade point average who enrolled in a two- or four-year Indiana public college in fall 2010	24,810
5 (analysis of rural–nonrural differences with respect to enrolling in a two- versus four-year college)	Graduates entering Indiana public colleges not missing data on the percentage of students passing the end-of-course English assessment	Graduates of Indiana high schools in 2010 with valid data on the school-level characteristic, percentage of students passing the end-of course English assessment	30,536
5 (analysis of rural–nonrural differences with respect to undermatching with the college of enrollment)	Graduates entering Indiana public colleges with valid data on the percentage of students passing the end-of-course English assessment and on grade point average	Graduates of Indiana high schools in 2010 with valid data on the school-level characteristic, percentage of students passing the end-of-course English assessment and on grade point average	24,743

Source: Authors' creation.

who enrolled in a private or out-of-state postsecondary institution that does not participate in the National Student Clearinghouse.

For Indiana Commission for Higher Education data, a student was considered enrolled in fall 2010 if that student was enrolled on the institution's census enrollment date. For students enrolled in a private Indiana or out-of-state college (according to the National Student Clearinghouse), students who were enrolled as of October 4, 2010, were considered enrolled in fall 2010. Colleges' actual census enrollment dates and terms may differ. These dates were chosen after reviewing the census enrollment dates for colleges frequently attended by Indiana high school graduates (in-state and out-of-state colleges).

In the commission and clearinghouse data, a small number of students were enrolled in more than one college in fall 2010. The "primary" institution was identified by taking the institution associated with a full-time enrollment before an institution associated with a part-time enrollment. For students with the same status at multiple institutions, the institution associated with the largest number of enrolled credits was selected as the primary institution.

For some enrollments, the commission and clearinghouse data were contradictory. Specifically, some students identified by the commission as enrolled in an Indiana public college were not identified by the clearinghouse as enrolled in an Indiana public college and vice versa. In all cases, commission data were considered more accurate than clearinghouse data because the matching algorithm in the Indiana state longitudinal data system uses information additional to what is used for the matching that occurs between Indiana data and National Student Clearinghouse data.

Type of college first entered. The type of college a student entered (two- or four-year) in fall 2010 was identified using Integrated Postsecondary Education Data System data. Although this system classifies Vincennes University as a four-year college, the Carnegie Foundation (2010) classifies Vincennes as a "four-year, primarily associates" college. In the full analytic sample 1,936 students in 11 colleges were enrolled in colleges with this classification, the majority of whom (1,754) enrolled in Vincennes University. These colleges have open-admissions policies and grant primarily associate's degrees. To reflect the mission of Vincennes University and to remain consistent with Indiana Commission for Higher Education reporting, the analysis classifies Vincennes University and other colleges classified as "four-year, primarily associates" as two-year colleges.

College selectivity. Four-year colleges were classified into three categories on the basis of the Barron's selectivity ranking (Barron's Educational Series, 2010). Barron's classifies colleges into categories according to the academic qualifications of students enrolled in the college (ACT or SAT scores, class rank, and high school GPA) and the percentage of applicants accepted. The Barron's index has been used in many studies of college outcomes (for example, Dale & Krueger, 2011; Hoxby, 2001; Roderick et al., 2008), and the National Center for Education Statistics makes it available to users with a restricted data license for merging with many of its longitudinal datasets (for example, National Longitudinal Study of 1972, High School & Beyond, National Educational Longitudinal Study of 1988, Educational Longitudinal Study of 2002, and Beginning Postsecondary Students Longitudinal Study). For this analysis, the Barron's categories were collapsed to three: less selective (corresponding to Barron's categories of less competitive and noncompetitive), selective (corresponding to the Barron's competitive category), and very selective (corresponding to the Barron's categories of very, highly, and most competitive). One four-year college, Purdue University–North Central Campus, was not ranked by Barron's in 2010. Because this college's admission rates and ACT/ SAT scores were similar to those of four-year public colleges in Indiana rated by Barron's as less competitive, Purdue University–North Central Campus was considered to have a ranking of less selective. (See table B2 for a list of Indiana public four-year colleges by selectivity.)

Indiana Statewide Testing for Educational Progress—Plus test scores. For the cohort in this study, Indiana Statewide Testing for Educational Progress—Plus (ISTEP+) math and

Table B2. Selectivity of Indiana's 14 public four-year colleges

Less selective	Selective	Very selective[a]
University of Southern Indiana	Ball State University	Indiana University–Bloomington
Indiana University–East	Indiana State University	Purdue University, Main Campus
Indiana University–Kokomo	Indiana University–Purdue University, Indianapolis	
Indiana University–Northwest		
Indiana University–South Bend		
Indiana University–Southeast		
Purdue University–North Central Campus[b]		
Purdue University–Calumet Campus		
Indiana University–Purdue University, Fort Wayne		

a. Combined category comprising highly competitive and very competitive institutions.

b. Not ranked by Barron's. Selectivity instead based on admission rates and ACT/ SAT scores.

Source: Authors' classification based on Barron's selectivity rankings (Barron's Educational Series, 2010).

English language arts assessments were administered to capture learning in grade 10. Math and English language arts test scores were provided by the Indiana Commission for Higher Education for grade 10. For students in the study cohort, the ISTEP+ exams were administered in fall 2009. The grade 10 ISTEP+ math and English language arts assessments compose the Graduate Qualifying Examination, which students must pass to receive a diploma. Beginning in 2009/10, end-of-course examinations have been administered for Algebra I and English 10. Composite test scores were calculated for this analysis by separately standardizing the math and English language arts test scores, summing the result, and then standardizing the sum. Standardization was based on the test scores of all 2010 high school graduates in the full analytic sample.

School percentage of grade 10 students passing the English end-of-course assessment in 2010. This measure reflects the achievement level of a student's high school peers in the year when the student graduated. Because the state-administered tests changed between the time the students in the study cohort were sophomores and when they became seniors, this school-level measure is based on a different test (the grade 10 English end-of-course assessment) from the test score included at the student level. (The ISTEP+ English language arts test score is one component of the composite test score measure included in the regressions.)

The study team considered including the variable "percentage of students eligible for the school lunch program" as a high school characteristic in the regression models. The variable was highly correlated, however, with the percentage of grade 10 students passing the English end-of-course assessment in 2010 (correlation coefficient = –.82) and had slightly more missing data (150 students). The study team did not consider including the percentage of students passing the Algebra I end-of-course assessment. This measure does not necessarily reflect the achievement level in high school because students in relatively more advanced math classes can take this assessment in grades 7 and 8.

Presumptive eligibility. A student's presumptive eligibility is the highest selectivity level of college to which a student is likely to be admitted on the basis of his or her academic qualifications and does not reflect actual college admittance or eligibility for individual students. The current study used ACT/SAT scores and GPA to determine students' levels of presumptive eligibility.[8] Although it is possible to determine a graduate's level of presumptive eligibility without an ACT/SAT score, GPA is a key variable in the construction of the qualifications rubric, and presumptive eligibility cannot be determined without GPA. Thus, graduates missing a valid GPA (5,814 students) were excluded from this analysis.

Specifically, researchers took several steps to answer this question. First, on the basis of the ACT/SAT scores and GPA of the high school graduates in the sample, a qualifications rubric was created to show the modal academic characteristics of students who enrolled in colleges of a specific selectivity in Indiana. The rubric represents the actual college-going patterns of Indiana high school graduates who enrolled in an Indiana public college. Second, the qualifications of each student in the dataset were compared with the rubric to determine the category of selectivity for which a student was presumptively eligible.

The qualifications rubric was calculated according to procedures developed by Roderick et al. (2008). To begin, the study team grouped Indiana public colleges by type and selectivity (that is, two-year; and less selective, selective, and very selective four-year). A detailed 21 × 19 contingency table was then created with all possible GPA scores at or

above 2.0 (2.0, 2.1, …, 4.0) in the columns and all possible ACT/SAT scores (converted to the ACT metric) at or above 18 in the rows (for example, 18, 19,…, 36). Each cell of the table represented the number of students who enrolled in an Indiana public college with that particular combination of GPA and ACT/SAT score. For each cell, the modal selectivity rating of the colleges for which that group of students enrolled was calculated. GPA and ACT/SAT scores were grouped for ease of interpretation on the basis of the spread of selectivity ratings. Specifically, the ranges for GPA were less than 2.0, 2.0–2.4, 2.5–2.9, 3.0–3.4, and 3.5–4.0; and the ranges for ACT/SAT were less than 18, 18–21, 22–29, and 30–36. The resulting ranges were grouped on both GPA and ACT/SAT score, resulting in a contingency table represented by ranges of GPA and ACT/SAT scores rather than individual scores. Because ACT/SAT scores are not a requirement for admission to two-year colleges, students missing these scores were presumed eligible for two-year colleges.

Graduates' presumptive eligibility ranking was determined by the modal selectivity rating of the cell in the rubric corresponding to their respective ACT/SAT scores and GPAs. For example, the modal selectivity rating of colleges for students scoring between 22 and 29 on the ACT/SAT and with a GPA between 2.5 and 2.9 was for selective colleges; thus, all graduates with ACT/SAT scores and GPAs that fall within those ranges were presumptively eligible for a selective college (see table C4 in appendix C for the final qualifications rubric).

Indicator of enrolling in a college less selective than one's level of presumptive eligibility. Graduates' presumptive eligibility rankings were compared against the selectivity level of the college in which they actually enrolled. Graduates who enrolled in a college less selective than a college for which they were presumed eligible (for example, if a student was presumptively eligible for a selective college and enrolled in a less selective college) were flagged.

Characteristics of the analytic samples. Table B3 shows the the sample proportions (unless the label indicates the mean) at the student level for variables included in the dataset for the overall analytic sample, for students in the sample entering Indiana two- and four-year public colleges in fall 2010, and for students in the analytic sample for

Table B3. Student characteristics of analytic samples, by research question

	Research questions 1 and 2		Research question 3		Research question 4		Research question 5			
	All 2010 Indiana high school graduates		Indiana high school graduates who enrolled in an Indiana public college in fall 2010		Indiana high school graduates in the presumptive eligibility analysis		Indiana high school graduates in the two- versus four-year model		Indiana high school graduates in the undermatching model	
Characteristic	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Gender										
Female	32,872	50.94	16,681	54.5	13,509	54.5	16,636	54.5	13,474	54.5
Male	31,662	49.06	13,943	45.5	11,301	45.6	13,900	45.5	11,269	45.5
Race/ethnicity										
Asian, non-Hispanic	898	1.4	567	1.9	504	2.0	562	1.8	499	2.0
Black, non-Hispanic	6,581	10.2	2,827	9.2	2,135	8.6	2,818	9.2	2,129	8.6
White, non-Hispanic	52,149	80.8	25,299	82.6	20,671	83.3	25,234	82.6	20,621	83.3
Hispanic (any race)	3,168	4.9	1,193	3.9	904	3.6	1,192	3.9	903	3.7
Other/more than one race, non-Hispanic	1,738	2.7	738	2.4	596	2.4	730	<0.1	591	2.4

(continued)

Table B3. Student characteristics of analytic samples, by research question *(continued)*

Characteristic	Research questions 1 and 2		Research question 3		Research question 4		Research question 5			
	All 2010 Indiana high school graduates		Indiana high school graduates who enrolled in an Indiana public college in fall 2010		Indiana high school graduates in the presumptive eligibility analysis		Indiana high school graduates in the two- versus four-year model		Indiana high school graduates in the undermatching model	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Eligibility for school lunch program										
Eligible	18,449	28.6	7,124	23.3	5,272	21.2	7,093	23.3	5,251	21.2
Not eligible	45,908	71.1	23,468	76.7	19,525	78.7	23,411	76.8	19,479	78.7
Unknown eligibility	177	0.3	32	0.1	13	0.1	32	<0.1	13	0.1
ISTEP+ score[a]										
Below 1170	20,138	31.2	6,612	21.6	4,089	16.5	6,603	21.6	4,086	16.5
Between 1170 and 1247	20,265	31.4	10,472	34.2	8,364	33.7	10,460	34.3	8,358	33.8
1248 or above	20,765	32.2	12,464	40.7	11,610	46.8	12,401	40.6	11,554	46.7
Does not have	3,366	5.2	1,076	3.5	747	3.0	1,072	3.5	745	3.0
ACT composite score										
Below 21	5,826	9.0	3,376	11.0	2,813	11.3	3,373	11.0	2,811	11.4
Between 21 and 23	3,349	5.2	2,009	6.6	1,885	7.6	2,003	6.6	1,879	7.6
Between 24 and 36	5,580	8.6	3,250	10.6	3,156	12.7	3,211	10.5	3,118	12.6
Does not have	49,779	77.1	21,989	71.8	16,956	68.3	21,949	71.9	16,935	68.4
SAT composite score (reading, writing, and math)										
Below 1350	11,646	18.0	6,922	22.6	5,348	21.6	6,919	22.7	5,347	21.6
Between 1350 and 1560	11,286	17.5	7,325	23.9	6,588	26.6	7,313	23.9	6,580	26.6
Between 1570 and 2400	12,307	19.1	7,726	25.2	7,394	29.8	7,675	25.1	7,347	29.7
Does not have	29,295	45.4	8,651	28.2	5,480	22.1	8,629	28.3	5,469	22.1
Dual credit										
Earned at least one	5,569	8.6	5,149	16.8	4,447	17.9	5,114	16.7	4,415	17.8
Did not earn any	58,965	91.4	25,475	83.2	20,363	82.1	25,422	83.3	20,328	82.2
Advanced Placement exam										
Took at least one	17,904	27.7	11,084	36.2	10,504	42.3	11,049	36.2	10,473	42.3
Did not take any	46,630	72.3	19,540	63.8	14,306	57.7	19,487	63.8	14,270	57.7
Passed Advanced Placement exam										
Took and passed at least one	7,575	11.7	4,605	15.0	4,466	18.0	4,584	15.0	4,447	18.0
Took at least one exam but did not pass any	10,329	16.0	6,479	21.2	6,038	24.3	6,465	21.2	6,026	24.4
Took college entrance exam (ACT or SAT)										
Took ACT or SAT	39,170	60.7	24,103	78.7	21,057	84.9	24,033	78.7	20,998	84.9
Did not take ACT or SAT	25,364	39.3	6,521	21.3	3,753	15.1	6,503	21.3	3,745	15.1
Cumulative grade point average										
Below 2.8	8,119	12.6	7,448	24.3	7,448	30.0	7,445	24.4	7,445	30.1
Between 2.9 and 3.5	10,603	16.4	10,126	33.1	10,126	40.8	10,107	33.1	10,107	40.9
3.6 or above	7,452	11.5	7,236	23.6	7,236	29.2	7,191	23.5	7,191	29.1
Missing	38,360	59.4	5,814	19.0	—	—	5,793	19.0	—	—
Miles between high school of graduation and college of enrollment										
Less than 21.6	12,388	19.2	10,966	35.8	7,585	30.6	10,935	35.8	7,569	30.6
Between 21.6 and 72.5	12,460	19.3	10,345	33.8	8,312	33.5	10,331	33.8	8,300	33.5
72.5 or more	12,781	19.8	9,313	30.4	8,913	35.9	9,270	30.4	8,874	35.9
No mileage information available	26,905	41.7	—	—	—	—	—	—	—	—

— is not applicable.

ISTEP+ is Indiana Statewide Testing for Educational Progress—Plus.

Note: Because of multicollinearity, not all student academic characteristics could be included in the regressions. This table presents additional variables (for example, SAT scores) to provide additional information about the academic preparation of Indiana students. Percentages may not sum to 100 because of rounding.

a. Mean of the unstandardized combined math and English language arts scores, for ease of interpretation.

Source: Authors' calculations based on data from the Indiana state longitudinal data system and travel distance analysis (Esri, 2013).

Table B4. School characteristics of the analytic samples

Characteristic	Research questions 1 and 2		Research question 3		Research question 4		Research question 5			
	All 2010 Indiana high school graduates		Indiana high school graduates who enrolled in an Indiana public college in fall 2010		Indiana high school graduates in the presumptive eligibility analysis		Indiana high school graduates in the two- versus four-year model		Indiana high school graduates in the undermatching model	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Students graduating from a rural high school	20,817	32.3	30,624	33.2	24,810	32.5	30,536	33.3	24,743	32.6
School performance on English end-of-course exam										
Students in schools with less than 57.9 percent passing	21,092	32.8	8,967	29.4	6,874	27.8	8,967	29.4	6,874	27.8
Students in schools with between 58 percent and 69 percent passing	21,667	33.7	10,241	33.5	8,176	33.0	10,241	33.5	8,176	33.0
Students in schools with more than 69 percent passing	21,588	33.6	11,328	37.1	9,693	39.2	11,328	37.1	9,693	39.2
Miles to the nearest two-year college										
Students in schools with distance less than 8.4 miles	13,016	33.0	10,265	33.5	8,240	33.2	10,182	33.3	8,175	33.0
Students in schools with distance between 8.4 and 17.2 miles	12,824	32.5	10,013	32.7	8,235	33.2	10,009	32.8	8,233	33.3
Students in schools with distance more than 17.2 miles	13,565	34.4	10,346	33.8	8,335	33.6	10,345	33.9	8,335	33.7
Miles to the nearest four-year college										
Students in schools with distance less than 5.4 miles	12,986	33.0	9,978	32.6	7,982	32.2	9,894	32.4	7,917	32.0
Students in schools with distance between 5.4 and 12.6 miles	12,871	32.7	10,089	32.9	8,261	33.3	10,085	33.0	8,259	33.4
Students in schools with distance more than 12.6 miles	13,548	34.4	10,557	34.5	8,567	34.5	10,557	34.6	8,567	34.6
College enrollment, fall 2010										
Two-year Indiana public college (all types)	9,601	31.4	9,601	31.4	4,223	17.0	9,580	31.4	4,218	17.1
Vincennes University	1,754	5.7	1,754	5.7	1,563	6.3	1,753	5.7	1,562	6.3
Four-year Indiana public college										
Less competitive	6,919	22.6	6,919	22.6	6,684	26.9	6,958	22.8	6,874	27.8
Competitive	7,105	23.2	7,105	23.2	6,990	28.2	7,082	23.2	6,968	28.2
More competitive	6,999	22.9	6,999	22.9	6,913	27.9	6,916	22.7	6,683	27.0

Note: Percentages may not sum to 100 because of rounding.

Source: Authors' calculations based on data from the Indiana state longitudinal data system distance analysis (Esri, 2013), and Barron's Educational Series (2010).

examining presumptive eligibility. Table B4 does the same for sample proportions (unless the label indicates the mean) at the high school and college levels.

Mapping data. Several student- and school-level variables were created to generate the geographic data displays used throughout this report and appendixes. For school variables, values provided from the Indiana Department of Education were used whenever possible.

For all maps, rural and nonrural designations for high schools were supplied by the department. The following data were used to generate each geographic data display:

- *ACT/SAT composite performance:* ACT and SAT scores were combined and scaled to the ACT metric using concordance tables developed jointly by ACT and the College Board that show which ACT composite score corresponds to which combination of SAT scores, and vice versa, on the basis of 2006 high school graduates who completed both the ACT and SAT (ACT, Inc., 2008).
- *Percentage passing at least one Advanced Placement exam:* school percentages of students passing at least one Advanced Placement exam during their high school career were provided by the department of education.
- *Percentage passing English end-of-course examination:* school percentages of students passing the English end-of-course examination were provided by the department.
- *Percentage eligible for the school lunch program:* school percentages of students eligible for the school lunch program were provided by the department.
- *GPA:* school-level mean GPAs were calculated by taking the mean of all student GPAs provided in the sample for each school.
- *ISTEP+ composites:* see explanation in previous section (*ISTEP+ test scores*) for information about how composite scores for each student were calculated. School mean composite scores were calculated and values were separated into terciles for rural and nonrural schools for display on the map.
- *College locations:* latitude and longitude coordinates for the majority of postsecondary institutions were provided by the Indiana Commission for Higher Education. For schools missing this information, addresses were used to geocode the school locations using the ArcGIS online address locator.
- *Enrollment in two-year colleges and four-year colleges of varying selectivity:* to begin, variables were created to flag students who attended two- and four-year colleges of varying selectivity on a full- and part-time basis, yielding eight flags: two-year part-time, two-year full-time, four-year part-time less selective, four-year part-time selective, four-year part-time very selective, four-year full-time less selective, four-year full-time selective, and four-year full-time very selective. Next, student data were aggregated to the school level, and all enrollment flags were summed for each school, yielding a total of students in each school attending each type of college on a full- or part-time basis. Finally, these school enrollment totals were divided by the total of student records in the sample from a particular school to yield a percentage enrollment estimate for each type of college (two-year, four-year by selectivity) by enrollment intensity (full- and part-time). These percentages are the values displayed at the school level for each enrollment map (see maps 1 and 2 in the main text and maps C1–C4 in appendix C).
- *Closest two- and four-year colleges:* see *Data analysis,* below for an in-depth explanation of the methodology used to calculate distances to the closest two- and four-year colleges.
- *Travel distances to two-year colleges and four-year colleges of varying selectivity:* see *Data analysis* below for an in-depth explanation of the methodology used to calculate distances from graduating high school to college of enrollment. For these maps, school averages of student distances to college were calculated for each college type (two- and four-year) and selectivity level.

Missing data. Overall, rates of missing data were low (table B5). For students missing school lunch program eligibility status in 2009/10 (639 students), values from 2008/09 or

Table B5. Rates of missing data in the analytic sample for the variables included in the analysis

Variable	Research questions 1 and 2: All 2010 Indiana high school graduates		Research question 3: Indiana high school graduates who enrolled in Indiana public colleges in fall 2010		Research question 4: Indiana high school graduates in the presumptive eligibility analysis		Research question 5: Indiana high school graduates in the two- versus four-year model		Research question 5: Indiana high school graduates in the undermatching model	
	Number of valid cases	Percent missing	Number of valid cases	Percent missing	Number of valid cases	Percent missing	Number of valid cases	Percent missing	Number of valid cases	Percent missing
Student demographic characteristic										
Gender, 2009/10	64,534	0.0	30,624	0.0	24,810	0.0	30,536	0.0	24,743	0.0
Race/ethnicity, 2009/10	64,534	0.0	30,624	0.0	24,810	0.0	30,536	0.0	24,743	0.0
School lunch program eligibility status, 2009/10	63,895	1.0	30,507	0.4	24,746	0.3	30,419	0.4	24,679	0.3
School lunch program eligibility status (missing 2009/10 values replaced with earlier values)	64,357	0.3	30,592	0.1	24,797	0.1	30,504	<0.1	24,730	0.1
Student academic characteristic										
Grade 10 ISTEP+ standardized math score	61,533	4.7	29,648	3.2	24,135	2.7	29,564	3.2	24,070	2.7
Grade 10 ISTEP+ standardized English language arts score	61,537	4.6	29,668	3.1	24,145	2.7	29,584	3.10	24,080	2.7
Grade 10 ISTEP+ standardized composite test score	61,168	5.2	29,548	3.5	24,063	3.0	29,464	3.50	23,998	3.0
Indicator of taking ACT or SAT	64,534	0.0	30,624	0.0	24,810	0.0	30,536	0.00	24,743	0.0
ACT composite score	14,755	77.1	8,635	71.8	7,854	68.3	8,587	71.90	7,808	68.4
SAT composite score (critical reading, writing, and math)	35,239	45.4	21,973	28.2	19,330	22.1	21,907	28.30	19,274	22.1
Combined ACT/SAT score (on SAT scale)	39,170	39.3	24,103	21.3	21,057	15.1	24,033	21.30	20,998	15.1
Earned at least one dual-credit	64,534	0.0	30,624	0.0	24,810	0.0	30,536	0.00	24,743	0.0
Number of Advanced Placement exams taken	17,904	72.3	11,084	63.8	10,504	57.7	11,049	63.80	10,473	57.7
Number of Advanced Placement exams passed	17,904	72.3	11,084	63.8	10,504	57.7	11,049	63.80	10,473	57.7
High school cumulative grade point average	26,174	59.4	24,810	19.0	24,810	0.0	24,743	19.00	24,743	0.0
High school characteristic										
Percentage of all students who passed English end-of-course assessment in 2010	64,347	0.3	30,536	0.3	24,743	0.3	30,536	0.0	24,743	0.0
Percentage of all students who passed Algebra I end-of-course assessment in 2010	64,204	0.5	30,485	0.5	24,695	0.5	30,485	0.2	24,695	0.2
Percentage of students who are eligible for the school lunch program	64,135	0.6	30,474	0.5	24,716	0.4	30,404	0.4	24,654	0.4
Percentage of students who passed an Advanced Placement exam	60,258	6.6	28,639	6.5	23,268	6.2	28,574	6.4	23,208	6.2
Urbanicity of high school	64,534	0.0	30,624	0.0	24,810	0.0	30,536	0.0	24,743	0.0
College characteristic										
College type of primary institution in fall 2010	39,405	38.9	30,624	0.0	24,810	0.0	30,536	0.0	24,743	0.0
Barron's rating for primary institution in fall 2010	28,446	55.9	30,624	0.0	24,810	0.0	30,536	0.0	24,743	0.0

Source: Authors' calculations based on data from the Indiana state longitudinal data system and Barron's Educational Series (2010).

2007/08 were used when available (for 462 students). Missing data cannot be distinguished from nonparticipation for the ACT, SAT, Advanced Placement exams, and dual credits. If a student did not have an ACT or SAT score, it is assumed that the student did not take the ACT or SAT. If a student did not have an Advanced Placement score, it is assumed that the student did not take an Advanced Placement exam, and if a student did not have

a record of dual credits earned, it is assumed that the student did not earn any. For hierarchical linear models, which require complete cases, missing values for grade 10 ISTEP+ composite test scores and school lunch program eligibility were replaced with the sample mean and a missing data indicator was created.

Data analysis

Research question 1. To answer research question 1 on the proportion of graduates of rural and nonrural high schools who enrolled in college, enrolled in different types of colleges (degree of selectivity), and enrolled full-time, the study team calculated the percentage of students' college enrollment status, college selectivity, enrollment intensity (full- or part-time), and college location and control (public versus private) separately for rural and nonrural 2010 high school graduates. Chi-square tests indicate statistically significant differences in college enrollment patterns for rural and nonrural graduates. In most cases the *p*-values, which were corrected using a Bonferroni adjustment for multiple testing, were less than 0.001.[9] This level of statistical significance reflects the large sample size, and not all results are necessarily policy relevant.

Research question 2. To answer research question 2 on whether 2010 graduates of rural and nonrural high schools differ in their academic preparation or eligibility for the school lunch program, the study team calculated the percentage of students' academic characteristics (grade 10 ISTEP+ math and English language arts composite scores, ACT/SAT scores, ACT/SAT completion rates, and Advanced Placement exam achievement) and eligibility for the school lunch program separately for rural and nonrural high school graduates. Chi-square tests indicated statistically significant differences in academic preparation and eligibility for the school lunch program for rural and nonrural graduates. In all cases the *p*-values, which were corrected using a Bonferroni adjustment for multiple testing, were less than 0.003. As with the results of research question 1, this level of statistical significance reflects the large sample size, and not all results are necessarily policy relevant.

Research question 3. To answer research question 3 on the location of two- and four-year Indiana public colleges and on how distance to college varied for graduates of rural and nonrural high schools who enrolled in Indiana public colleges, the study team conducted several mapping analyses.

To address the question about the distribution of two-year colleges and four-year colleges of varying selectivity in Indiana and their proximity to Indiana high schools, the study team conducted a near analysis using geographic information system software (ArcMap 10.2; Esri, 2013). The near analysis tool, part of the proximity toolset in the ArcMap software, calculates distance and proximity information between input features and the closest feature in another layer or feature class within the mapping document. First, the coordinates of all Indiana high schools as well as the coordinates of all two- and four-year colleges within Indiana (and states sharing a border with Indiana) were loaded into a mapping document using an Indiana-specific map projection (Universal Transverse Mercator zone 16 latitude band N) to ensure accurate mileage estimates. Using the high school point file as the input feature class, the near analysis determined the closest point in both the two- and four-year college feature classes to identify the closest two- and four-year colleges to each high school. For each high school, the results returned identifying information for the closest two- and four-year colleges, as well as the straight-line distance (in miles) to each institution. These

distances were then mapped using proportional symbols to display these differences geographically for rural and nonrural schools (see maps C11 and C12 in appendix C).

Addressing how distance to college varied for graduates of rural and nonrural high schools who enrolled in Indiana public colleges required identifying the average distance traveled by rural and nonrural students to two-year colleges and four-year colleges of varying selectivity. Using the route analysis function of the network analyst extension within Arc Map 10.2, each student's actual shortest travel distance (in miles) from high school of graduation to college of enrollment was first calculated. The impedance set for this route analysis was distance so that the analysis solved for the shortest possible travel distance between the two points. This route analysis used the Streets Network Dataset contained on the Esri (2013) Data and Maps, which uses TeleAtlas 2009 street data to calculate routes. Hence, for each student who attended college, the shortest possible travel distance between that student's high school and college of enrollment was calculated.

Next, data were aggregated to the school level, and distance means were calculated for each college type (two- and four-year) and selectivity level for each school. The resulting means allowed for a geographic display of the average distance traveled by students in each high school to colleges of each type and selectivity (see table C3 in appendix C) and for rural–nonrural comparisons to be made.

All analyses of distance traveled to attend college for rural and nonrural high school graduates used the distance between the graduating high school and college of enrollment for each student to calculate estimates of distance traveled. For many rural schools, students may live many miles away from the high school in which they are enrolled. Ideally, estimates of distance traveled would use students' home addresses as the starting points, but this information was not available in the dataset provided by the Indiana Department of Education.

Research question 4. To answer the first part of research question 4 on the proportion of rural and nonrural high school graduates who enrolled in an Indiana public college whose academic characteristics made them "presumptively eligible" for two- or four-year public colleges of varying selectivity, the study team used ACT/SAT scores and GPA to determine students' levels of presumptive eligibility. The study team took several steps to answer this question. First, on the basis of the ACT/SAT scores and GPA of the high school graduates in the sample, a qualifications rubric was created to show the modal academic characteristics of students who enrolled in colleges of a specific selectivity in Indiana. The rubric represents the actual college-going patterns of Indiana high school graduates who enrolled in an Indiana public college. Second, the study team compared the qualifications of each student in the dataset with the rubric to determine the category of selectivity for which a student was presumptively eligible. (See discussion above on creation of the presumptive eligibility variable for how the rubric was created and table C4 in appendix C for the final qualifications rubric.) The percentages of rural and nonrural graduates presumptively eligible for each level of selectivity were calculated and are displayed in table 2 in the main report.

To answer the second part of research question 4 on the proportion of rural and nonrural high school graduates who enrolled in a college undermatched with their level of presumptive eligibility, the study team compared graduates' presumptive eligibility rankings

with the selectivity level of the college in which they actually enrolled. Graduates who enrolled in a college less selective than a college for which they were presumed eligible (for example, if a student was presumptively eligible for a selective college and enrolled in a less selective college) were flagged. Separate tables were calculated for rural and nonrural graduates, indicating, for each level of presumptive eligibility, the proportion of graduates who enrolled in each college type and level of selectivity, and showing the extent to which rural and nonrural graduates were enrolling in colleges less selective that colleges for which they are presumptively eligible (see tables 3 and 4 in the text).

Research question 5. To answer research question 5 on whether, after accounting for student- and school-level characteristics for graduates who enrolled in a public college, any rural–nonrural differences remained in enrolling in a two- versus four-year college or enrolling in an Indiana public college less selective than the level for which a student is presumptively eligible (undermatching), the study team ran two multilevel logistic regression models.

Hierarchical generalized linear models, estimated using hierarchical linear model software, were used to account for the binary outcome and nested nature of the data in which students are nested within high schools. Specifically, to model the binary outcome, the probability of achieving the outcome, $u_{ij} = P(Y_{ij} = 1)$ for student i in high school j, is transformed using the logit link, which is the log of the odds, where the odds is the probability of the event (that is, enrolling in a two- or four-year college; enrolling in a college less selective than the level for which a student is presumptively eligible) divided by 1 minus the probability of the event:

$$\eta_{ij} = \log\left(\frac{u_{ij}}{1-u_{ij}}\right)$$

The transformed variable was then modeled as the outcome in the following two-level model:

Level 1 model for binary outcomes: students-within-schools

$$\eta_{ij} = \beta_{0j} + \sum_{p=1}^{P} \beta_{1j} a_{pij} + e_{ij}$$

where $i = 1, \ldots, n_j$ students in school j; $j = 1, \ldots, j$ high schools; a_{pij} = pth student characteristic for student i in high school j, $p = 1, \ldots, P$; *and* e_{ij} = random error term for student i in high school j.

Level 2 model: schools

$$\beta_{0j} = \gamma_{00} + \sum_{r=1}^{R} \gamma_{0r} W_{0rj} + u_j$$

$$\beta_{pj} = \gamma_p \text{ for } p > 0$$

where β_{0j} = rth characteristic for high school j, $r = 1, \ldots, R$, and u_j = random error for high school j.

The models included the student and high school characteristics in table C5 in appendix C, which presents the odds ratios, 95 percent confidence intervals, and p-values.

Predicted probability. The main body of the report describes output from the regression models in terms of predicted probabilities rather than log odds or odds ratios. For example, to calculate the change in predicted probability in enrolling in a two-year rather than a four-year college associated with graduating from a rural high school, the following steps were taken. First, the linear predictor of the log odds of enrolling in a two- versus four-year college was calculated for students who graduated from a rural high school. This linear predictor was calculated as the sum of the estimated coefficient of graduating from a rural high school multiplied by 1 minus the grand mean of graduating from a rural high school, plus the intercept. Second, the probability of enrolling in a two-year rather than a four-year college for students who graduated from a rural high school was calculated as a transformation of the linear predictor: this probability equals (1/(1+exp(–1**linear_predictor*))). Third, the corresponding linear predictor and probability of enrolling in a two-year rather than a four-year college was calculated for students who graduated from a nonrural high school. Finally, the difference between the two predicted probabilities was calculated. This value indicates the difference in predicted probabilities associated with graduating from a rural high school for a "typical" student, where typical refers to a student whose values for all variables except graduating from a rural high school are at the grand mean values among students in the model, and the random student and high school effects are equal to zero.

Appendix C. Additional results

The tables, figures, and maps in this appendix present additional and more detailed results from the analysis, arranged in the order of the research questions with which they are associated.

Table C1. Percentage of Indiana high school graduates enrolling in college, by high school locale and college selectivity, intensity, location, and public versus private control, 2010

Enrollment and college characteristics	Rural high school graduates (*n* = 20,817 students)	Nonrural high school graduates (*n* = 43,717 students)
College enrollment		
Enrolled in college	62.1	60.6
Did not enroll in college	37.9	39.4
Among students who enrolled in any college		
College selectivity		
Two-year	30.8	25.4
Less selective	19.8	21.5
Selective	26.8	25.5
Very selective	22.6	27.7
Enrollment intensity		
Full-time	91.0	90.0
Part-time	8.9	10.0
College location and public versus private control[a]		
Indiana—private	7.5	7.0
Indiana—public	48.8	46.8
Out-of-state—private	2.7	3.4
Out-of-state—public	3.1	3.4

Note: Percentages may not sum to 100 because of rounding.

a. Percentages sum to the share of rural (62.1 percent) and nonrural (60.6 percent) high school graduates who enrolled in college.

Source: Authors' calculations based on data from the Indiana state longitudinal data system

Table C2. Academic preparation indicators for Indiana rural and nonrural high schools, 2010

Indicator	Rural schools		Nonrural schools	
	Number	Percent	Number	Percent
Standardized ISTEP+ composite rates[a]				
Lower third	46	26.9	78	38.4
Middle third	64	37.4	61	30.1
Upper third	61	35.7	64	31.5
Percentage passing English 10 end-of-course assessment				
50 percent or less	16	9.4	40	20.3
51–75 percent	129	75.4	134	68.0
Greater than 75 percent	26	15.2	23	11.7
Mean ACT/SAT composite score				
19.5 or less	22	12.9	53	26.4
19.6–22	135	79.0	120	59.7
22.1–23.5	14	8.2	20	10.0
Greater than 23.5	0	0.0	8	4.0
Percentage taking and passing at least one Advanced Placement exam				
10 percent or less	123	71.9	129	63.6
11–15 percent	25	14.6	31	15.3
16–29 percent	23	13.5	32	15.8
Greater than 29 percent	0	0.0	11	5.4
Mean grade point average				
3.00 or less	37	21.8	64	31.9
3.01–3.25	88	51.8	98	48.8
3.26–3.50	41	24.1	36	17.9
Greater than 3.50	4	2.4	3	1.5

ISTEP+ is Indiana Statewide Testing for Educational Progress.

Note: For the standardized ISTEP+ composite rate and percentage taking and passing at least one Advanced Placement exam categories, the high school graduates analytic sample was used. The categories for percentage passing English 10 end-of-course assessment were calculated using data from the Indiana Department of Education website. For the mean ACT/SAT composite score categories, the graduates entering an Indiana public college analytic sample was used. For mean grade point average, the analytic sample that included graduates with a valid grade point average entering an Indiana public college was used. The number of rural and nonrural high schools vary slightly for different indicators based on the analytic sample used. For example, in the sample that includes only graduates with a valid grade point average entering an Indiana public college, 170 rural high schools and 201 nonrural high schools were included in the analysis.

a. Based on scores of students in the high school graduates analytic sample.

Source: Authors' calculations based on data from the Indiana state longitudinal data system and publicly available data from the Indiana Department of Education website.

Table C3. Differences in distance traveled to public two- and four-year colleges of varying selectivity for 2010 graduates of Indiana rural and nonrural high schools (miles)

Selectivity level	Rural graduates	Nonrural graduates	All graduates
Two-year	44.5	38.9	41.0
Less selective four-year	53.5	45.3	47.9
Selective four-year	72.5	75.8	74.7
Very selective four-year	88.8	94.0	92.5

Source: Authors' calculations based on data from the Indiana state longitudinal data system and Barron's Educational Series (2010).

Table C4. Qualifications rubric of presumptive eligibility for two- and four-year colleges of varying selectivity for Indiana high school graduates enrolling in an Indiana public college in fall 2010

ACT/SAT score[a]	Cumulative high school grade point average				
	Less than 2.0	2.0–2.4	2.5–2.9	3.0–3.4	3.5–4.0
Missing ACT/SAT	Two-year college	Two-year college	Two-year college	Two-year college	Two-year college
Less than 18	Two-year college	Less selective college	Less selective college	Less selective college	Selective college
18–21	Two-year college	Less selective college	Less selective college	Selective college	Selective college
22–29	Two-year college	Less selective college	Selective college	Selective college	Very selective college
30 or higher	Two-year college	[b]	Less selective college	Very selective college	Very selective college

Note: Table is based on 24,810 Indiana high school graduates who enrolled in an Indiana public college in fall 2010 with valid grade point average (GPA).

a. ACT and SAT scores were combined using concordance tables developed jointly by ACT and the College Board that show which ACT composite score corresponds to which combination of SAT scores and vice versa, on the basis of 2006 high school graduates who completed both the ACT and SAT (ACT, Inc., 2008). Graduates missing ACT/SAT scores are presumed eligible for two-year colleges regardless of GPA.

b. No high school graduates fell within the range of 30 or above on the ACT/SAT and had a GPA between 2.0 and 2.4.

Source: Authors' calculations based on data from the Indiana state longitudinal data system and Barron's Educational Series (2010).

Table C5. Regression results predicting enrollment in a two-year rather than a four-year college and enrollment in a college less selective than presumptive eligibility for 2010 graduates of Indiana rural and nonrural high schools

Predictor	Enrolled in a two-year college rather than a four-year college		Enrolled in a college less selective than presumptive eligibility	
	Odds ratio	95 percent confidence interval	Odds ratio	95 percent confidence interval
Student characteristic				
Female	0.76***	(0.72, 0.82)	1.23***	(1.15, 1.31)
Black	0.98	(0.85, 1.13)	0.74***	(0.63, 0.87)
Hispanic	1.00	(0.83, 1.20)	0.90	(0.76, 1.06)
Indicator of ACT/SAT score	0.24***	(0.23, 0.26)	na	na
At least one dual credit earned	1.06	(0.95, 1.19)	1.48***	(1.35, 1.63)
Took at least one Advanced Placement exam but did not pass any	0.30***	(0.27, 0.34)	1.09	(0.98, 1.21)
Took and passed at least one Advanced Placement exam	0.19***	(0.15, 0.23)	0.96	(0.84, 1.10)
Distance (in 10-mile increments) between high school of graduation and college of enrollment	0.91***	(0.90, 0.92)	0.91***	(0.90, 0.93)
School lunch program eligibility status missing values flag	0.85	(0.37, 1.98)	0.31	(0.05, 1.94)
Grade 10 ISTEP+ standardized composite missing values flag	1.39***	(1.22, 1.60)	1.03	(0.87, 1.21)
School lunch program eligibility with missing values replaced	1.19***	(1.10, 1.29)	0.93	(0.86, 1.01)
Grade 10 ISTEP+ standardized composite score with missing values replaced	0.31***	(0.29, 0.33)	1.36***	(1.28, 1.46)
High school characteristic				
Rural high school	1.37***	(1.17, 1.61)	1.18**	(1.04, 1.34)
Percentage of grade 10 students passing the English 10 end-of-course assessment	0.97	(0.49, 1.92)	0.52**	(0.31, 0.88)
Distance (in 10-mile increments) to the nearest four-year college	1.36***	(1.24, 1.50)	1.14***	(1.07, 1.22)

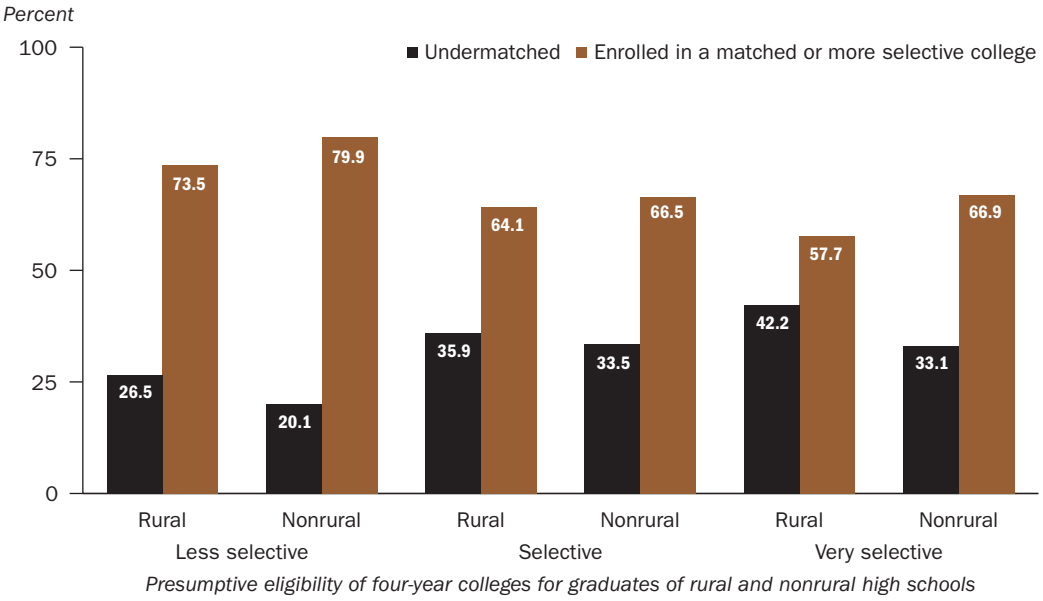
na is not applicable because the predictor was not used in a particular regression analysis.

ISTEP+ is Indiana Statewide Testing for Educational Progress—Plus.

***Bonferroni adjusted *p*-value < .001; **Bonferroni adjusted *p*-value < .01; *Bonferroni adjusted *p*-value < .05. Bonferroni adjustments take into account that the analysis examines two related dependent variables.

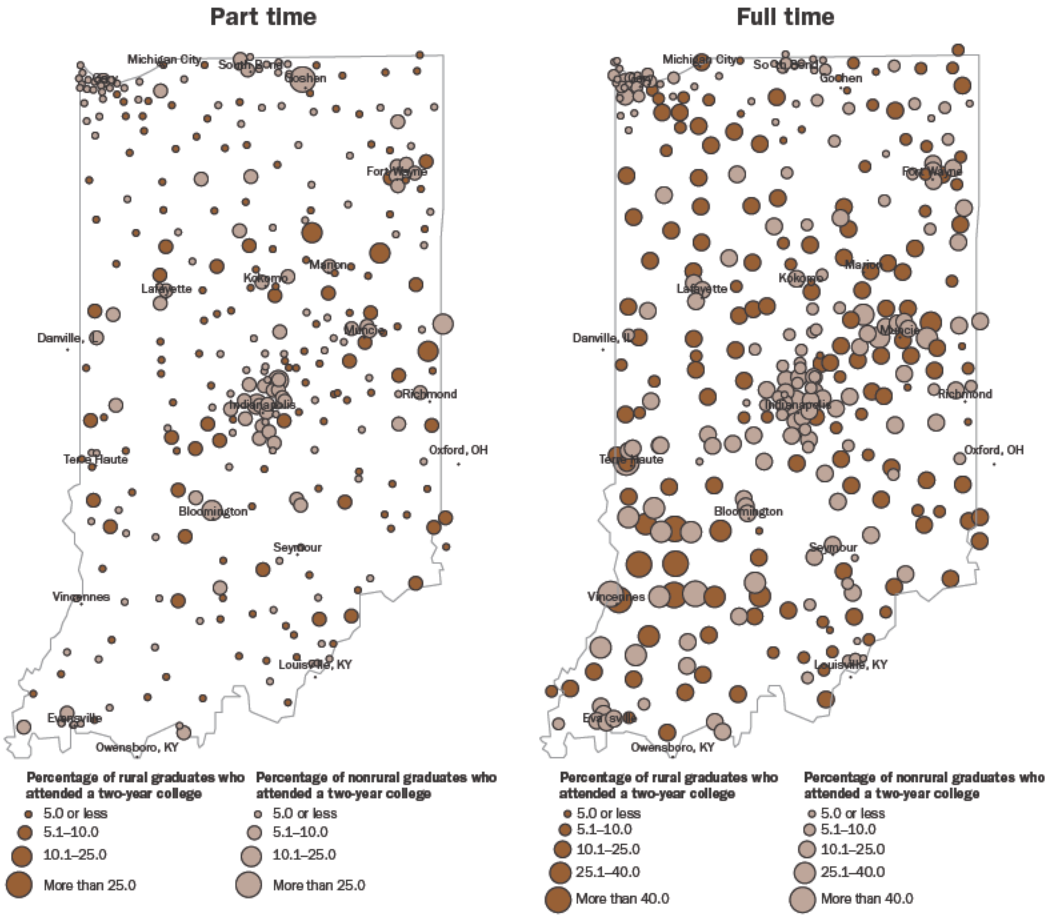
Source: Authors' calculations based on data from the Indiana state longitudinal data system, travel distance analysis (Esri, 2013), and Barron's Educational Series (2010).

Figure C1. Among 2010 Indiana high school graduates presumptively eligible for four-year colleges, rural graduates were more likely than nonrural graduates to undermatch with their college



Source: Authors' calculations based on data from the Indiana state longitudinal data system and Barron's Educational Series (2010).

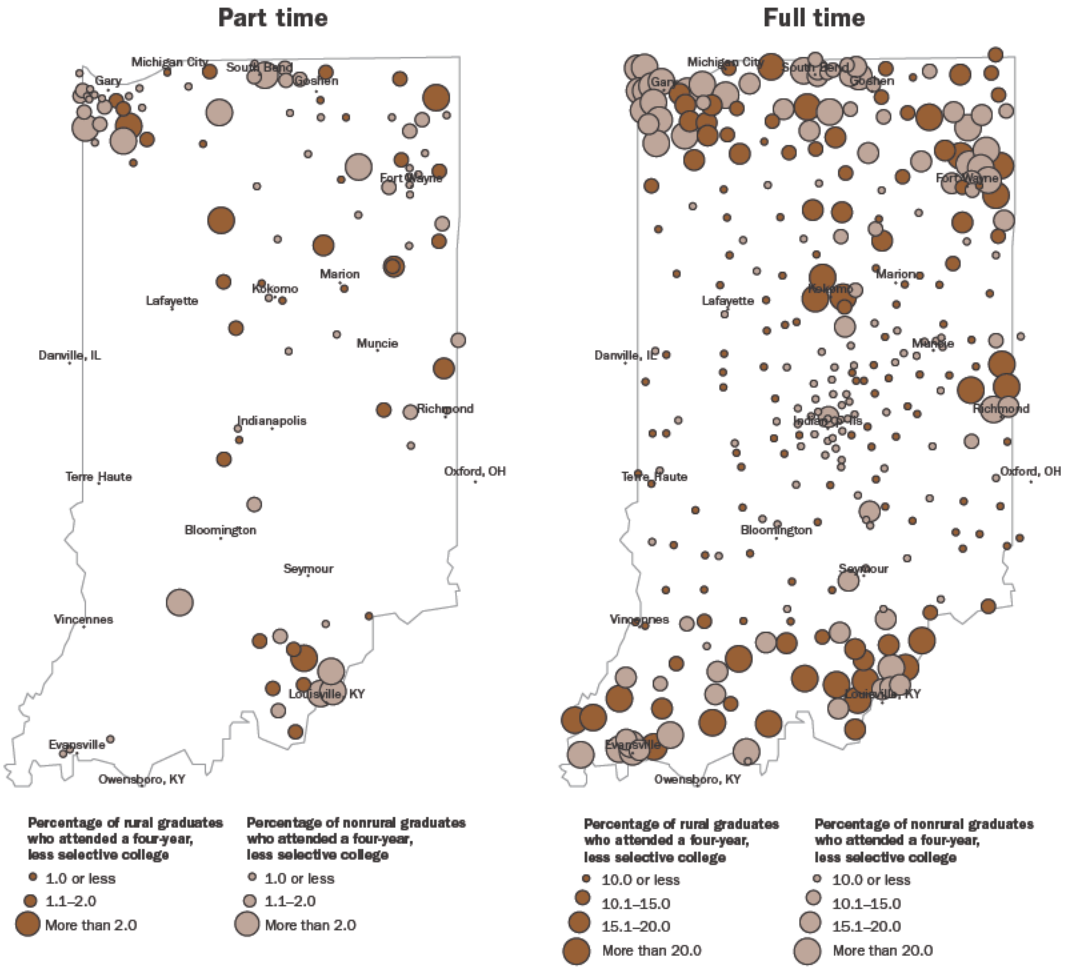
Map C1. Enrollment in two-year colleges on a part- and full-time basis for 2010 graduates of Indiana rural and nonrural high schools



Note: Each circle represents the location of a high school. Two-year colleges include Vincennes University, which is a four-year college with an open-admissions policy that grants primarily associate's degrees.

Source: Authors' calculations based on data from the Indiana state longitudinal data system and latitude and longitude coordinates of high schools (U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, n.d. b).

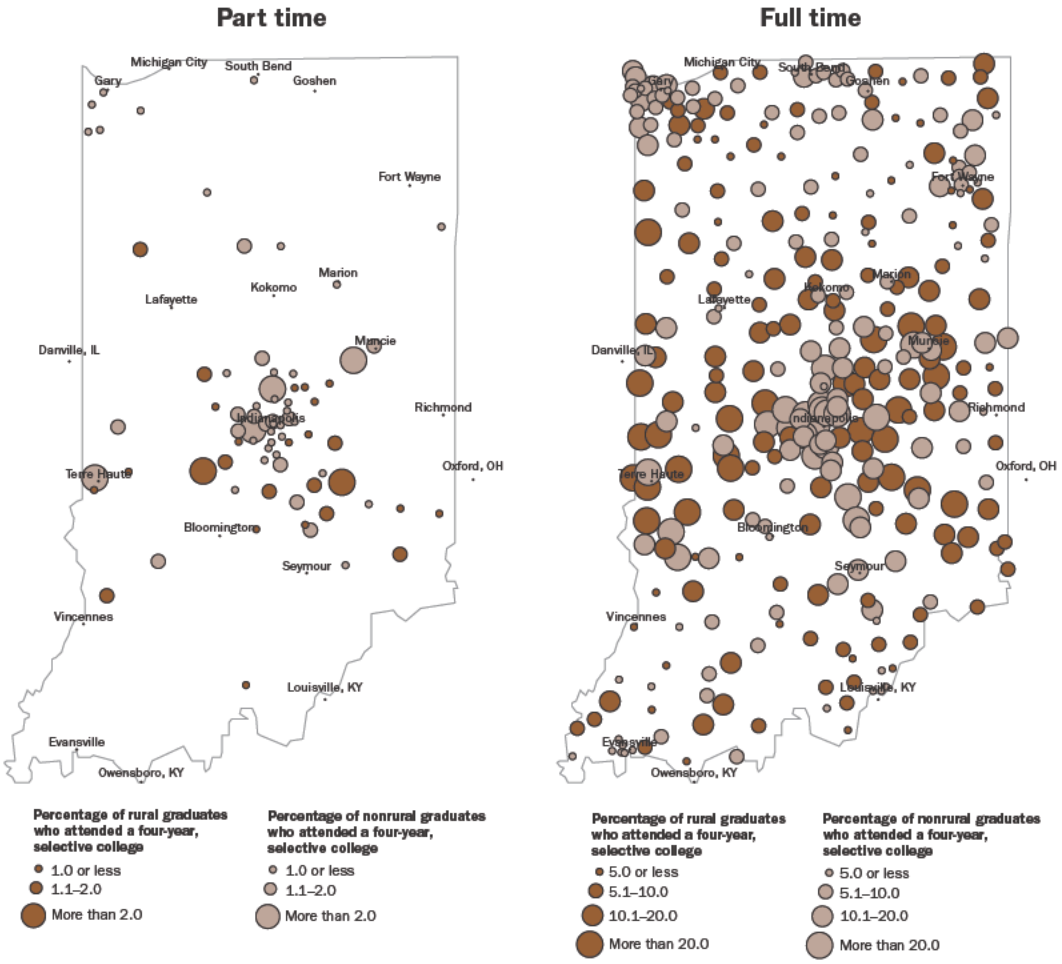
Map C2. Enrollment in four-year, less selective colleges on a part-and full-time basis for 2010 graduates of Indiana rural and nonrural high schools



Note: Each circle represents the location of a high school.

Source: Authors' calculations based on data from the Indiana state longitudinal data system, latitude and longitude coordinates of high schools (U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, n.d. b), and Barron's Educational Series (2010).

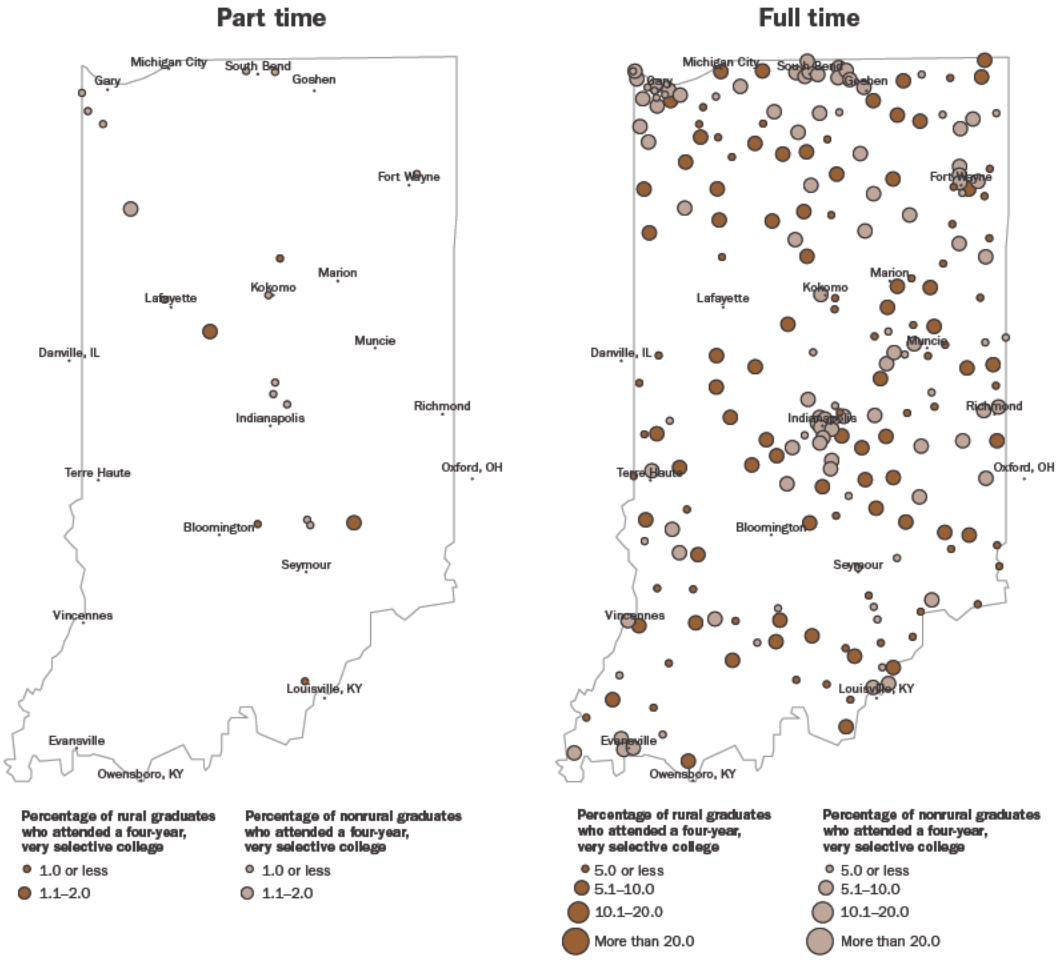
Map C3. Enrollment in four-year, selective colleges on a part- and full-time basis for 2010 graduates of Indiana rural and nonrural high schools



Note: Each circle represents the location of a high school.

Source: Authors' calculations based on data from the Indiana state longitudinal data system, latitude and longitude coordinates of high schools (U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, n.d. b), and Barron's Educational Series (2010).

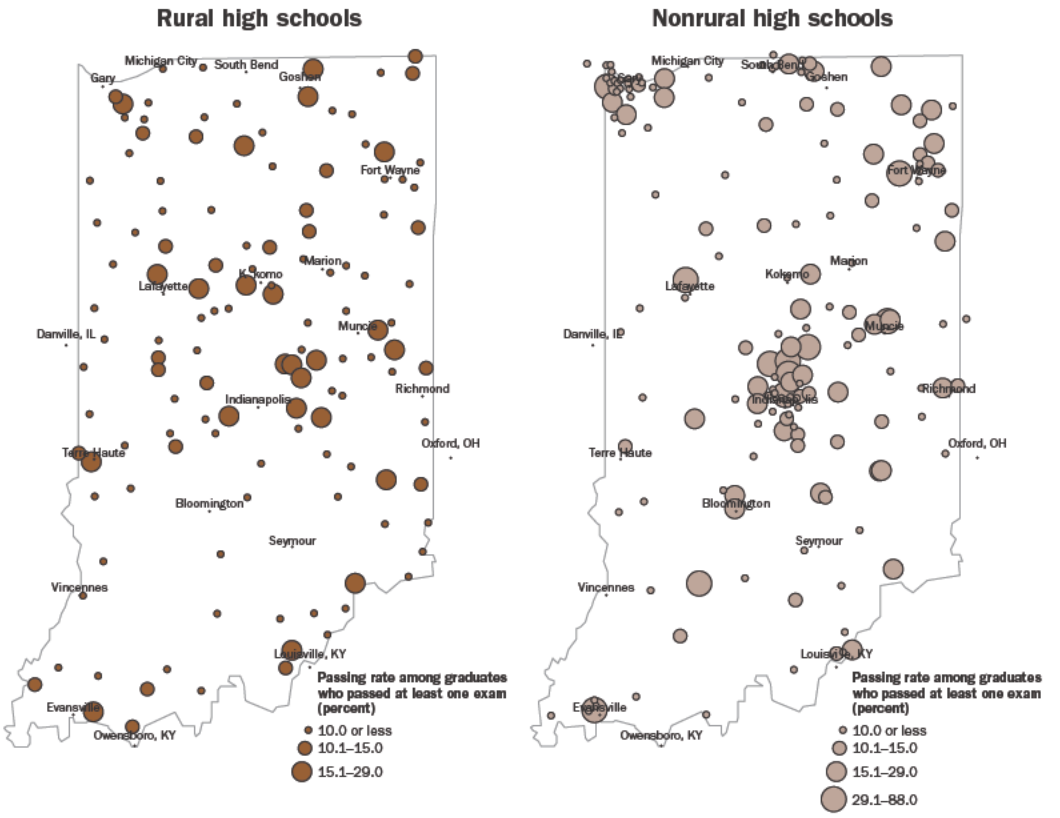
Map C4. Enrollment in four-year, very selective colleges on a part- and full-time basis for 2010 graduates of Indiana rural and nonrural high schools



Note: Each circle represents the location of a high school.

Source: Authors' calculations based on data from the Indiana state longitudinal data system, latitude and longitude coordinates of high schools (U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, n.d. b), and Barron's Educational Series (2010).

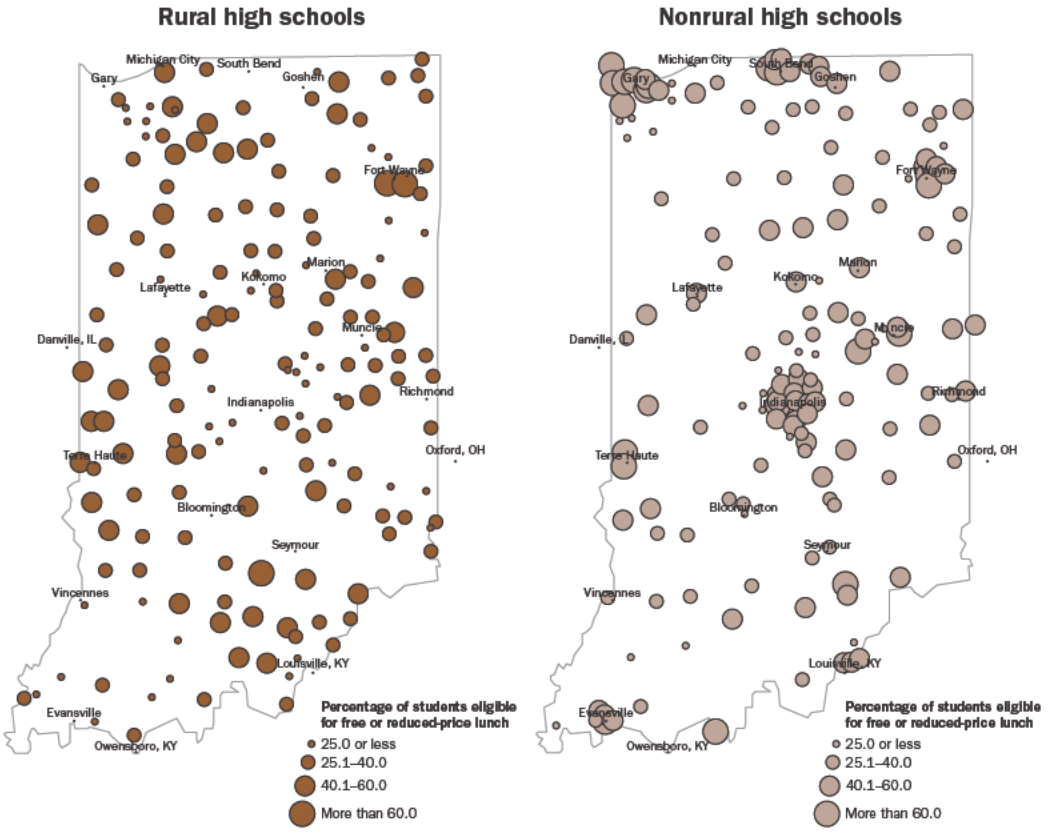
Map C5. High school Advanced Placement exam passing rates for 2010 graduates of Indiana rural and nonrural high schools who passed at least one Advanced Placement exam



Note: Each circle represents the location of a high school.

Source: Authors' calculations based on data from the Indiana state longitudinal data system and latitude and longitude coordinates of high schools (U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, n.d. b).

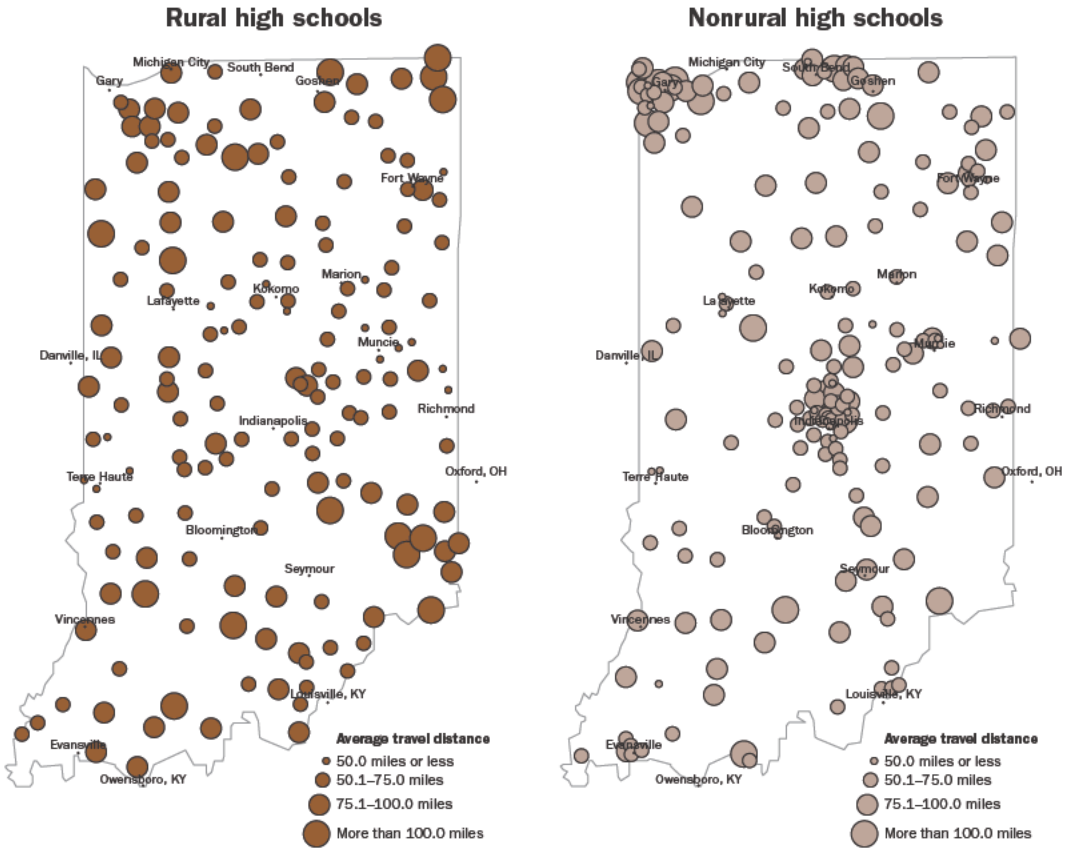
Map C6. Nonrural high schools in Indiana showed higher percentages of 2010 graduates eligible for the school lunch program than did rural schools



Note: Each circle represents the location of a high school.

Source: Authors' calculations based on data from the Indiana state longitudinal data system and latitude and longitude coordinates of high schools (U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, n.d. b).

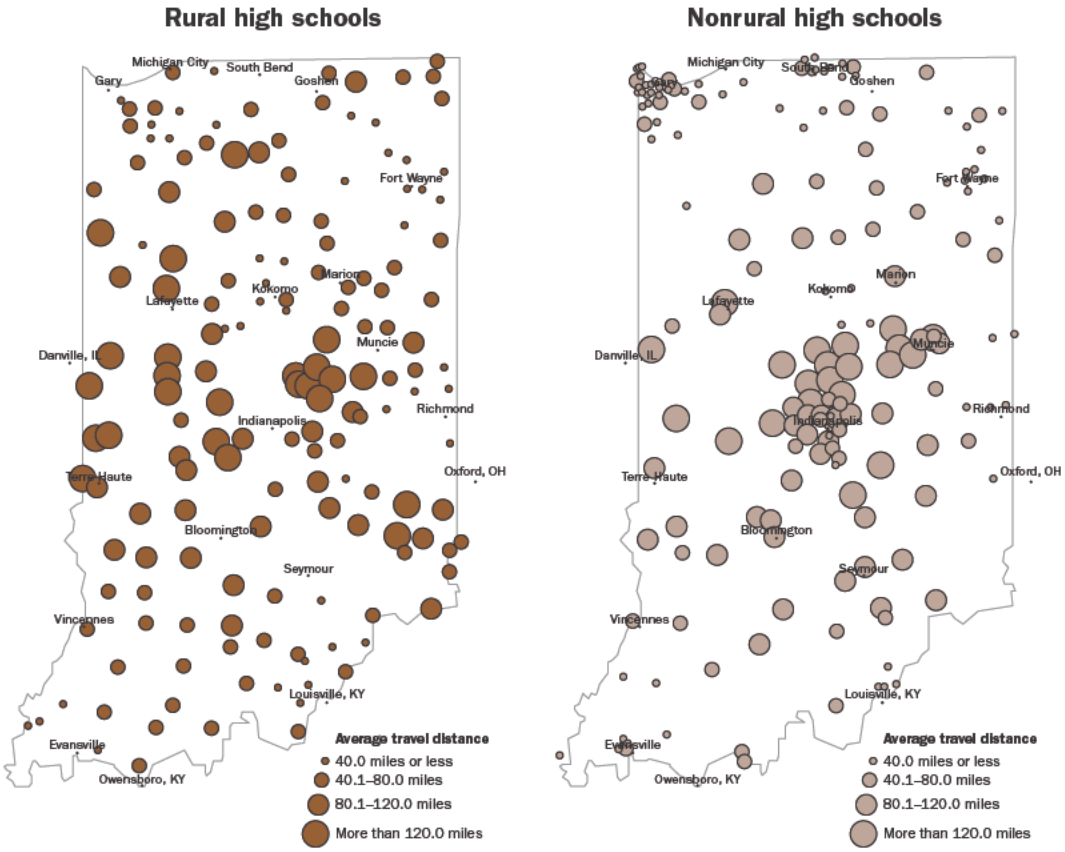
Map C7. Average travel distance to four-year colleges for 2010 graduates of Indiana rural and nonrural high schools



Note: Each circle represents the location of a high school.

Source: Authors' calculations based on latitude and longitude coordinates of high schools (U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, n.d. b), latitude and longitude coordinates of colleges provided by the Indiana Commission for Higher Education, and aggregated travel distances from students' high schools of graduation to colleges of enrollment (Esri, 2013).

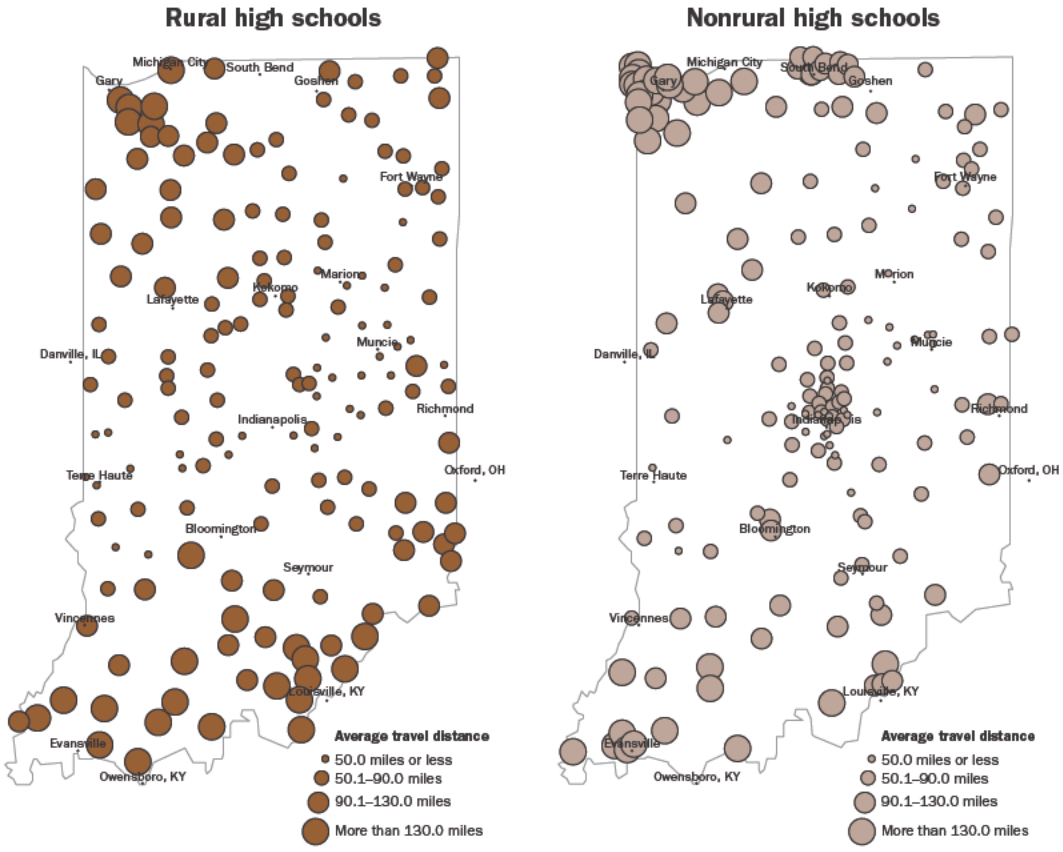
Map C8. Average travel distance to four-year, less selective colleges for 2010 graduates of Indiana rural and nonrural high schools



Note: Each circle represents the location of a high school.

Source: Authors' calculations based on latitude and longitude coordinates of high schools (U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, n.d. b), latitude and longitude coordinates of colleges provided by the Indiana Commission for Higher Education, Barron's Educational Series (2010), and aggregated driving distances from students' high schools of graduation to colleges of enrollment (Esri, 2013).

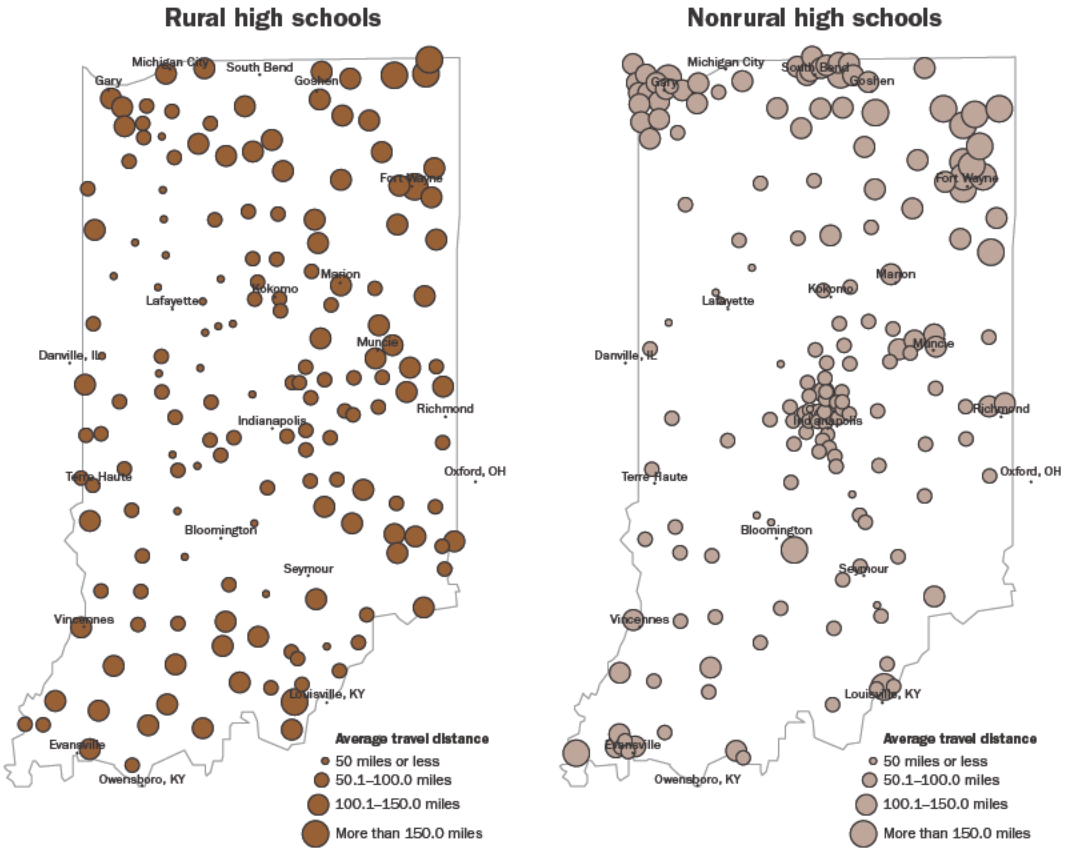
Map C9. Average travel distance to four-year, selective colleges for 2010 graduates of Indiana rural and nonrural high schools



Note: Each circle represents the location of a high school.

Source: Authors' calculations based on latitude and longitude coordinates of high schools (U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, n.d. b), latitude and longitude coordinates of colleges provided by the Indiana Commission for Higher Education, Barron's Educational Series (2010), and aggregated travel distances from students' high schools of graduation to colleges of enrollment (Esri, 2013).

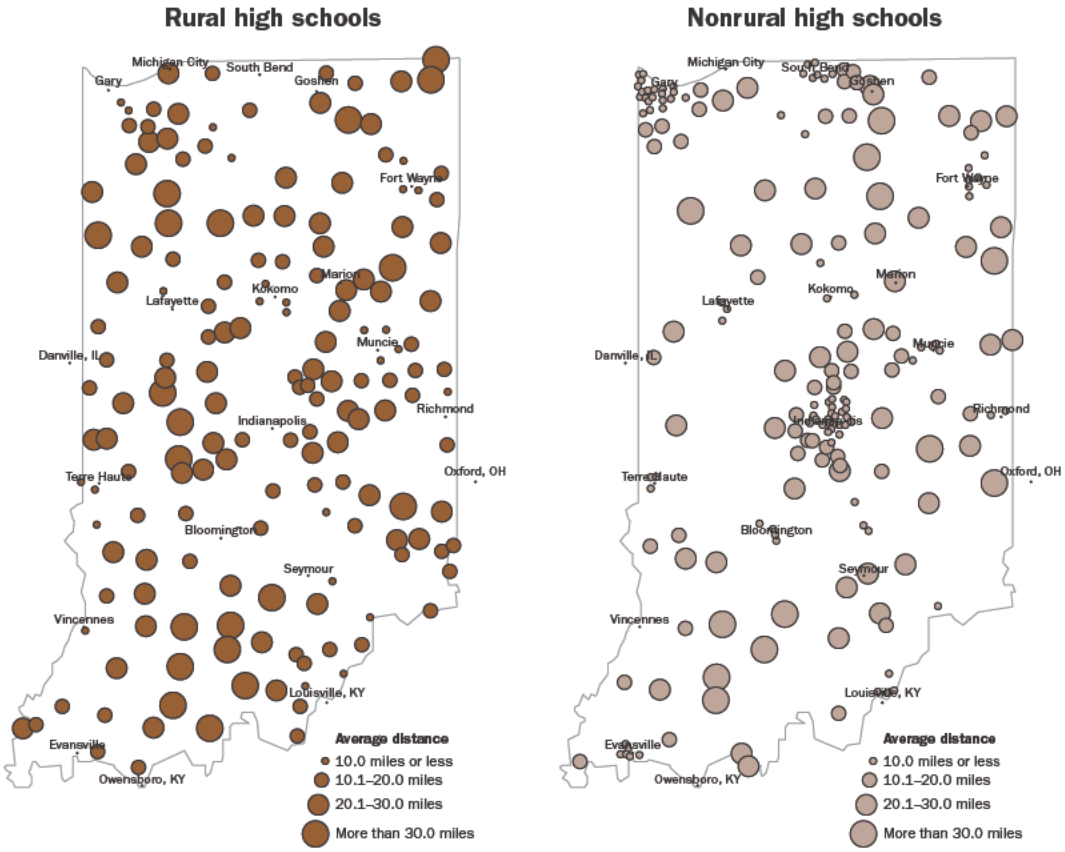
Map C10. Average travel distance to four-year, very selective colleges for 2010 graduates of Indiana rural and nonrural high schools



Note: Each circle represents the location of a high school.

Source: Authors' calculations based on latitude and longitude coordinates of high schools (U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, n.d. b), latitude and longitude coordinates of colleges provided by the Indiana Commission for Higher Education, Barron's Educational Series (2010), and aggregated travel distances from students' high schools of graduation to colleges of enrollment (Esri, 2013).

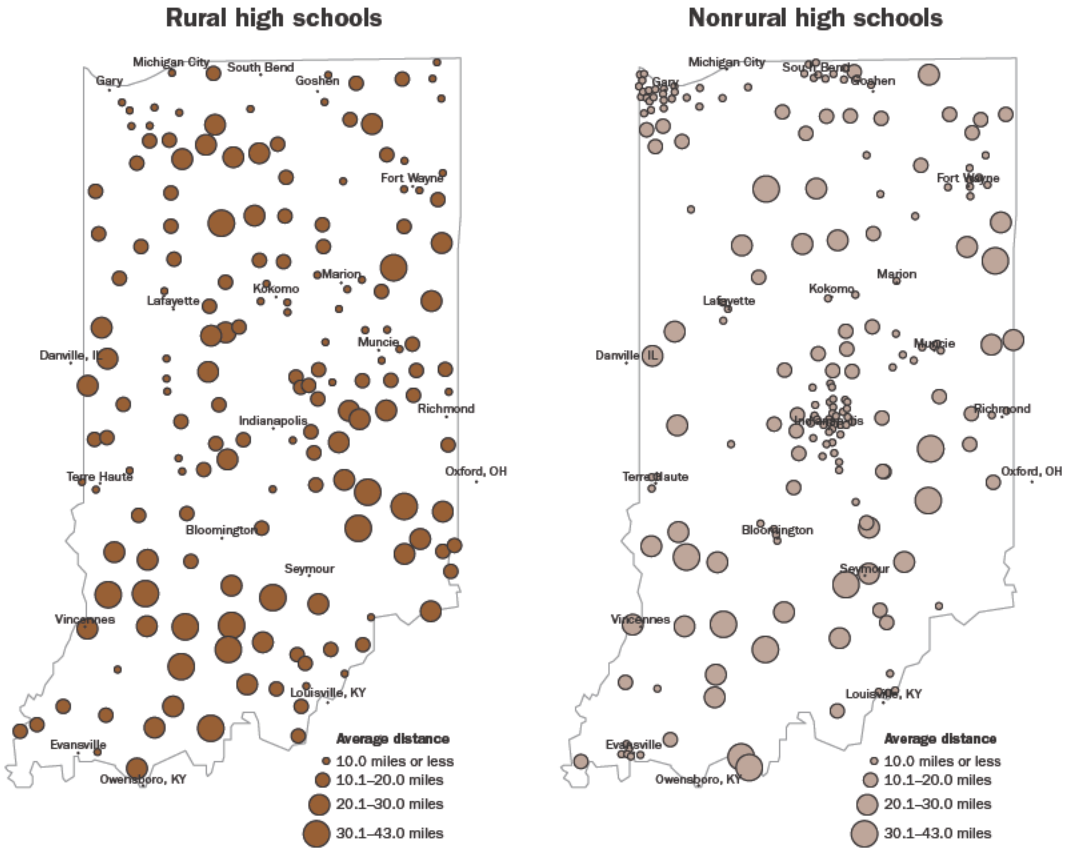
Map C11. Distance (straight line) to the closest two-year college from Indiana rural and nonrural high schools



Note: Each circle represents the location of a high school.

Source: Authors' calculations based on latitude and longitude coordinates of high schools (U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, n.d. b), latitude and longitude coordinates of colleges provided by the Indiana Commission for Higher Education, data from the Indiana state longitudinal data system, and Esri (2013).

Map C12. Distance (straight line) to the closest four-year college from Indiana rural and nonrural high schools



Note: Each circle represents the location of a high school.

Source: Authors' calculations based on latitude and longitude coordinates of high schools (U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, n.d. b), latitude and longitude coordinates of colleges provided by the Indiana Commission for Higher Education, data from the Indiana state longitudinal data system, and Esri (2013).

Appendix D. Additional results from regression analyses

Research question 5 examined the extent to which, once student- and school-level academic, sociodemographic, and distance variables were controlled for, disparities remained between 2010 graduates of Indiana rural and nonrural high schools with respect to enrolling in a two-year rather than a four-year college and undermatching (enrolling in a college less selective than a college for which graduates are presumptively eligible). In addition to rural locale and distance from high schools to college, several control variables were significantly associated with the probability of the two outcome variables. Although these results do not answer the original research question, they do reveal interesting differences in academic and sociodemographic characteristics of the probability of enrollment in two-year rather than four-year colleges and undermatching. (See appendix B for a detailed discussion of the regression models.) These additional results are presented here.

Taking Advanced Placement exams

Two measures of Advanced Placement (AP) exam taking were used: taking and passing at least one AP exam and taking at least one AP exam but not passing any. For the typical student, taking and passing at least one AP exam was associated with a 21 percentage point decrease in the probability of enrolling in a two-year rather than a four-year college. Further, taking at least one AP exam but not passing any was associated with 17.2 percentage point decrease in the probability of enrolling in a two-year rather than a four-year college. This suggests that simply taking an AP exam, regardless of whether a student passes it, is associated with a decrease in the probability of enrollment in a two-year college. These two measures were not significantly associated with undermatching.

Percentage of students passing the grade 10 English end-of-course assessment

At the school level, the percentage of students passing the grade 10 English end-of-course assessment significantly predicted the probability of undermatching. Specifically, a one standard deviation increase in the percentage of students in a high school passing the English end-of-course assessment (which is equal to 13.28 percentage points) was associated with a 2 percentage point increase in the probability of undermatching. This measure was not significantly associated with the probability of enrolling in a two-year rather than a four-year college.

Eligibility for the school lunch program

For the typical student, eligibility for the school lunch program was associated with a 3 percentage point increase in the probability of enrolling in a two-year rather than a four-year college. Furthermore, for the typical rural high school graduate, eligibility for the school lunch program was associated with a 9 percentage point increase in the probability of enrolling in a two-year rather than a four-year college. Eligibility for the school lunch program was not significantly associated with undermatching.

Earning dual credit

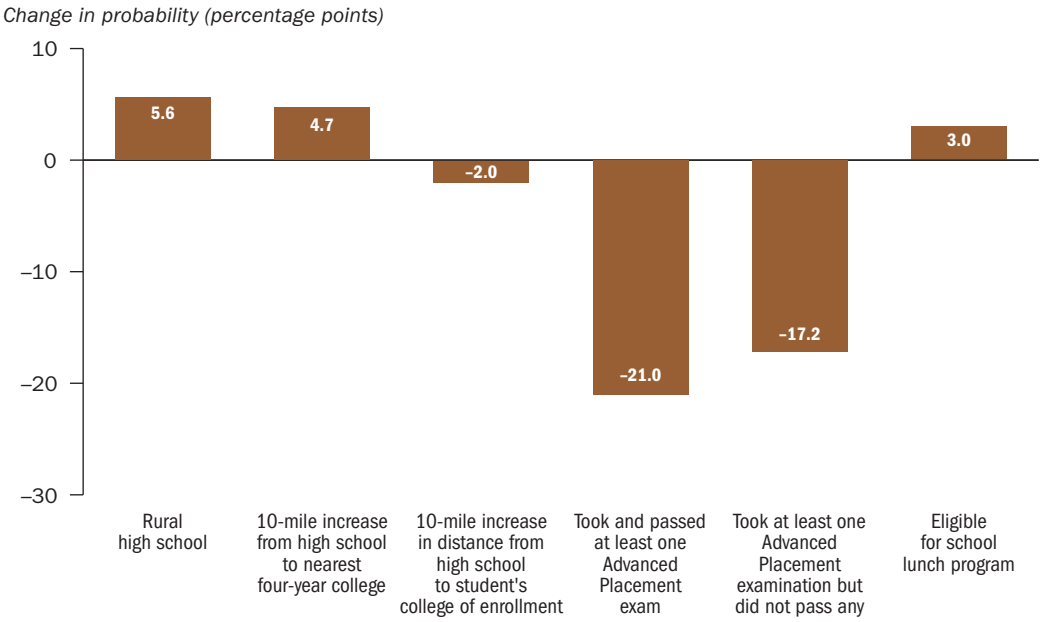
Earning at least one dual credit was significantly associated with the probability of undermatching. For the typical student, there was an 8 percentage point increase in the

probability of undermatching if that student had earned at least one dual credit. Earning at least one dual credit was not statistically significant in predicting enrollment in a two-year rather than a four-year college.

Predicted probabilities for a student's enrolling in a two-year rather than a four-year college and for enrolling in a college undermatched with the student's presumptive eligibility

Figure D1 shows predicted probabilities for a student's enrollment in a two-year rather than a four-year college. Figure D2 shows predicted probabilities for undermatching.

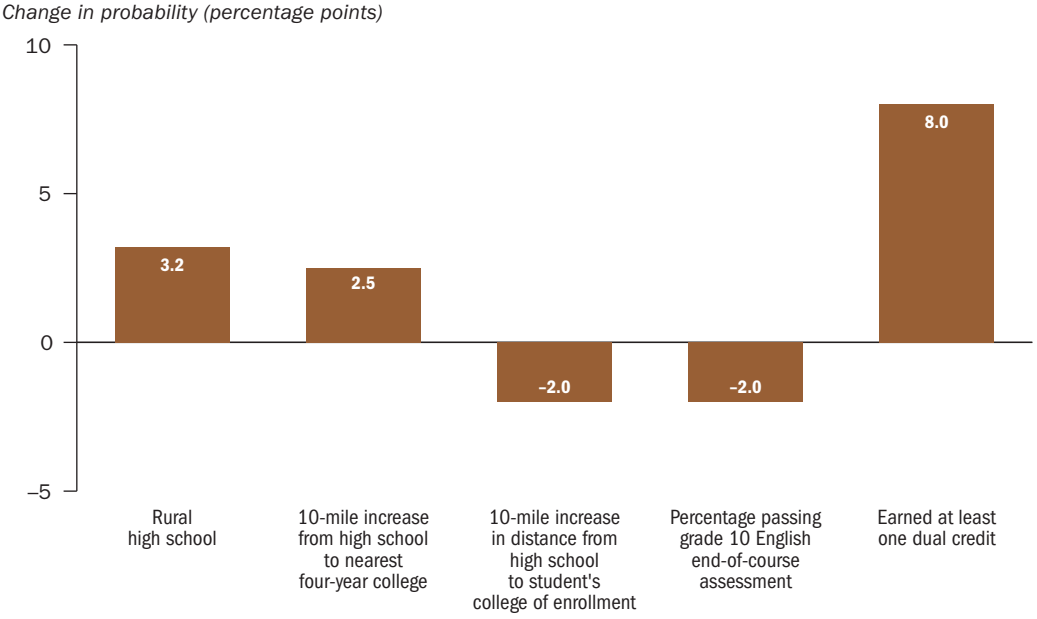
Figure D1. Predicted probabilities of enrolling in a two-year rather than a four-year college for 2010 Indiana high school graduates



Note: Predicted probabilities based on the typical high school graduate—graduate of an average high school with average academic and sociodemographic characteristics. Reference categories for each comparison are rural high schools compared with nonrural high schools; took and passed at least one Advanced Placement exam and took at least one Advanced Placement exam but did not pass any were compared with did not take any Advanced Placement exams; and eligible for the school lunch program was compared with not eligible for the school lunch program. For continuous variables, probabilities were based on a 10-mile increase in distance between the graduates' high school and the nearest four-year college (school-level) and to the graduate's college of enrollment (student-level).

Source: Authors' calculations based on regression models and data from the Indiana state longitudinal data system and U.S. Department of Education (2010).

Figure D2. Predicted probabilities of undermatching for 2010 Indiana high school graduates



Note: Predicted probabilities of undermatching are based on the typical high school graduate—graduate of an average high school with average academic and sociodemographic characteristics. Reference categories for each comparison are rural high school compared with nonrural high school, and earned at least one dual credit was compared with did not earn any dual credits. For continuous variables, probabilities are associated with one 10-mile increase in the distance to the nearest college (school-level) and to the graduate's college of enrollment (student-level), and a one standard deviation increase (13.28 percentage point increase) in the percentage of grade 10 students passing English end-of-course assessment.

Source: Authors' calculations based on regression models and data from the Indiana state longitudinal data system and the U.S. Department of Education (2010).

Notes

1. The rural–nonrural distinction in this report is based on the National Center for Education Statistics urban-centric locale codes (see http://nces.ed.gov/ccd/rural_locales.asp). Locale codes of 11, 12, 13, 21, 22, 23, 31, 32, or 33 (which correspond to cities of different sizes, suburbs of different sizes, and towns within urban clusters) are classified as nonrural. All other locale codes are classified as rural.
2. The grade 10 ISTEP+ math and English language arts assessments make up the Graduate Qualifying Examination, which students must pass to receive a diploma. Since 2009/10, the ISTEP+ has been administered to grades 3–8 and end-of-course examinations have been administered for Algebra I and English 10.
3. Because all predictors were centered on their overall means across all rural and nonrural students, the term "typical" represents an average student in the analytic samples. (See appendix B for a discussion of the predicted probability calculation.)
4. Ivy Tech Community College website, "Student Housing," retrieved April 15, 2014, from http://ivytech.edu/northeast/student-life/housing.html.
5. The U.S. Census Bureau (1994) classifies rural areas as any area with fewer than 2,500 inhabitants that is located outside of an urban area. All other areas are classified as urban. These classifications do not necessarily align with the current study's classification of rural and nonrural.
6. Among students presumptively qualified for a selective four-year college, for example, just 26 percent of those students enrolled in a selective (or very selective) college and 29 percent enrolled in a two-year college or did not enroll in college.
7. Presumptive eligibility was based on the ACT/SAT scores and GPA of the actual college-going population of high school graduates. Because two-year colleges do not require ACT/SAT for admission, those missing ACT/SAT were presumed eligible for two-year colleges, but calculating presumptive eligibility required a valid GPA.
8. Presumptive eligibility ratings do not reflect measures of course rigor because such variables were not included in Indiana's data. At least one previous study examined presumptive eligibility using just SAT scores and GPA (Bowen et al., 2009) and yielded results similar to those of Roderick et al. (2008), the methodology of which was adopted for this study.
9. Rural–nonrural differences in enrollment intensity were not statistically significant after adjustment for multiple comparisons ($p = .0552$).

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Summaries of research findings for specific audiences

Applied Research Methods
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