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Introduction

Research on the effects of financial aid on postsecondary access has garnered the attention of policy makers, academic researchers, and institutional researchers since the 1970s (Jackson & Weathersby, 1975; Paulsen, 1990). The

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focus of financial aid research has changed over time, shifting from early studies of the effects of aid on the overall demand for postsecondary education or college choice, to more focused studies on a range of topics including federal need-based grants (Goldrick-Rab, Harris, & Trostel, 2009; Mundel, 2008), student loans (Heller, 2008; Hossler, Ziskin, Gross, Kim, & Cekic, 2009), state- or foundation-based grant programs (Andrews, DesJardins, & Ranchhod, 2010; DesJardins, 1999; DesJardins & McCall, 2014; DesJardins, McCall, Ott & Kim, 2010; Toutkoushian & Hillman, 2012), institutional merit-aid (DesJardins, 2001; Doyle, 2010; Hossler, et al., 2009; Leeds & DesJardins, In Press; Singell & Stater, 2006), the expectation and timing of aid provision (Chen & DesJardins, 2010; DesJardins, Ahlburg, & McCall, 1999; Kim, DesJardins, & McCall, 2009;), the application process for aid programs (Bettinger, Long, Oreopoulos, & Sanbonmatsu, 2009; Dynarksi & Scott-Clayton, 2006), and the timing at which students receive information about college (Bettinger, et al., 2009; Kalsik, 2012; Perna, 2006). Many studies including Baum and McPherson (2008) and Perna (2010) have concluded that postsecondary access and possibly better student-institutional matching might result from lower-income students having earlier information about their net costs for attending college.

INDIANA'S TWENTY-FIRST CENTURY PROGRAM

One of the most frequently-studied state financial aid programs is Indiana's Twenty-first Century Scholars (TFCS) program. The TFCS program was created in 1989, and is open to all students who are residents of Indiana and eligible for free and reduced price lunch as of middle school. It is a last dollar grant program in that after all federal and institutional financial aid is considered, the State of Indiana provides recipients with whatever funding is needed to cover 100 percent of public college tuition and fees (but not room and board), or an equivalent dollar amount to attend an in-state private institution for up to four years. Thus, it is worth noting that for Scholars attending in-state public institutions there is no cap on the award other than meeting remaining need to cover tuition and fees, whereas at in-state private institutions the award is capped at the maximum the same student would receive to attend an in-state public college or university. For TFCS Scholars who enrolled in public in-state colleges or universities in 2003–04, their TFCS grant varied from $58 to $6,517 with a mean of $2,372.

Ziskin) for managing the dataset and ensuring secure access to the data, Matt DeMonbrun and Kristen Glasener for their help resolving data issues, Todd Schmitz for providing data on enrollments at Indiana institutions, and Asher Rosinger and Kelly Ochs Rosinger for their help compiling the dataset. This project was funded by the Spencer Foundation grant #200800134, with additional financial support from Indiana University, the University of Georgia, and the University of Michigan.

Although students in the TFCS program do not know the exact amount of financial aid that they will receive from the grant at the time they sign up for the program, they know that it will be sufficient to cover tuition and fees at in-state public institutions.

The TFCS program has often been cited as one of the most progressive need-based state scholarship programs in the country. This is because the means test is simple (based solely on eligibility for the federally-funded free and reduced lunch program) and participation is relatively easy (willingness in middle school to sign a document called the TFCS Pledge indicating the student wants to attend college and refrain from drug use and legal problems while in school). Students in grades 6 and 7 at public and private schools who sign the Pledge are referred to as "enrolled Scholars." To successfully complete the program and receive the grant, students must maintain a C average in high school, graduate from an Indiana high school, apply for financial aid to college, and apply to at least one postsecondary institution.[1] Students who complete all of these requirements are then known as "affirmed Scholars."

In addition to grant funding, the TFCS program also provides enrolled Scholars with a range of support services during high school through one of sixteen designated "TFCS centers" located around the state. Each student is assigned to a TFCS center based on the geographic location of their home. Although students can participate in the program without going to their appointed center, there are many additional benefits for those who do utilize their center. The centers provide academic support (e.g., tutoring and counseling) as well as college choice support such as information about college, visits to designated campuses, and assistance with completing college applications.

Policy Context

Against the backdrop of the current public policy environment it is hard to imagine a time when the utility of research on Indiana's TFCS program would be more relevant. The economic downturn beginning in 2008 increased the number of students who are eligible for and making use of federal financial aid (Supiano, 2009). In addition, there is growing concern about the level of loan debt incurred by students (Liberto, 2012; Martin & Lehren, 2012). Not surprisingly, there are calls for major changes in both the Pell Grant Program and federal student loan programs (Bill and Melinda Gates Foundation, 2012). At the same time, many states have had to reduce their

[1]Even though the TFCS Scholars program is referred to as a "need-based" program, there is also a merit component in that students must maintain a C average in high school. A more complete discussion of the typology of state financial aid programs can be found in Delaney and Ness (2011).

state financial aid awards because of declines in state revenue. These factors are converging and there appears to be more openness than at any time since the passage of the Higher Education Act of 1965 (Pub. L. No. 89–329) to consider major changes in the focus and structure of both federal and state aid programs (see, for example, Baum & McPherson, 2008; Lumina Foundation, April 14, 2014).

In this current policy environment, TFCS is an ideal financial aid program to study, because it combines financial aid with early information to students and follow up support to navigate the college choice process. These features of the program are in line with many of the key elements of reforms for federal and state financial aid programs that are being considered by public policy makers. TFCS is regarded as a relatively generous need-based grant program, so research on it can help answer questions on the impact of need-based aid on postsecondary access, choice, and persistence. Likewise, research on TFCS can help policy makers better understand the impact of early interventions on postsecondary access and persistence. This is so because low-income students have to sign up to participate in the TFCS grant program at a relatively young age, and thus they know early on that the price of attending college should not be a barrier for them. TFCS students and their families also receive many non-financial benefits from taking part in the program. For example, enrolled TFCS scholars are regularly provided information about college through a program entitled Learn More (http://www.in.gov/learnmoreindiana/) and the State of Indiana's extensive regional Gear-Up network, and they can get personal assistance preparing for college and selecting an institution through their appointed TFCS center.

Taken together, it is not surprising that the Twenty-first Century Scholars program has already received considerable attention from researchers (see the series of studies conducted by St. John and colleagues from 2000 to 2005). To date these studies provide a rich resource to draw upon and illustrate the importance of creating state longitudinal databases for examining financial aid programs. These prior studies focused on whether affirmed Scholars – i.e., those who fulfilled the TFCS requirements for the grant – made different college choice decisions than all other students. Overall these studies concluded that the TFCS program "…has helped Indiana increase its college access rates remarkably in recent years" (St. John, Gross, Musoba, & Chung, 2005, p.2). St. John, Musoba, Simmons, & Chung (2002), for example, found that 85% of affirmed Scholars went to college compared to 56% of all other students. After controlling for selected observable characteristics of students and the schools they attend, the authors found that students who completed the TFCS program were four to six times more likely than all other students to enroll in college (Musoba, 2004; St. John, et al., 2002; St. John, et al., 2004). That is, when enrolled Scholars did what was required of them to become an affirmed Scholar, they were much more likely than other students to go

to college. It is important to note, however, that the comparison group in these studies consisted of all students who were not affirmed Scholars, which includes students who began the program but did not complete it and students who did not qualify for the program.

Notwithstanding the research of St. John and colleagues, there are two aspects of the TFCS program that require further investigation. The first is regarding how researchers define the treatment effect of the TFCS program. Prior studies focused solely on students who were affirmed Scholars, and not the larger set of enrolled Scholars.[2] This is important because students who are affirmed Scholars may be more motivated to attend college in the first place. This is evidenced by their behavior: affirmed Scholars must have applied for financial aid and admission to college, and thus by definition have taken some of the steps often necessary to go to college. Many students who sign up for the TFCS program do not successfully complete it. In the cohort of students used in our study, for example, of the 7,717 students who enrolled in the TFCS program only about half (3,990) went on to become affirmed Scholars (Policy Brief, n.d.). As a result, the findings for affirmed Scholars may not apply to the broader group of enrolled Scholars. Policymakers need to know whether students who sign up for the program are more likely to go to college than their non-TFCS counterparts because the program is intended to remove the uncertainty about college affordability for students and to provide them with assistance about going to college during middle and high school.

The second aspect of the TFCS program that deserves further attention is the way in which student self-selection into the program may have affected the key findings of prior research. The students who initially signed up for the program may be different from those who did not, and if the reasons for this decision are correlated with any subsequent educational outcomes being examined, then the estimated impact of TFCS participation on college enrollments will be biased (Goldberger, 2008; Heckman, 1990; Heckman & Robb, 1986; Willis & Rosen, 1979). It is likely that students who enrolled in TFCS in middle school were already more predisposed than other students to go to college, or had unobservable characteristics such as motivation to succeed that would affect both their decision to take part in the TFCS program and to enroll in college. Without making appropriate adjustments, we cannot determine if the college-going behavior of students enrolled in the

[2]An argument can be made that it is important to determine whether those students who fulfill the TFCS Pledge are more successful in going to college because the "treatment" includes enrolling in the program and doing all of the other things contained in the Pledge, such as applying to at least one college and applying for financial aid. Nonetheless, it is also important to determine whether participating in the program leads students to do the things that are needed to increase their participation rates in postsecondary institutions.

TFCS program is due to the program itself or unobservable characteristics that led them to take part in the program.

Our study extends the prior research by focusing on whether participating in—rather than completing—Indiana's TFCS program affects the likelihood of students going to college. We created a longitudinal student unit record database of more than 42,000 9th grade students in Indiana in 1999–00 and retrospectively followed them over a 13-year period.[3] The database includes information from a statewide survey of 9th grade students, whether the student enrolled in the TFCS program, as well as socioeconomic data on their communities and their subsequent college enrollment decisions.

Empirically, we first employ binary and multinomial logistic regression to obtain estimates of the impact of taking part in the TFCS program on college enrollments without making adjustments for the self-selection of students into the program. We find that TFCS participants are slightly more likely than similar non-participants to enroll in any type of college. With regard to the type of college attended, the multinomial logistic regression models provide evidence that TFCS participants are also more likely to attend institutions where the scholarship could be used. However, in each case our estimates of the impact of the TFCS program on enrolled Scholars are much smaller than the effects reported by other researchers for affirmed Scholars. We then employed several statistical approaches that include instrumental variables and propensity score weighting to reduce the potential bias due to self-selection into the TFCS program. The results showed that after accounting for self-selection, enrolled Scholars were more likely than non-TFCS Scholars to enroll in college and in particular initially enroll at in-state public 2-year and 4-year institutions. The estimated treatment effects for TFCS participation increased after using instrumental variables techniques; however, the program effects were still notably smaller than what prior research had found. Although each of these approaches has its limitations in our particular application, the resulting analysis provides policy makers with more rigorous estimates than earlier studies of the effects of the TFCS program on the college-going behavior of students.

Theoretical Framework & Previous Research

Theoretical Frameworks

The main theoretical framework that we use for our study is based on the college choice literature and the theory of postsecondary education as an investment in human capital. According to human capital theory, education

[3]Ewell and Boeke (2007) discuss some of the advantages of using state unit record systems for evaluations of student progress.

is a means by which individuals can increase their skills and qualifications that are subsequently rewarded in the labor market (Becker, 1975; Mincer, 1958; Schultz, 1961). Students estimate the direct costs (net tuition) and indirect costs (foregone earnings) they may incur from going to college and compare these to the expected financial benefits they will receive in terms of higher earnings in the future. Financial aid programs may affect a student's demand for attending college in two ways: by raising the expected net benefits of attending college and by increasing the student's ability to pay the net price of attendance. Increases in financial aid should have a positive effect on the likelihood of a student wanting to go to college through each of these mechanisms.

A related strand of theory relates to the various stages that students go through in forming their aspirations for attending college (Hossler, Braxton, & Coopersmith, 1989; Perna, 2006). According to this model, a student begins by forming expectations about whether or not to go to college. After this stage, he or she makes decisions about the types of institutions to consider and perhaps forms an initial choice set. The choice set narrows as the student moves into the application stage, makes the decision of whether to enroll in a college and if so, where. Net price – and hence financial aid – becomes more important as the student moves through these phases. Indeed there is a robust line of research that connects the underlying constructs of human capital theory with studies of the net price of college attendance.

Models of college choice advanced by Hossler and Gallagher (1987), Hossler, et al. (1989), Paulsen (1990), McDonough (1997), Hossler, Schmit, and Vesper (1999), Hamrick and Hossler (1996), and more recently by Kinzie et al. (2004) and Perna (2006) help frame this study and provide additional guidance on the selection of variables. One model that brings both postsecondary participation and persistence together is the nexus model of college advanced by St. John, Paulsen, and Starkey (1996). In this model, the decision to attend college, which college to enter, choice of major, and the decision to persist until graduation is described as a series of choices influenced by student and family background, net price of attendance, as well as experiences while enrolled in postsecondary education.

Financial Aid Research

The links between financial aid and postsecondary decisions of students have been researched using different approaches. One direction, informed by cost-benefit analysis, has led researchers to investigate the effects of different types of aid (grants, loans, work-study) on students' perceived ability to pay. The packaging of financial aid as it relates to college choice for underrepresented students has followed this direction (Nora, 1990; Nora & Horvath, 1989). Though financial aid alone may not remove barriers to success for currently-enrolled students from lower-income families (Stine-

brickner & Stinebrickner, 2003), studies demonstrate that it can have an equalizing effect across racial and ethnic groups (Fry, 2005; Lichtenstein, 2002; Nora, 1990; Perna, 2000; St. John, Paulsen, & Carter, 2005) by removing financial barriers to access, encouraging preparation, and enabling students to focus more fully on academic concerns—though the effects of aid likely vary among different underrepresented racial groups (Chen & DesJardins, 2010; Heller, 1997). Other studies have focused on the determinants of early stages of demand for higher education (DesJardins, Ahlburg, & McCall, 2006; DesJardins, Dundar, & Hendel, 1999; Hossler & Maple, 1993; Hossler & Stage, 1992; Savoca, 1990; Stage & Hossler, 1989; Tierney, 1983; Tierney, Corwin, & Colyar, 2005; Toutkoushian, 2001; Wells, Seifert, Padgett, Park, & Umbach, 2011).

Overall, there is little disagreement that grants can increase postsecondary participation among low income students. In their review of studies of the effect of financial aid on college going and completion, Goldrick-Rab, Harris, and Trostel (2009) conclude that the evidence is clear that grants have a positive impact on postsecondary access. Perna (2010) and Deming and Dynarski (2009) reach a similar conclusion regarding the effects of grants on the postsecondary enrollment of low income students. In addition to having a positive effect on postsecondary access, financial aid has been shown to have an equalizing effect across racial and ethnic groups (Chen & DesJardins, 2010; Lichtenstein, 2002; Nora, 1990; St. John, et al., 2005), not only by removing financial barriers to access, but also by encouraging preparation and enabling students to focus more fully on academic concerns (Heller, 1997; Perna, 2000).

It is worth adding one caveat to this overview of the effects of grants on college access. The studies summarized in this section refer only to federal and state grants. Institutionally-funded grants may have differential effects on students. For example, Singell and Stater (2006) conclude that merit-based grants have an impact on the postsecondary destinations of students, but that these grants do not directly increase a student's propensity to persist, rather the grants attract students who are more likely to persist once enrolled.

PAST RESEARCH ON INDIANA'S TFCS PROGRAM

St. John and colleagues (2000; 2001; 2001; 2002; 2003; 2004; 2005) conducted a series of studies of Indiana's TFCS program. In these studies, the authors focused on whether students who completed all of the requirements of the Twenty-first Century Scholars Program (affirmed Scholars) were more likely to apply for financial aid, enroll in college, and persist in college once enrolled. The authors relied on a longitudinal unit-record database in Indiana that included a cohort of 9th grade students in 1995 who were retrospectively followed through their second year at in-state public colleges and universi-

ties in the state. Their results indicated that these affirmed Scholars were significantly more likely than other students to go to college. The differences in college participation rates between the two groups were remarkable (see Table 7). Affirmed Scholars were four times more likely than other students to enroll at in-state four-year public colleges and six times more likely to enroll at in-state two-year public colleges or in-state private colleges. These studies also concluded that affirmed Scholars were twice as likely as other students to enroll at out-of-state colleges, even though affirmed Scholars are unlikely to go out of state because, by definition, they come from lower-income families and the TFCS grant cannot be used at out-of-state institutions. These earlier studies of the effects of the TFCS program did not focus on the larger set of students who began the TFCS program (enrolled Scholars), rather they concentrated their analysis on the group of students who met all the criteria to become affirmed Scholars (e.g., fill out the FAFSA, apply to at least one college, graduate from high school). This form of sample selection may have biased their results. In addition, the earlier studies did not address the possible bias induced in their results because students self-selected into the program. In our study we remedy these potential sources of bias by focusing on enrolled Scholars and employing methods that can help mitigate any self-selection bias.

Data And Methodology

Dataset Construction

The longitudinal unit record dataset we compiled for this study drew data from several sources. We began with data from a statewide survey conducted in 1999–00 of 9th grade students in the State of Indiana. The survey was administered by LearnMore and sent out to virtually all of the public and private schools in the state in which 9th grade was taught. Each school administered the survey and returned completed surveys to LearnMore.[4] It should be noted that this is the same survey instrument that was used in the previous studies of the TFCS program, but for a later year. The LearnMore survey included questions that captured demographic information on students (e.g., gender, race/ethnicity, family status, age), their post-graduation educational and occupational aspirations, perceived college attendance bar-

[4]Details of the exact number of surveys administered and completed were not tracked by LearnMore. The survey was administered by all public schools in the state and most private schools except for a few very small or specialized private schools. In the Fall 1999 there were 81,049 9th graders in public schools in Indiana (NCES), and an estimated additional 10% to 15% of students enrolled in private schools. Accordingly, the 60,587 returned surveys represents roughly two-thirds of the state's estimated population of 9th graders, and our final analytical sample is close to half of the estimated total.

riers, and so on. One important piece of information that was not collected in the LearnMore surveys, however, was the student's family income.

We augmented the survey information with data from several other sources. We matched survey participants with data from the state about those who enrolled in the TFCS program while in middle school. We then matched the data for each student with information from Claritas, which tracked the socioeconomic characteristics of the neighborhoods (blocks) in which these students lived. The matching was accomplished by mapping each student's home address into Census tracts at the block level using their home address and then combining these data with Claritas data on the blocks within Census tracts.[5] The Claritas dataset contains identifiers for each block and Census tract and other measures useful for our study including the median household income and education level within each Census tract. These data were then matched to data from the National Student Clearinghouse (NSC) to determine which students went to college and where they first enrolled. By using data from the NSC, we can more reliably identify the postsecondary enrollment decisions of students who did not enroll at institutions within the state of Indiana than was possible in previous studies of the TFCS program.[6] Finally, because Indiana University campuses (4-year, in-state public institutions) did not participate in the NSC until 2007, we matched students in the 9th grade survey against enrollment data for Indiana University campuses in Fall 2003, Spring 2004 and Fall 2004. After excluding students with missing data on the variables used in our statistical models, the final dataset consisted of 42,227 observations.[7]

Dependent Variables

The dependent variables used in this study were derived from the initial college enrollment decisions of students. We grouped students into one of seven categories with regard to college: (1) did not attend college, (2) first enrolled in a two-year in-state public institution, (3) first enrolled in any other two-year institution, (4) first enrolled in a four-year in-state public institu-

[5]The matching in this study was accomplished with the help of the programs LinkageWiz (www.LinkageWiz.com) and R.

[6]Due to data limitations, the prior studies of Indiana's TFCS program inferred out-of-state enrollments by assuming students who applied for financial aid but did not enroll at an in-state institution must have enrolled at an out-of-state institution.

[7]In particular, the LearnMore survey had approximately 6,000 missing cases for race/ethnicity, and 10,000 missing cases due to insufficient data on home address, which was needed to match the data to Census tracts. We compared the students who were in the final sample with those who were excluded from final sample, and found that overall the two groups had similar values for the dependent and explanatory variables that we used in the analysis. The only exceptions were that excluded students were several percentage points less likely to attend college and/or be first-generation college students.

tion, (5) first enrolled in a four-year out-of-state public institution, (6) first enrolled in a four-year, in-state private institution, and (7) first enrolled in a four-year out-of-state private institution.[8] Accordingly, the first dependent variable is categorical and represents which of these seven outcomes pertain to each student. This variable captures the type of institution where a student initially enrolled after high school. Recall that the TFCS scholarship can only be used at institutions located within the State of Indiana (groups 2, 3, 4, and 6), and that the scholarship covered a higher proportion of the cost of attendance for students in groups 2 and 4.

The college enrollment decisions were then aggregated in two ways to create dependent variables focusing on access to higher education. The second dependent variable denotes whether the student enrolled at any postsecondary institution, where the variable is equal to one if the student enrolled in any two- or four-year postsecondary institution and zero otherwise. The final dependent variable aggregates the original seven responses into three choices: (1) did not attend college, (2) first enrolled in any two-year institution, and (3) first enrolled in any four-year institution.

Explanatory Variables

The regressors included in the models are grouped into several categories. The first category represents demographic factors for each student, including their gender, race/ethnicity (five categories), age as of 9th grade, whether either of their parents had attended college (three categories), and family status (three categories). The second type of explanatory variable represents academic factors as measured by the student's middle school GPA, estimated from self-reported grades. The third group of control variables relate to the geographic location where each student resides. Geographic location and SES were operationalized by the median income and education level of families within each census tract, and a set of sixteen dichotomous variables for the TFCS center to which each student in the state was assigned. Finally, the main variable of interest in this study is a dichotomous variable indicating whether the student signed up for Indiana's TFCS program during middle school.

[8]We would like to thank two anonymous referees for helping us identify the groupings of college enrollment options. We combined all other 2-year institutions into one category due to the small number of students in more detailed categories. It should be noted, however, that some students within this category who attended two-year, in-state private institutions may have been able to use the TFCS scholarship to cover some portion of tuition and fees.

STATISTICAL MODELS

Logistic Regression Models

For each of the three dependent variables, we began with a series of logistic regression models of the form:

$$(1) \qquad Y = \alpha + \delta T + \boldsymbol{X\beta} + \varepsilon$$

where Y = college enrollment variable of interest, T = treatment variable (T=1 if an enrolled Scholar, else 0) with coefficient δ, $\boldsymbol{X}$ = a set of personal, family, and geographic control variables with coefficients β, and ε represents a random error term. When Y is dichotomous we used binary logistic regression to estimate the parameters in β, and when Y consisted of more than two categorical outcomes we used multinomial logistic regression. Estimating this equation via logit/probit techniques gives rise to what is often called a "naïve estimate" for the impact of T on Y, because it does not control for the factors influencing a student's decision to enroll in the TFCS program. All standard errors were clustered at the Census tract level to account for the nested structure of students within neighborhoods and provide more conservative estimates of the TFCS treatment effect.

The logistic regression models are similar in structure to what was used in prior studies of the TFCS program. However, when employing this naïve statistical approach the estimated effect of the TFCS treatment may be biased due to the self-selection of students into the program. Selection into the TFCS program could be due to at least two mechanisms. The first is that only students from lower-income families (i.e., eligible for free or reduced price lunch) may participate. The naïve logistic regression models are estimated for the entire sample, thus many of the students in the sample are not eligible for the treatment. Including all students in the analysis may lead to biased estimates of the effect of TFCS program participation because the counterfactual ("all non-TFCS participants") includes many students who could not have received the treatment. The second mechanism is that even among students who are eligible for the TFCS program, participation is voluntary and thus may be affected by unobservable factors such as motivation to succeed. If these unobservable factors are also correlated with the decision to go to college, then estimates of the effect of TFCS participation (δ) on college enrollment will be biased. We employ two different strategies to try to reduce this potential bias: propensity score weighting (PSW) and instrumental variables (bivariate probit, Heckit two-step, and control function models).

Propensity Score Weighting

As noted above, TFCS eligibility is conditional upon a student being from a lower-income background. Due to this restriction, TFCS students may be systematically different than their non-TFCS counterparts and the outcomes of interest may be a function of these baseline discrepancies. One method to address this issue, known as propensity score matching, relies on matching techniques where students in the treated and non-treated groups are matched based on similarities in their estimated probabilities of being treated ($e(z)$). A related approach, known as propensity score weighting (PSW), involves using the propensity score as weights to create a balanced sample in "which the distribution of measured baseline covariates is independent of treatment assignment" (Austin, 2011, p. 408). The main advantage of PSW is that these weights are used in a similar form to survey sampling weights thus allowing researchers to use these weights with a variety of statistical models.[9]

In this study we used PSW to fit multinomial models where, conditional on the weights applied, the only empirical difference in the predictors of interest was TFCS status. The object of PSW is to minimize differences in these two groups by weighting the non-treated group by the estimated probabilities (propensities) of being in the treatment group. Using regression methods, these propensities for treatment ($e(z)$) are calculated based on the observable characteristics of all students, and then converted into weights as follows:

$$(2) \qquad w(x) = \begin{cases} 1 & \text{if } T = 1 \\ k \ \frac{e(z)}{1 - e(z)} & \text{if } T = 0 \end{cases}$$

where k is a normalized constant that will cancel out in the outcomes analysis (Ridgeway, McCaffrey, Morral, Burgette, & Griffin, 2014).

After the weighting has been applied to the non-treated group, on average the treated and non-treated participants should be similar based on their observable characteristics ($\boldsymbol{X}$):

$$(3) \qquad E(X \mid T=1) = w(X)\, E(X \mid T=0)$$

This is known as the balancing assumption ($x \perp T|e(z)$), where conditional on the propensity of treatment, the treatment assignment (T) is independent of participants' characteristics ($x = \boldsymbol{X}$), which results in treated and non-treated participants having similar (post-matching) observed characteristics. If the balancing assumption holds, then we can compare the average outcomes for the treated and untreated groups to determine the average treatment effect:

[9]Although other balancing methods are available, several of which we used as a sensitivity check, the weighting approach provided us with the flexibility to mirror the specifications used in the 2SLS approach (for more details about matching methods see Becker & Ichino, 2002; Reynolds & DesJardins, 2009; Rubin, 1973; Rubin & Thomas, 2000).

$$(4) \qquad E\{Y_1|e(z), T=1\} - E\{Y_0|e(z), T=0\} = E\{Y_1 - Y_0|e(z)\},$$

where enrolled Scholars ($T = 1$) and other students ($T = 0$) are selected and matched based on $e(z)$ and their outcomes (Y_i) compared (Agodini & Dynarski, 2004; Reynolds & DesJardins, 2009; Rosenbaum & Rubin, 1983).

Instrumental Variables

In this study we used three instrumental variable techniques to remedy the possible self-selection (endogeneity of TFCS participation) issue.[10] The first approach is a bivariate probit model, which is an instrumental variable technique that is used in instances where the dependent variable and treatment variable are both dichotomous. The bivariate probit model is a standard maximum likelihood approach where the selection and outcome equations are estimated simultaneously. The second approach is a two-step estimator known as the Heckit model. This is a limited information maximum likelihood approach where instrumental variables are used to identify the equation (see Cerulli, 2011). Finally, we also used a control function model which is an IV approach where the residuals from the first-stage equation are calculated and then used as explanatory variables in the second-stage equation. The control function model is more flexible than the previous two IV approaches because the first-stage equation can be parametric or semi-parametric (see Bielby, House, Flaster, & DesJardins, 2013). Together, these three techniques give us a range of estimates to test the sensitivity of the findings to the particular way in which we used instrumental variables to better isolate the effect of TFCS participation on college enrollment.

All three IV approaches can be applied in a straightforward manner when the dependent variable is binary (Y=enroll, not enroll). However, the bivariate probit and Heckit models cannot be directly used to estimate parameters of interest when the dependent variable consists of more than two possible outcomes. Accordingly, for these dependent variables we estimated a series of binary models for each distinct outcome (such as Y=enroll in a two-year, in-state public institution) relative to the base outcome (Y=not enroll). The resulting average marginal effects for these models represent the probability of a TFCS student enrolling in a specific type of institution relative to non-TFCS students.[11]

The instrumental variable that we used in each of these three models is the distance from each student's home to their assigned TFCS center. The State of Indiana established sixteen TFCS centers around the state to provide

[10]Anderson (2005) provides a thorough discussion of the evolution of these two methods. Interested readers are also referred to Baum, Schaffer & Stillman (2010), Baum (2008), and Cerulli (2011).

[11]The average marginal effects were found by calculating the marginal effects for each individual on a case-by-case basis, and then averaging across the sample.

a range of supplemental support services (such as tutoring, mentoring, and help in preparing for college) for enrolled Scholars. Each student in the state is assigned to one of these centers based on geographic location. We hypothesize that there will be a negative relationship between this distance and a student's likelihood of enrolling in the TFCS program, because as the distance increases, it would be more difficult for students to go to the center and take advantage of the various support services offered by the program to participants (Alfonso, 2006; Card, 1995; Long & Kurlaender, 2009). The TFCS center to which a student is assigned will possibly have an effect on their likelihood of enrolling in the program if the centers differ in their perceived quality and convenience to TFCS participants. In addition, because the centers work with schools to recruit eligible students for the program, differences in the intensity and quality of recruitment efforts by centers could further contribute to the effects of centers on selection into the TFCS program.

Our instrumental variable was evaluated via the assumptions associated with a valid instrument as proposed by Angrist, Imbens, and Rubin (1996). We employed a series of ad hoc and formal tests of these assumptions in this study, the results of which are summarized in the Appendix. First, we used a first-stage (Angrist & Pischke, 2008) F-test to determine if there was evidence of weak instrument problems. Using the F-test criteria, for each model estimated there was no evidence of a weak instrument. We also employed a conditional likelihood ratio test as another check on the weak instrumental variable issue. In five out of nine models, we were able to reject the null hypothesis of a weak instrument.[12] In three of the four instances where we could not reject the null hypothesis, the sample sizes were relatively small for the outcome of interest (such as enrolled in a four-year out-of-state public institution), which affected the power of the test. Finally, we conducted a test to determine whether the treatment variable was endogenous. In ten of the eighteen models, we were able to reject the null hypothesis that the treatment variable was exogenous at the 10% significance level or lower, and in most of the remaining models the dependent variable had relatively few cases. Overall, we conclude that the instrumental variable models successfully passed the majority of tests and were particularly better for the categories of the dependent variable with more observations.

Results

Table 1 contains the means for the key variables used in our analysis. The first nine rows provide information about the dependent variables in our models and the subsequent rows detail the explanatory variables used in the models. We found that 62% of the students in our sample enrolled in college

[12]The conditional likelihood ratio test is not applicable for the control function model.

after graduating from high school, and among those who attended college, more than 70% initially chose a four-year institution. The most popular enrollment choices for students in the cohort were four-year public in-state institutions (30%), followed by two-year in-state public institutions (15%). For the treatment variable, about 8% of the students participated in the TFCS program. Interestingly, only 34% of the students in the sample reported that at least one of their parents graduated from a 4-year college and 41% of the sample lived in non-traditional families (i.e., did not reside with both birth parents). Both of these factors are important correlates of TFCS participation.

TABLE 1.

DESCRIPTIVE STATISTICS

Variable	*Mean*	*Standard Deviation*
Dependent Variables—Initial Enrollment In:		
All Other	3.2%	—
Four-Year Institution	44.1%	—
Public, In-State	30.4%	—
Public, Out-of-State	2.9%	—
Private, In-State	6.7%	—
Private, Out-of-State	4.1%	—
Explanatory Variables:		
Hispanic	2.0%	—
Other Race	10.3%	—
Live w/Both Parents	59.0%	—
Live w/Mother	14.2%	—
Live w/Other	26.9%	—
Parental Ed: College	34.0%	—
Parental Ed: No College	48.1%	—
Parental Ed: Unknown	17.9%	—
Middle School GPA	2.93	0.79
Median Income	$49,531	$18,297
Median Education	12.85	0.87

Notes: Sample size = 42,227. Totals may not add up to 100% due to rounding.

To begin our focus on the TFCS program, we broke down the means for the college enrollment variables separately for TFCS participants and all other students. We found that overall TFCS participants were, on average, just as likely as non-participants to enroll in college. However, enrolled Scholars were 4.5 percentage points more likely than other students to attend two-year institutions, and 3.6 percentage points less likely to attend four-year institutions. Table 2 presents differences in the means for the key explanatory variables between TFCS participants and all other students:

Table 2.

Breakdown of Selected Variables by TFCS Participant Status

Variables	*TFCS Participant*	*Non-TFCS Participant*	*Diff*	*Non-TFCS Participant PSW*	*Diff*
Dependent Variables—Initial Enrollment In:					
Any Institution	63.3%	62.3%	+1.0%		
Two-Year Institution	22.5%	18.0%	+4.5%***		
Public, In-State	20.1%	14.8%	+5.3%***		
All Other	2.4%	3.2%	-0.8%**		
Four-Year Institution	40.8%	44.4%	-3.6%***		
Public, In-State	30.9%	30.4%	+0.5%		
Public, Out-of-State	1.7%	3.0%	-1.3%***		
Private, In-State	6.0%	6.7%	-0.7%		
Private, Out-of-State	2.2%	4.3%	-2.1%***		
Explanatory Variables:					
Male	41.5%	49.9%	-8.4%***	42.10%	-0.50
Age	14.78	14.81	-0.03***	14.78	0.00
White	66.8%	82.0%	-15.1%***	66.06%	-0.20
Black	18.1%	5.0%	+13.0%***	17.9%	0.20
Asian	0.6%	0.9%	-0.3%	0.6%	0.00
Hispanic	3.6%	1.9%	+1.7%***	3.4%	0.20
Other Race	10.9%	10.2%	+0.7%	10.05%	-0.10
Live w/Both Parents	38.0%	60.7%	-22.7%***	38.3%	-0.20
Live w/Mother	31.9%	12.7%	+19.2%***	31.5%	0.30
Live w/Other	30.2%	26.6%	+3.6%***	30.2%	-0.10
Parent Ed: No College	57.7%	47.3%	+10.4%***	57.5%	-0.20
Parent Ed: Unknown	22.8%	17.5%	+5.3%***	22.2%	0.40
Parent Ed: College	19.5%	35.2%	-15.7%***	19.8%	-0.30
Middle School GPA	2.89	2.93	-0.04**	2.88%	0.01
Median Income	$41,126	$50,023	-$8,969***	$41,133	-$118.0
Median Education	12.61	12.87	-0.26***	12.61	0.00

Notes: Sample size = 42,227. Two-sample t-tests assuming equal variances. *p<.05, **p<.01, ***p<.001. Percentages may not add up to 100% due to rounding.

There are many (average) differences between students in the two groups. In particular, we found that enrolled Scholars were more likely than other students to be female, non-Hispanic black, live in a single-parent household with only their mother, not have college-educated parents, and/or have lower middle school grades. With the exception of gender, each of these factors would tend to reduce the likelihood of students enrolling in college. The last two columns in Table 2 indicate that once the propensity score weights were employed, the differences in observable variables between TFCS participants and non-participants disappeared.

In Table 3 we present the results from the binomial and multinomial logistic regression models for enrolling in college, where we do not account for the possible self-selection of students into the TFCS program. In the first column (Model 1) the dependent variable is whether the student enrolled in any postsecondary institution. The next three columns (Model 2) contain the findings where the dependent variable has three possible outcomes: no college, enroll in a two-year institution, or enroll in a four-year institution. All coefficients have been converted to average marginal effects for consistency and ease of interpretation.

Beginning with the non-TFCS treatment variables, although there were no gender differences in the overall college-going rate, males were more likely than females to enroll at four-year institutions. Older students were less likely than younger students to enroll in college at any level, which perhaps reflects students who were held back in school by their parents or school administrators. Black students were about 6% more likely than white students to enroll in college after controlling for other personal characteristics; however, the positive effect was concentrated in two-year institutions. A student's family status was another significant predictor of college enrollment. Students who live with both parents were 7% more likely to go to college and 9% more likely to enroll in four-year institutions. Interestingly, students who lived alone with their mother were also more likely than the reference group to go to college. Turning to parental education, students who did not report having a college-educated parent were themselves 7% less likely to go to college, with the largest drop off found for enrolling in four-year institutions. Not surprisingly, students with higher grades in middle school were significantly more likely than their peers to enroll in college. We found a quadratic relationship between middle school GPA and the likelihood of a student enrolling at a two-year institution, with the probability of enrolling in a two-year institution maximized at a GPA of 2.21.

With regard to the main variable of interest, we found that most of the differences in two- and four-year college participation rates between those who took part in the TFCS program and non-participants were due to differences in observable factors. After adding control variables for the fixed effects of neighborhoods, enrolled Scholars were 2.4% more likely than non-participants to enroll in any institution. When we broke the dependent variable out into three categories, we found that TFCS participants were most likely to initially enroll in two-year institutions.

In Table 4, we report the findings of the effect of TFCS treatment on enrollment in college using four techniques that account for the self-selection of students into the program. As a point of comparison, the first column repeats the average marginal effects from the logistic regression models in Table 3, where no selection adjustment was made. The second column contains the

TABLE 3.

EFFECTS OF TFCS PARTICIPATION ON COLLEGE ENROLLMENT—NO SELECTION ADJUSTMENT

	Model 1: Y = First Enrolled in Any Institution	*Model 2: Y = Enrolled in*		
		Not Enrolled	*Two-Year*	*Four-Year*
TFCS Enrolled	0.024**	-0.026**	0.014*	0.011
	(0.009)	(0.008)	(0.007)	(0.008)
Male	-0.008	0.008	-0.033***	0.025***
	(0.004)	(0.004)	(0.004)	(0.004)
Age	-0.088***	0.092***	-0.021***	-0.070***
	(0.005)	(0.005)	(0.004)	(0.005)
Asian	-0.024	0.035	-0.032	-0.003
	(0.025)	(0.027)	(0.024)	(0.022)
Black	0.061***	-0.053***	0.074***	-0.021
	(0.010)	(0.011)	(0.008)	(0.011)
Hispanic	-0.049**	0.047**	-0.021	-0.027
	(0.016)	(0.016)	(0.015)	(0.017)
Other Race	-0.032***	0.033***	0.007	-0.040***
	(0.007)	(0.007)	(0.006)	(0.007)
Live w/Both Parents	0.072***	-0.072***	-0.017***	0.089***
	(0.005)	(0.005)	(0.005)	(0.005)
Live w/Mother	0.031***	-0.031***	0.008	0.023**
	(0.007)	(0.007)	(0.006)	(0.008)

Table 3, Cont.

	Model 1: Y = First Enrolled in Any Institution	*Model 2: Y = Enrolled in*		
		Not Enrolled	*Two-Year*	*Four-Year*
Parents Ed: No College	-0.067***	0.060***	0.033***	-0.093***
	(0.005)	(0.005)	(0.005)	(0.005)
Parents Ed: Unknown	-0.072***	0.065***	0.026***	-0.091***
	(0.006)	(0.006)	(0.006)	(0.006)
Middle School GPA	0.143***	-0.255***	0.225***	0.031
	(0.020)	(0.023)	(0.019)	(0.024)
GPA Squared	0.003	0.019***	-0.051***	0.033***
	(0.004)	(0.004)	(0.003)	(0.004)
Median Income	0.007***	-0.006**	-0.003	0.008***
	(0.002)	(0.002)	(0.002)	(0.002)
Median Schooling	0.014***	-0.013**	-0.001	0.014***
	(0.004)	(0.004)	(0.004)	(0.004)
Log Likelihood: Null	-28561		-44726	
Log Likelihood: Model	-25265		-38589	
Pseudo R^2	0.115		0.137	

Notes: Sample size for each model is n=42,227. Logistic regression analysis was used for Model 1 (Y=enrolled, not enrolled), and multinomial logistic regression analysis was used for Model 2 (Y = not enrolled, enrolled 2-year, enrolled 4-year). Coefficients for all variables are reported as average marginal effects. Standard errors are shown in parentheses and are clustered at the census tract level (1,289). Each model also included fixed effects for the assigned TFCS center. Reference group for race is 'Non-Hispanic white.' Reference group for family living status is 'Live in any other arrangement.' Reference group for generation status is 'Not first-generation college student.' Median income and median education are measured at the census tract level. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

estimated average treatment effect for TFCS participation using the bivariate probit model. The findings from the Heckit two-step link function are presented in the third column. In the fourth column, we display the TFCS effects using the control function approach. Recall that these three options address self-selection employing an instrumental variables technique. The last column presents the estimates obtained using propensity score weighting.

We found that the signs and significance levels for the TFCS participation variable were fairly consistent across the different methods used in this study. Beginning with the first row, the average marginal effects of TFCS participation on enrollment in any college were statistically significant and ranged from 2% for logistic regression up to 21% using the control function approach. Although the PSW results were the most similar to the logistic regression results since they each rely only on observable variables to make comparisons between groups, the PSW models found that enrollment in the TFCS program had the largest impact on attending a four-year institution. Focusing on the last three rows in the table, we see that TFCS participants were still more likely than non-TFCS participants to enroll in two-year institutions after taking self-selection into account.

In Tables 5 and 6 we repeat the analyses for the case where the dependent variable consists of seven possible categories. Accordingly, this model focuses on whether participation in the TFCS program affects the *type* of institution first attended by a student. The analysis is particularly important because the TFCS grant can only be used to attend institutions in the State of Indiana, and the percentage of tuition covered by the scholarship varies by type of institution. Again, all results are presented as average marginal effects. Table 5 results were obtained from a multinomial logistic regression where no adjustments were made for the self-selection of students into the TFCS program. In Table 6, we examine whether the impact of TFCS participation on the type of institution selected is robust when we employ the IV and matching techniques discussed above.

The findings in Table 5 reveal that, prior to adjusting for self-selection, TFCS participants were 2.4% more likely than non-TFCS participants to enroll at two-year in-state public institutions and 4.2% more likely to enroll at four-year in-state public institutions. Similarly, TFCS participants were also 1.1% more likely than non-TFCS participants to attend in-state private institutions, and less likely to go out-of-state where the scholarship could not be used. In Table 6, the average marginal effects from the PSW model were similar to the multinomial logistic regression model in both magnitude and significance levels. Turning to the IV results, we found that for the most part the average marginal effects of TFCS participation were similar in sign and significance levels across the IV methods we used. One exception to this finding was for 2-year, in-state public institutions where the treatment

TABLE 4.

EFFECT OF TFCS PARTICIPATION ON COLLEGE ENROLLMENT—ADJUSTING FOR SELECTION

Effect of TFCS on:	*No Adjustment*	*Bivariate Probit (IV)*	*Heckit Two-Step (IV)*	*Control Function*	*Propensity Score Weighting*
Attend Any Institution[1]	0.024**	0.128**	0.137*	0.213***	0.038***
	(0.009)	(0.046)	(0.055)	(0.047)	(0.009)
Not Attend College[2]	-0.026**	n/a	n/a	-0.200***	-0.039***
	(0.008)			(0.046)	(0.010)
Attend Two-Year Institution[2]	0.014*	0.168*	0.179*	0.089*	0.006
	(0.007)	(0.078)	(0.073)	(0.041)	(0.009)
Attend Four-Year Institution[2]	0.011	0.106	0.078	0.112*	0.034**
	(0.008)	(0.070)	(0.060)	(0.052)	(0.011)

Notes: Sample size for each model is n=42,227. 1Logistic regression analysis was used (Y=enrolled, not enrolled). 2Multinomial logistic regression analysis was used (Y = not enrolled, enrolled 2-year, enrolled 4-year). Coefficients for all variables are reported as average marginal effects. Standard errors are shown in parentheses and are clustered at the census tract level (1,289). Standard errors were bootstrapped (200 reps) for the control function model. All models controlled for the same set of explanatory variables as shown in Table 3. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

TABLE 5.

EFFECT OF TFCS PARTICIPATION ON TYPE OF INSTITUTION ATTENDED—NO SELECTION ADJUSTMENTS

	Not Attend College	*Attend 2-Year Institution: In-State Public*	*Other 2-Year*	*Attend 4-Year Institution: In-State Public*	*Out-of-State Public*	*In-State Private*	*Out-of-State Private*
TFCS Enrolled	-0.030***	0.024***	-0.015***	0.042***	-0.013**	0.011*	-0.019***
	(0.008)	(0.006)	(0.004)	(0.008)	(0.004)	(0.005)	(0.005)
Male	0.013**	-0.031***	0.005**	0.003	-0.002	0.010***	0.002
	(0.004)	(0.003)	(0.002)	(0.004)	(0.002)	(0.002)	(0.002)
Age	0.094***	-0.012***	-0.005**	-0.057***	-0.009***	-0.005*	-0.007***
	(0.005)	(0.003)	(0.002)	(0.005)	(0.002)	(0.002)	(0.002)
Asian	0.034	-0.051*	0.012	0.033	0.002	-0.047**	0.018*
	(0.028)	(0.025)	(0.009)	(0.022)	(0.008)	(0.015)	(0.008)
Black	-0.042***	0.057***	0.011**	-0.031**	0.027***	-0.024**	0.003
	(0.011)	(0.007)	(0.004)	(0.011)	(0.004)	(0.008)	(0.005)
Hispanic	0.057***	-0.040**	0.012*	-0.019	0.009	-0.005	-0.013
	(0.015)	(0.014)	(0.005)	(0.018)	(0.007)	(0.010)	(0.008)
Other Race	0.038***	0.004	0.006*	-0.040***	0.002	-0.016***	0.006
	(0.007)	(0.006)	(0.003)	(0.008)	(0.003)	(0.005)	(0.003)
Live w/Parents	-0.066***	-0.006	-0.009***	0.051***	0.000	0.023***	0.007**
	(0.005)	(0.004)	(0.002)	(0.005)	(0.002)	(0.003)	(0.003)
Live w/Mother	-0.028***	0.014**	-0.007**	0.013	0.000	0.001	0.007
	(0.007)	(0.005)	(0.003)	(0.008)	(0.003)	(0.005)	(0.004)

Table 5, Cont.

	Not Attend College	*Attend 2-Year Institution: In-State Public*	*Other 2-Year*	*Attend 4-Year Institution: In-State Public*	*Out-of-State Public*	*In-State Private*	*Out-of-State Private*
Parents Ed: No College	0.057***	0.033***	-0.003	-0.037***	-0.016***	-0.015***	-0.020***
	(0.005)	(0.004)	(0.002)	(0.005)	(0.002)	(0.003)	(0.002)
Parents Ed: Unknown	0.059***	0.027***	-0.002	-0.034***	-0.015***	-0.016***	-0.018***
	(0.006)	(0.005)	(0.003)	(0.006)	(0.003)	(0.004)	(0.003)
Middle School GPA	-0.215***	0.176***	0.033***	0.130***	-0.014	-0.052***	-0.058***
	(0.022)	(0.016)	(0.008)	(0.027)	(0.011)	(0.014)	(0.008)
GPA Squared	0.012**	-0.041***	-0.007***	0.002	0.005**	0.017***	0.012***
	(0.004)	(0.003)	(0.002)	(0.005)	(0.002)	(0.002)	(0.001)
Median Income	-0.006**	-0.002	-0.000	0.009***	-0.000	0.000	-0.002*
	(0.002)	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
Median Schooling	-0.014**	0.001	-0.002	0.007	0.007***	-0.007***	0.008***
	(0.004)	(0.003)	(0.001)	(0.004)	(0.001)	(0.002)	(0.001)
Log Likelihood: Null	-64981						
Log Likelihood: Model	-58339						
Pseudo R^2	0.102						

Notes: Sample size =42,227. Multinomial logistic regression analysis was used (Y = not enroll, 2-year in-state public, all other 2-year, 4-year in-state public, 4-year out-of-state public, 4-year in-state private, 4-year out-of-state private). Coefficients for all variables are reported as average marginal effects. Standard errors are shown in parentheses and are clustered at the census tract level (1,289). Each model also included fixed effects for the assigned TFCS center. Reference group for race is 'Non-Hispanic white.' Reference group for family living status is 'Live in any other arrangement.' Reference group for generation status is 'Not first-generation college student.' Median income and median education are measured at the census tract level. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

TABLE 6.

EFFECT OF TFCS PARTICIPATION ON TYPE OF INSTITUTION ATTENDED—ADJUSTING FOR SELECTION

Effect of TFCS on:	*No Adjustment*	*Bivariate Probit (IV)*	*Heckit Two-Step (IV)*	*Control Function*	*Propensity Score Weighting*
No College	-0.030***	n/a	n/a	-0.243***	-0.041***
	(0.008)			(0.042)	(0.010)
Two-Year Institutions:					
In-State Public	0.024***	0.219**	0.236**	0.044	0.024**
	(0.006)	(0.076)	(0.074)	(0.037)	(0.008)
All Other	-0.015***	-0.060	-0.081	-0.032	-0.017***
	(0.004)	(0.032)	(0.055)	(0.017)	(0.003)
Four-Year Institutions:					
In-State Public	0.042***	0.229***	0.222***	0.237***	0.050***
	(0.008)	(0.053)	(0.064)	(0.050)	(0.010)
Out-of-State Public	-0.013**	0.065	0.137**	0.104***	-0.010***
	(0.004)	(0.042)	(0.049)	(0.024)	(0.002)
In-State Private	0.011*	-0.116***	-0.137*	-0.074**	0.011**
	(0.005)	(0.021)	(0.063)	(0.024)	(0.004)
Out-of-State Private	-0.019***	-0.037	-0.007	-0.035*	-0.016***
	(0.005)	(0.022)	(0.057)	(0.015)	(0.003)

Notes: Sample size for each model is n=42,227. Dependent variable Y = not enroll, 2-year in-state public, all other 2-year, 4-year in-state public, 4-year out-of-state public, 4-year in-state private, 4-year out-of-state private. Coefficients for all variables are reported as average marginal effects. Standard errors are shown in parentheses and are clustered at the census tract level (1,289). Standard errors were bootstrapped (200 reps) for the control function model. All models controlled for the same set of explanatory variables as shown in Table 3. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

effect was positive and significant using the bivariate probit and Heckit approaches but insignificant using the control function method. Similarly, the TFCS treatment effect for 4-year, out-of-state institutions was insignificant using the bivariate probit model but positive and significant with the other self-selection approaches. Overall, the IV results were similar in sign and significance level to the naïve models, except for 4-year institutions that were not in-state public. These differences are possibly attributed to the relatively small group of students in our sample who enrolled out-of-state or at in-state private institutions, and the issues we encountered with the IV tests for these specific groups. Accordingly, the findings for subgroups other than in-state public institutions should be viewed with caution.

To see how our results compare to prior studies of the TFCS program, in Table 7 we present selected findings from the TFCS study conducted by St. John et al. (2002) along with our results. The study by St. John and colleagues was conducted using multinomial logistic regression (without adjustments for self-selection) for a cohort of 9th grade students in 1995–96. To make our estimates comparable to this study, we recalculated the effects of the TFCS variable in terms of odds ratios rather than average marginal effects. It should also be noted that the study by St. John et al. did not control for the exact same student- and school-level characteristics as our current study.

Nonetheless, the comparison in Table 7 provides some insight into how the definition of the TFCS treatment affects the conclusions drawn about the program's effectiveness. The table shows that the odds ratios we obtained for enrolled TFCS Scholars were substantially smaller than the odds ratios for affirmed TFCS Scholars reported in the study by St. John et al. For example, although St. John and colleagues found that affirmed TFCS Scholars were more than twice as likely as other students to attend out-of-state institutions, we found that as expected enrolled TFCS Scholars were less likely to go out of state because the TFCS grant cannot be used at institutions outside of Indiana. After adjusting for self-selection using bivariate probit analysis, our estimated odds ratio for enrolled TFCS Scholars attending in-state, public 4-year institutions increased to 2.56, but was still notably smaller than reported in the St. John et al. study. The contrast in findings is not surprising given that affirmed TFCS Scholars are a select subset of enrolled TFCS Scholars who have by definition done many of the things necessary to go to college.

SUMMARY AND DISCUSSION

In this study, we employed a number of different statistical approaches to determine whether participating in Indiana's TFCS program affects the college going rates of students and the choices they make as to where to go to college. One of the key distinguishing features of our study of the TFCS program is that we focused on those students who signed up for, rather

Table 7.

Comparison of Odds Ratios for TFCS Variable on Type of Institution Attended—No Selection Adjustment

Institution Type:	*Odds Ratios for: Affirmed TFCS Scholars*[a]	*Enrolled TFCS Scholars*[b]
Two-Year Institutions:		
In-State Public	6.374***	1.252***
Out-of-State	n/a	0.703***
Four-Year Institutions:		
In-State Public	4.432***	1.216***
In-State Private	6.126***	1.309**
Out-of-State Public	n/a	0.684*
Out-of-State Private	n/a	0.695**
Any Out-of-State	2.549***	n/a

Notes: [a]Results for affirmed TFCS Scholars were obtained from St. John et al. (2002). Data are for a cohort of 9th graders in 1995. Multinomial regression model controlled for gender, race/ethnicity, parental education, family status, middle school grades, postsecondary plans, school location, percent of minority students in school, and percent of Honors diploma grads in school. [b]Results for enrolled TFCS Scholars were taken from multinomial regression model shown in Table 5 after converting average marginal effects to odds ratios. None of the models reported here adjust for the self-selection of students into the TFCS program. n/a = model was not estimated. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

than completed, the TFCS program. In so doing, our study broadens our understanding of how the program is affecting the postsecondary decisions of students who are eligible for the program. The analysis presented here is also important because we demonstrate how to take into account the self-selection of students into a program such as TFCS.

Overall, we found that students who participated in Indiana's TFCS program were slightly more likely than non-TFCS participants to enroll in college. The estimates of program effects indicated that TFCS participants were 2.4% more likely than non-participants to enroll in college. When we controlled for the possible self-selection of students into the program using instrumental variables, the average marginal effects were positive and larger than in the logistic models (ranging from 13% to 21%), but were still notably smaller than the effects for affirmed TFCS Scholars reported in prior research on the program. Likewise, when we decomposed the enrollment variable into multiple groups we observed that TFCS participants were more likely to choose in-state public institutions where the TFCS grant could be used. Accordingly, the program appears to have a modest impact on both access and choice for lower-income students in the state.

The effects of TFCS participation on college enrollment and type of institution attended were substantially smaller than the very large positive effects reported in earlier studies of the TFCS program. The different results are

most likely attributed to the way in which the treatment group was defined in these studies. Prior studies of the TFCS program focused on only those students who completed all of the requirements to become affirmed Scholars, meaning, among other things, that they graduated from high school, applied to at least one college, and applied for financial aid. Not surprisingly, these students who did what was required to fulfill the TFCS Pledge and become affirmed Scholars had much greater odds of going to college than other students. In contrast, our analysis prior to accounting for self-selection showed that the gains in college participation rates are much smaller when the larger set of TFCS participants is considered, only about half of whom did what was required to become affirmed Scholars. Even after we adjusted the model for self-selection, the average marginal effects were not close to what had been reported by previous researchers for affirmed Scholars.

Accordingly, an important aspect of the TFCS program that deserves additional attention is the attrition of enrolled Scholars during high school. Data from the state consistently shows that roughly half of the students who initially sign up for the TFCS program do not fulfill all of the requirements needed to become affirmed Scholars. If the large effects of the TFCS program from prior studies are not due to self-selection, then it could be concluded that those students who begin the program and do what is required to complete it are very successful in gaining access to postsecondary education. As a result, , the relatively small effects that we found for enrolled TFCS Scholars might be improved by determining when and how these students are lost in the pipeline and finding ways to help them become affirmed Scholars. However, it is also possible that the effects of TCFS are modest, and that affirmed scholars are students who were already motivated to attend college at the time they enrolled. This would not necessarily negate the value of TCFS, as it would still enable low income students to graduate with reduced levels of debt thus having an impact on equity. It would, nevertheless, raise questions about the efficacy of TCFS as having a strong impact on postsecondary encouragement and access.

It is important to note that there were a number of limitations that we faced in the course of conducting this study. Due to insufficient data, it was challenging to control for the effects of differences in students that might have affected their selection into the TFCS program. In particular, the dataset does not include information on each student's family income. At that time the State of Indiana did not keep data on students who were eligible for free and reduced lunch, which was the key variable used for identifying eligibility for the program. The best that could be done in our study was to add control variables for the average income and educational level of residents in the Census tract where a student resides, as well as parental educational attainment and family living status.

Another limitation is that the dataset does not contain information on which TFCS participants became affirmed Scholars. We do not know which components of the TFCS program were completed by students, the extent to which they utilized the services at the TFCS centers, or how much financial aid they would receive from the TFCS grant. Without this information, we could not conduct a more precise test of whether the effects of the TFCS program differ for enrolled Scholars versus affirmed Scholars, how student self-selection affects the results for affirmed Scholars, or how the dosage of the treatment affects the decisions of students. Because student eligibility is only determined at the time that students sign up for the program, it is likely the case that most of the TFCS participants who enrolled at in-state institutions received the grant. However, there will also be other students who were affirmed Scholars and decided to either not attend college or to attend an institution where the TFCS grant could not be used. Future studies of the TFCS program would benefit by obtaining detailed data on the experiences of all students who enrolled in the TFCS program, as well as the free/reduced price lunch status of all students in the cohort.

The creation of the longitudinal database was hampered by the fact that we did not have unique identifiers for matching students across databases. We therefore had to employ probabilistic matching based on self-reported data on names, birth date, address, gender, and phone number, and could not match every student in the 9th grade sample. Nonetheless, the matching technique we used resulted in more than 80% reliable matches between the 9th grade survey and the census tract data. Similarly, the reliance on self-reported data introduces concerns for data validity and accuracy that could not be assessed or corrected through other means. However, several researchers have found that student self-reported data is generally accurate and useable for studies such as this one (Gonyea, 2005; Laing, Sawyer, & Noble, 1988).

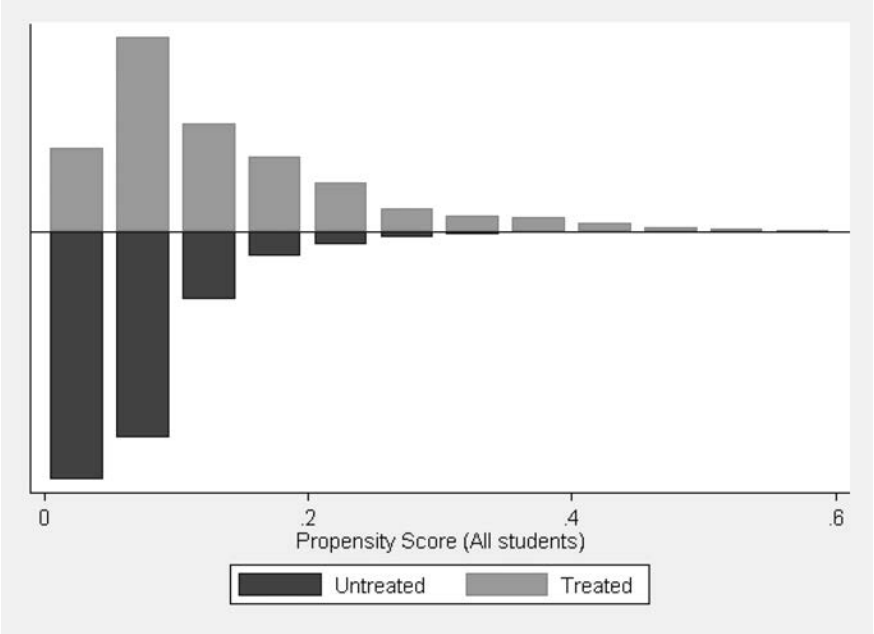
Within the limitations of this study, the results provide interesting insights into the role of need-based financial aid programs in affecting access to higher education and college choice for students from lower-income families. A number of states have introduced broad-based financial aid programs to help improve access to higher education and entice more students to attend college within the state's boundaries. These programs vary considerably in characteristics such as the size of the grant, where the grant may be used, who is eligible for the grant, when eligibility is determined, whether additional support services are provided to students, and the conditions that students must meet to receive and keep the grant. Programs such as TFCS have particular combinations of these attributes, making it difficult to isolate the effect of any one feature of the program on students. All that can be concluded from the results presented here is that this specific combination of program attributes had a very modest positive effect on access to higher education. It is therefore important to pursue research that will help policy

makers identify how features of broad-based financial aid programs affect the choices made by students.

The results from this study to some extent echo the work of Hossler, et.al. (2009) in which the authors conclude that grants may only have a modest impact upon student persistence. Studies such as this can provide insights into the complex impact of growing up in lower-income families. It lends more credence to theories such as social reproduction theory and the roles of social and cultural capital (Rowan-Kenyon, 2007; Wells, 2008; Wells, Seifert, Padgett, Park, & Umbach, 2011) in the development of postsecondary aspirations and college completion. If financial aid does not play a major role in equalizing postsecondary enrollment and graduation, these are important empirical insights into research on status attainment.

APPENDIX

Figure A1. Common support across all the different PSW specifications shown in Tables 4 and 6.



All students

All common support figures corresponding to each specification indicate enough overlap between treated and control participants to confirm the feasibility of conducting comparisons based on PSW principles. Nonetheless, it is interesting to note that with all the covariates in the models we can only successfully identify people in the upper end of the distribution with at most a 60% propensity toward TFCS participation. This suggests there may be other covariates that may be influencing the identification of these participants that are not captured by our variables, thus creating the need to rely on other methods such as instrumental variables.

TABLE A1.

RESULTS FROM INSTRUMENTAL VARIABLES TESTS

Outcome Groups for Y	*Estimation Method*	*Group Comparison*	*First Stage F-Test*[1]	*Conditional Likelihood Ratio Test*[2]	*Endogeneity Test H_0: Exogenous*[3]
0 = Not Enrolled	Bivariate Probit & Heckit	Group 1 vs. 0	28.90	15.34 vs. 4.07	p = .001
1 = Enrolled	Control Function	Group 1 vs. 0	96.94	n/a	p = .008
1 = Not Enrolled	Bivariate Probit & Heckit	Group 2 vs. 1	40.22	15.70 vs. 3.84	p = .001
2 = Enrolled 2-Year	Control Function	Group 2 vs. 1	96.94	n/a	p = .049
3 = Enrolled 4-Year	Bivariate Probit & Heckit	Group 3 vs. 1	22.94	3.09 vs. 3.56	p = .185
	Control Function	Group 3 vs. 1	96.94	n/a	p = .172
1 = Not Enrolled	Bivariate Probit & Heckit	Group 2 vs. 1	42.40	18.07 vs. 3.84	p = .001
2 = 2-Year Public In-State	Control Function	Group 2 vs. 1	96.94	n/a	p = .000
3 = All Other 2-Year	Bivariate Probit & Heckit	Group 3 vs. 1	34.79	3.03 vs. 3.84	p = .216
4 = 4-Year Public In-State	Control Function	Group 3 vs. 1	96.94	n/a	p = .342
5 = 4-Year Public Out-of-State	Bivariate Probit & Heckit	Group 4 vs. 1	25.22	28.04 vs. 3.62	p = .001
6 = 4-Year Private In-State	Control Function	Group 4 vs. 1	96.94	n/a	p = .001
7 = 4-Year Private Out-of-State	Bivariate Probit & Heckit	Group 5 vs. 1	33.81	1.00 vs. 4.01	p = .353
	Control Function	Group 5 vs. 1	96.94	n/a	p = .278
	Bivariate Probit & Heckit	Group 6 vs. 1	39.31	5.01 vs. 3.71	p = .033
	Control Function	Group 6 vs. 1	96.94	n/a	p = .039
	Bivariate Probit & Heckit	Group 7 vs. 1	38.72	1.11 vs. 3.73	p = .337
	Control Function	Group 7 vs. 1	96.94	n/a	p = .524

Notes: [1]First Stage F-test rule of thumb: If calculated F statistic exceeds 10, then there is no evidence of weak instrument. [2]Conditional Likelihood Ratio Test: First number is the calculated test statistic; second number is the 95% critical value. If calculated test statistic > critical value, there is no evidence of weak instrument. [3]Endogeneity test: Null hypothesis is that Twenty First Century Scholar variable (the "treatment") is exogenous. When the p-value is significant, this provides evidence that the treatment variable is endogenous.

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