Do Performance-Based Funding Policies Affect Underrepresented Student Enrollment?

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October 2017

The Version of Record of this manuscript has been published on March 1, 2018 and is available in *The Journal of Higher Education* at https://www.tandfonline.com/doi/full/10.1080/00221546.2018.1434282.

Keywords: Performance funding, finance, accountability, enrollment, equity

Abstract: More states are using performance-based funding (PBF) systems in an effort to incentivize public colleges to operate more effectively. Responding to concerns about equity, states are also adopting provisions that encourage colleges to serve more students who at risk of not completing college. In this paper, I examine whether PBF policies in general—and more specifically policies that have provisions designed to incentivize colleges to enroll underrepresented students—are associated with the number of lower-income, underrepresented minority, and adult students enrolled at four-year public colleges. Using a generalized difference-in-difference framework, I find little evidence that PBF systems as a whole meaningfully affect underrepresented student enrollment. However, the presence of bonuses for serving at-risk students appears to help mitigate any efforts to enroll a more advantaged student body that may be present in other PBF systems.

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Building upon the last several decades of high-stakes accountability policies in K-12 education, public colleges and universities in many states are increasingly subject to pressures from policymakers to improve their performance (Deming & Figlio, 2016; Kelchen, 2018). One reason for heightened accountability pressures is that the price tag of attending public colleges has risen far above the rate of inflation over the last several decades, with listed tuition and fee prices quadrupling at four-year public colleges since 1981 (Ma, Baum, Pender, & Welch, 2016). At the same time, state funding for higher education has kept up with inflation, but has not kept up with a rapid rise in enrollment (State Higher Education Executive Officers, 2017).

In addition to being frustrated by the rising price tag of public colleges, many state policymakers are also concerned about the effectiveness of their higher education institutions. Graduation rates at public colleges have slowly risen over the last decade while most institutions continue to enroll a higher share of students who need assistance paying for college (Snyder, de Brey, & Dillow, 2016). However, these increases in graduation rates have often been insufficient in the eyes of state policymakers who question whether colleges are using taxpayer dollars in an efficient manner (e.g., Murray, 2011).

These concerns about the efficiency and effectiveness of public institutions have encouraged state legislators to change how colleges and universities are funded. Traditionally, states funded colleges and universities based on a combination of prior allocations and student enrollment (Layzell, 1999). Over the last several decades, a growing number of states have adopted performance-based funding (PBF) policies that tie at least a portion of state appropriations to outcome measures such as course progressions and the number of credentials completed.

As of 2015, approximately 37 states have adopted some version of PBF (National Conference of State Legislatures, 2015), with seven states tying at least ten percent of all higher education appropriations to outcome metrics (Snyder & Fox, 2016). Despite the growing political popularity of PBF, a growing body of empirical research has found these programs have at best generated very modest improvements in student outcomes (e.g. Hillman, Fryar, & Crespin-Trujillo, 2017; Hillman, Tandberg, & Fryar, 2014; Hillman, Tandberg, & Gross, 2015; Rabovsky, 2012; Rutherford & Rabovsky, 2014; Sanford & Hunter, 2011; Shin, 2010; Tandberg & Hillman, 2014; Tandberg, Hillman, & Barakat, 2014).

At the same time, multiple studies have found that colleges are responding to the incentives given by PBF programs in ways that are not intended—and often not desired—by policymakers. The initial round of PBF systems that focused on graduation rates or degree completions provided colleges with an incentive to become selective in order to gain more funds (Shulock, 2011), but many of the more recently-implemented policies gave colleges additional incentives for graduating low-income and at-risk students in an effort to reduce efforts to game the system (McKinney & Hagedorn, 2017; National Conference of State Legislatures, 2015). However, both quantitative and qualitative research has found evidence that colleges have responded to PBF systems by becoming more selective in admissions and changing institutional financial aid practices in order to recruit well-prepared students (Dougherty, Jones, Lahr, Natow, Pheatt, & Reddy, 2016; Kelchen & Stedrak, 2016; Umbricht, Fernandez, & Ortagus, 2017).

The existence of unintended consequences of state PBF systems raises concerns about the ability of academically qualified low-income, underrepresented minority, and adult students to access public higher education. This is a particular concern for students seeking to access selective public colleges given the larger labor market returns to attending these institutions

(Dale & Krueger, 2011; Hoekstra, 2009) and the prevalence of disadvantaged students attending colleges that are less selective than they could attend given their test scores (e.g., Belasco & Trivette, 2015; Hoxby & Turner, 2013; Smith, Pender, & Howell, 2013). PBF systems that include equity components are designed to help reduce these concerns.

Yet no research to this date has examined whether the presence of equity provisions in performance funding systems has affected the numbers of low-income, underrepresented minority, and adult students enrolled in public colleges and universities. This is an increasingly important question as PBF systems continue to proliferate and become higher-stakes. In this paper, I explore the following research questions:

(1) To what extent is there a relationship between a state having a performance-based funding (PBF) policy in place and the number of low-income, underrepresented minority, or adult students enrolled at four-year public colleges?

(2) To what extent is there a relationship between whether a state's PBF policy provides a bonus for serving underrepresented students and the number of low-income, underrepresented minority, or adult students enrolled at four-year public colleges?

(3) Do these relationships vary by institutional selectivity?

Literature Review

The first performance-based funding system was introduced in Tennessee in 1979 and allowed colleges to receive up to two percent in additional funds if they met five performance metrics. Tennessee's system added performance metrics for persistence and completion in 1993,

raising the potential amount of bonus funds to 5.45% of total funding (Banta, Rudolph, Van Dyke, & Fisher, 1996). Other states began to adopt PBF systems in the 1990s, with the number of states using performance funding rising from seven in 1995 to 19 in 2001 (Dougherty & Natow, 2015). Most of these systems had a small percentage of bonus funding tied to a sizable number of performance metrics, factors that led to the abandonment of many of these systems during the early 2000s recession that strained state budgets amid changes in political leadership (Dougherty & Natow, 2015; Dougherty, Natow, & Vega, 2012).

Although a small number of states adopted PBF policies during the mid-2000s, the largest expansion of PBF to date has occurred since 2011 (Jones, 2013). Between 2011 and 2015, at least 24 more states have adopted PBF policies, supported by a new wave of conservative legislatures, governors, and influential foundations such as the Lumina Foundation and the Bill and Melinda Gates Foundations (Bill and Melinda Gates Foundation, 2015; Dougherty & Natow, 2015; Gandara, Rippner, & Ness, 2017; Li, 2017; Lumina Foundation, n.d.; Miller & Morphew, 2017). Most of the new PBF policies (sometimes called PBF 2.0 or outcomes-based funding) tie base funding to performance instead of only using bonus funds in an effort to make these programs more fiscally sustainable and to induce colleges to change their behaviors.

The theory of action behind PBF programs is principal-agent theory (Spence & Zeckhauser, 1971), in which state governments (the principal) attempt to hold colleges (the agents) accountable for their outcomes by using a performance contract. These types of performance contracts have become quite popular in publicly-funded organizations, even though their effectiveness in improving outcomes is generally modest (Gerrish, 2016). The inherent assumption present in PBF is that colleges are not operating efficiently and that the promise of additional funds under increased monitoring can generate an improvement in performance.

Resource-constrained public colleges have an incentive to meet the goals of state performance funding systems under resource dependency theory (Aldrich & Pfeffer, 1976), so there is a reason to expect that colleges will strive to meet performance funding goals if they are able to do so unless these goals significantly differ from the institution's mission.

A growing body of qualitative research has shown that some colleges are in fact reacting to performance funding in desired ways. There is evidence that colleges subject to PBF are improving student advising and using new predictive analytic tools to help facilitate students' success (Dougherty, Jones, Lahr, Natow, Pheatt, & Reddy, 2016; Dougherty & Reddy, 2011; Li & Zumeta, 2016; Rabovsky, 2012) even if they are not reallocating large amounts of funds across functional expense categories (Kelchen & Stedrak, 2016; Rabovsky, 2012). However, colleges that serve large numbers of low-income students frequently report that their capacity to make large-scale changes is often limited due to a lack of resources to support new data systems or staff members (Dougherty & Natow, 2015; Hillman, 2016; Jones, 2014).

Many of the early peer-reviewed studies evaluating whether PBF programs improved student outcomes used retention or graduation rates as the outcome of interest, with generally null findings (Rabovsky, 2012; Rutherford & Rabovsky, 2014; Sanford & Hunter, 2011; Shin, 2010). The next wave of quantitative studies used the number of completions as the key outcome of interest, as this metric better reflected the overarching public policy goal of increasing the number of adults with postsecondary credentials. Again, most of the peer-reviewed empirical research did not find a strong link between PBF policies and the number of credentials awarded by four-year institutions (Hillman et al., 2017; Hillman, Tandberg, & Gross, 2014b; Li, 2016; Rabovsky, 2012; Tandberg & Hillman, 2014; Tandberg, Hillman, & Barakat, 2014). Yet there is

some evidence that longstanding PBF programs are associated with increased degree completions (Tandberg & Hillman, 2014).

In addition to the intended effects of PBF policies on colleges' practices, PBF also generates some unintended effects that may be undermining state public policy goals. A key concern is *cream skimming*, in which the agent attempts to take the easiest route possible in order to meet its required performance standards. Cream skimming has been repeatedly shown to exist in fields such as K-12 education and public administration (e.g., Courty, Kim, & Marschke, 2011; Figlio & Stone, 2001). In higher education, early PBF systems provided incentives for colleges to become more selective or strategically allocate financial aid dollars in an effort to enroll students with a higher likelihood of completion and not enroll students who are less likely to complete (Kelchen & Stedrak, 2016; Shulock, 2011).

As research has shown the potential for cream skimming, both organizations advocating for PBF and researchers generally consider providing bonus funds for underrepresented student success to be a best practice to help reduce incentives for colleges to become more selective to meet performance metrics (e.g., Cielinksi & Pham, 2017; Lumina Foundation, n.d.; Miller, 2016; Snyder & Fox, 2016). This has led a number of states to build provisions into their performance funding systems that explicitly reward colleges for successfully serving underrepresented students such as Pell recipients, adult learners, and racial/ethnic minority students. An example of this is Indiana, which allocated 15% of its PBF funds (or 0.9% of total state funding) in fiscal year 2015 based on a measure of "at-risk" completions that focuses on low-income students. This includes $1,500 for a certificate, $3,000 for an associate degree, or $6,000 for a bachelor's degree (Indiana Commission for Higher Education, n.d.).

Questions remain as to whether these at-risk student bonuses are sufficiently large to curb colleges' incentives to become more selective. For example, Indiana provides a far larger bonus for on-time bachelor's degree completion ($23,000) or a degree in a high-impact field ($20,000) than the bonuses for at-risk student success described above (Indiana Commission for Higher Education, n.d.). Quantitative research by Umbricht et al. (2017) found that Indiana's public colleges became more selective following the state's adoption of PBF, although minority enrollment did not significantly decrease in most of their model specifications. Two studies interviewing public college officials in states with high-stakes PBF systems and bonuses in place for serving at-risk students (Dougherty et al. (2016) in Indiana, Ohio, and Tennessee and Minckler (2016) in Ohio) also concluded that colleges were changing their admissions and financial aid practices to become more selective in spite of the safeguards in place in these systems. Yet no research has examined at a national level whether states with bonuses for underrepresented student success are associated with increased enrollment levels—the focus of this study.

Data, Methods, and Sample

To examine whether the presence of a performance-based funding system (with and without a bonus for serving at-risk students) affects enrollment levels of at-risk students, I constructed an eleven-year panel dataset on performance funding systems and at-risk student enrollment combined with information about state-level and institutional-level conditions during the same period.

Data

I used data on states' performance funding policies from the 2004-05 to 2014-15 academic years, with the starting date of 2004-05 chosen to cover the new wave of performance funding systems that began in the late 2000s and due to difficulties determining exact details of PBF systems in prior years. I used two different independent variables to capture the presence and design of a state's PBF system, based on a combination of prior reports and research on the topic (e.g., Dougherty & Natow, 2015; Gorbunov, 2013; Kelchen & Stedrak, 2016; National Conference of State Legislatures, 2015; Synder & Fox, 2016; Tandberg & Hillman, 2014) and analyses of states' performance funding documents. The first metric is a binary indicator for whether a state had a performance-based funding system in place and funded in a given year. The second metric—and one of the key contributions of my study—is an indicator for whether a state attempts to encourage colleges to enroll underrepresented or at-risk students. I constructed this metric by examining each state's PBF system to see whether there were incentives in place for four-year colleges to successfully enroll or graduate low-income, minority, and/or adult students.

As summarized in Table 1, only two states (Indiana and Tennessee) of the ten states with PBF systems in the 2004-05 academic year had provisions in place encouraging colleges to serve at-risk students. By 2015-16, 16 of the 28 states with PBF had these provisions, with most of the provisions having been added to state PBF policies between 2011 and 2014. Roughly half of these states provided incentives for graduating underrepresented students, while the other half provided enrollment incentives.

[Insert Table 1 here]

I considered three types of metrics of the number of underrepresented students enrolled at a particular college: lower-income, underrepresented minority, and adult students, with all data elements coming from the U.S. Department of Education's Integrated Postsecondary Education Data System (IPEDS) and being logged so results can be interpreted as percentage point changes. When available, I used metrics for both first-time students (to see if PBF affected student recruitment and enrollment management) and all undergraduate students (to also capture any potential changes in student retention and transfer).

The first economic diversity metric is the number of undergraduate students receiving Pell Grants, which was first available in the 2007-08 academic year and better reflects colleges with large percentages of part-time and transfer students than the first metric that includes just first-time, full-time students. For the entire length of the panel, I used the number of first-time, full-time students receiving federal grant aid, which is strongly correlated (over 0.95) with Pell receipt in later years of the panel. Beginning in the 2008-09 academic year, I also used the number of first-time, full-time in-state students receiving any grant aid and having family incomes in the $0-$30,000 and $30,001-$75,000 per year income brackets.

To examine racial/ethnic diversity, I used the number of underrepresented minority students (African-American, Hispanic, Native American, and multiracial) enrolled in a given year. This is available for both all undergraduates and first-time students for the full length of the panel, although the multiracial category was first included in IPEDS in the 2010-11 academic year. I also used the numbers of African-American and Hispanic students separately to explore whether the effects of PBF may differ by race or ethnicity. Fewer states appear to explicitly reward colleges for successfully serving minority students than low-income students due to political concerns (e.g., Gandara, 2016), but this is still an important metric to consider as

colleges are acutely aware of issues of racial/ethnic diversity. Finally, I used the number of all undergraduates age 25 or older as a measure of adult student enrollment (this measure is not available for first-time students). This definition is used by states such as Tennessee and Ohio to provide bonus metrics in their PBF systems (National Conference of State Legislatures, 2015). Because colleges are only required to report age distributions to IPEDS in odd-numbered years, I interpolated using the average of the two closest years if data were missing in even-numbered years.

For each of these three types of underrepresented students, I also included enrollment numbers of traditionally well-represented students (all of which are from IPEDS) as a check to see whether colleges are creaming by enrolling students who tend to have a higher probability of completion. The first metric is the number of undergraduate students who did not receive Pell Grants, which is a proxy for the number of students from middle-income and upper-income families. I derived this measure by subtracting the number of Pell recipients from the number of undergraduate students enrolled in the fall semester that was reported on the IPEDS student financial aid survey. This number is nearly identical to the result gained from dividing the number of Pell recipients by the percentage of Pell recipients, providing confidence that the number is correct. The second metric is the number of white and Asian first-year and undergraduate students as a proxy for non-underrepresented minority students. This excludes students with an unknown race/ethnicity and international students. Finally, I included the number of undergraduates who were age 24 or younger as a proxy for the number of traditional-age students. Because I used the number of students in these categories instead of the percentage of students, it is possible for both majority and minority students to see gains under PBF if the policy encourages enrollment or retention across the board.

My control variables (also summarized in Table 2) included a number of state-level factors that prior research has shown to affect college pricing and students' ability to pay and added predictive power to my regression models. The first set of factors reflects state funding for higher education. The largest portion of state funding is appropriations for higher education, and a body of empirical research shows a strong link between appropriations and in-state tuition rates (e.g., Delaney & Doyle, 2011; Koshal & Koshal, 2000; Rizzo & Ehrenberg, 2004). This measure is represented here as logged state appropriations per full-time equivalent (FTE) undergraduate student.[1] For colleges in a parent-child reporting relationship (e.g., Jaquette & Parra, 2014), I assumed equal per-FTE appropriations across the parent and child institutions.

I also controlled for logged state grant aid per young adult as a measure of additional funding made available to potential students. I constructed this measure using data from the National Association of State Student Grant Aid Programs (NASSGAP) combined with the number of young adults between ages 18 to 24 from the Census Bureau. I supplemented this measure with the percentage of state grant aid to undergraduate students that was based on financial need, with this percentage also coming from the annual NASSGAP survey. This captures whether a college is in a state with a large need-based or merit-based grant program, which could potentially affect which types of students a college enrolls. These metrics, along with all financial variables, were adjusted for inflation into 2014 dollars using the Consumer Price Index.

To capture a college's ability to set tuition (which could affect tuition prices and thus whether underrepresented students are able to attend a particular college), I used a set of state-level surveys on tuition and fee policies conducted by the State Higher Education Executive Officers Association. These surveys were given to state higher education fiscal officers in the

2005-06, 2010-11, and 2012-13 academic years, with the most recent year of available data used in between available observations.[2] I used variables for whether a state had caps in place on tuition and fees, as prior studies have found that tuition caps have not been effective in slowing tuition increases while fee caps have reduced fees but increased tuition (Kelchen, 2016; Kim & Ko, 2015). I also used SHEEO data to control for state governance structures, creating variables for whether the governor/legislature, coordinating or system board, or individual institutions had the primary authority for setting tuition. This is an important control variable as colleges with more latitude to set their own prices tend to set higher prices than colleges subject to centralized governance structures (Flores & Shepherd, 2014; Kim & Ko, 2015; Knott & Payne, 2004).

Finally, I controlled for other state-level factors that can affect college pricing separate from a performance-based funding system. I used data on logged per-capita state income (from the Bureau of Economic Analysis), the percentage of residents in poverty (from the Census Bureau) and average unemployment rates from the Bureau of Labor Statistics) to capture the percentage of potential college students with financial need as well as the state's ability to raise funds for higher education (e.g., Jaquette, Curs, & Posselt, 2016; Rizzo & Ehrenberg, 2004). I also included metrics of partisan control of the state House, Senate, and governor's office using data from Klarner (2015) and the National Conference of State Legislatures. Political balance has been shown to affect both tuition and appropriations, factors which affect underrepresented student enrollment numbers (e.g., Doyle, 2012; Tandberg, 2010; Weerts & Ronca, 2012) and the likelihood of adopting a PBF system (Li, 2017).

An additional variable of interest is institutional selectivity, as more-selective colleges may have the ability to respond to a performance funding system in different ways than less-selective colleges that can do relatively little to shape their incoming class. I used the Barron's

(2009) competitive index, which is a function of standardized test scores, high school grade point averages, and the percentage of students admitted, as a proxy for selectivity. Colleges in the very competitive, highly competitive, and most competitive categories are classified as more selective, while all other colleges are classified as being less selective.

Methods

To answer my research questions, I used generalized difference-in-difference panel regressions using three different groups of colleges: those subject to a PBF system with a financial component encouraging underrepresented student enrollment in a given year (at-risk PBF), those subject to a PBF system without an at-risk component (other PBF), and those not subject to PBF (no PBF). This resulted in four different sets of contrasts with different treatment and comparison groups: any PBF versus no PBF, at-risk PBF versus no PBF, at-risk PBF versus other PBF, and other PBF versus no PBF. The first contrast is the one commonly presented in the literature on performance funding, while the other three contrasts allow for more nuanced examinations as to whether the characteristics of performance funding systems affect the observed relationships with at-risk enrollment levels.

Following the general structure of Belasco, Rosinger, and Hearn (2015) and Tandberg, Hillman, and Barakat (2014), my analytic model was the following for college *i* in year *t*:

$$Y_{it} = \beta_0 + \beta_1(Treat * Post)_{it} + \beta_2 Approp_{it} + \beta_3 X_{it} + \lambda_i + \mu_t + \epsilon_{it}, \quad (1)$$

where Y represents the outcome variables—the logged number of low-income, underrepresented minority, or adult students enrolled in a given year (so results can be interpreted as percentage point changes). The key coefficient of interest is β_1, which reflects the coefficient on the

difference-in-difference model and allows for the treatment to take place across multiple time periods instead of in the single time period under a typical difference-in-difference model. This can be represented as the following:

$$\beta_1 = \left(Y_{Treat(post)} - Y_{Treat(pre)}\right) - \left(Y_{Comp(post)} - Y_{Comp(pre)}\right), \quad (2)$$

which reflects the difference across colleges in both the treatment and comparison conditions and across time. For example, in the at-risk PBF versus other PBF contrast, the treatment group is colleges subject to at-risk PBF provisions and the comparison group is colleges subject to other PBF; colleges without PBF are excluded. These two differences are captured by λ_i (institutional fixed effects that represent differences between colleges in the treatment and comparison conditions) and μ_t (year fixed effects that reflect differences between the post-treatment and pre-treatment year).

I also controlled for prior state appropriations each college received ($Approp_{it}$) and a vector of state-level characteristics (X_{it}) that is described in the previous section. As a robustness test, I ran models with limited sets of state characteristics and the results (not presented here but available upon request) were generally similar. Finally, I included an error term ϵ_{it} that was clustered at the state level to reflect how nearly every state subjected all of its institutions within a sector to a performance funding system. The use of clustering and fixed effects is crucial in panel datasets due to serially correlated error terms (Bertrand, Duflo, & Mullainathan, 2004). All dependent variables and financial characteristics were transformed using natural logarithms, reducing the influence of outliers and allowing the outcomes to be interpreted as percent changes.[3] To answer my final research question, I divided four-year colleges into two groups based on their selectivity as proxied by the Barron's (2009) competitiveness index. I then ran

equation (1) separately for less-selective and more-selective colleges and also ran an interaction model to see whether colleges respond to PBF systems in different ways based on their selectivity.

For my main results, I compared the presence of PBF in a given year to enrollment levels one year following when PBF was measured. This allows colleges an opportunity to change their recruitment, admissions, and retention practices in response to PBF. I also ran models with no lag (since colleges could be responding to PBF policies as they were being finalized) and a two-year lag. The results across all three time periods were generally similar, so the results from the alternative lag periods are presented in Online Appendix 1 for the sake of brevity.

A key condition for the results of difference-in-difference models to plausibly identify the effect of a policy change is for the parallel trends assumption to hold—requiring pre-treatment trends to be similar for colleges that ultimately ended up in the treatment and comparison groups. I tested to see if this assumption held by running my regressions with a one-year lead as a falsification test (comparing PBF in a given year to enrollment levels in the prior year). As Appendix 1 shows, there were few statistically significant differences under the falsification test; this strongly suggests that colleges were not responding to PBF systems before they took effect.

Sample

I began with the 536 public four-year colleges and universities in the fifty states that were classified as a degree-granting institution in the 2014-15 academic year, excluding graduate-only and special-focus institutions as well as the service academies due to their special

missions.[4] I then excluded three colleges for having missing data on the covariates of enrollment or appropriations throughout the length of the panel and followed the general convention in the higher education finance and public administration literatures excluding the seven colleges in Nebraska because of the state's unique nonpartisan, single-chamber legislature. The resulting analytic sample consisted of 526 colleges in 49 states.

Table 2 contains a summary of the key variables in the 2014-15 academic year, broken down by colleges subject to at-risk PBF provisions, those subject to PBF without an at-risk provision, and those not subject to PBF. I also tested for differences among the three groups using an F-test, with no significant differences across all three categories. In general, colleges not operating under a performance funding system tended to be in more affluent, politically liberal states with larger numbers of minority students and higher state appropriations. Colleges subject to PBF systems without at-risk components tended to be in less-affluent, conservative states with lower levels of minority students and more white and Asian students, while colleges subject to at-risk PBF systems were somewhere between the other two types of colleges.

[Insert Table 2 here]

Limitations

The first limitation of this analysis is that the measures for performance-based funding systems are rather crude, as some critiques of the current state of the literature on PBF have noted (e.g., Snyder, 2016). Although it would be helpful to use a measure that includes the percentage of funds at stake in a PBF system, this is difficult to do in practice for two reasons.

First, collecting historical data on the amount of funds tied to performance across individual colleges or states is an exceedingly difficult task—and researchers cannot always even agree if a state had a PBF system in place in a given year, let alone whether a state had a PBF 1.0 or PBF 2.0 system. Second, the amount of funds that may be tied to performance funding may not always be known when colleges begin to make their admission and pricing decisions for the following year due to midyear budget adjustments or changes in legislative priorities.

I attempted to create a more nuanced measure of performance funding by examining whether a state had provisions in place for enrolling or graduating at-risk students as well as separately considering colleges operating under performance funding systems without an at-risk metric. Although this metric captures whether a college has at least some incentive to enroll adult, low-income, and/or minority students, the amount of funds tied to at-risk students' success still varies both across states and within states over time as states frequently adjusted their PBF criteria. At-risk components began spreading to a larger number of states in 2011, which limits the statistical power of these analyses to some extent. A further complication is that colleges in some states (such as Minnesota and Missouri) can choose to give additional weight to certain metrics in their performance funding agreements. For these reasons, a binary metric is appropriate in this case.

Another limitation of my study is my focus on the number of lower-income, minority, and adult students enrolled at a particular college as measures of at-risk enrollment, which leaves out two important metrics. The first metric is the number of graduates for the above categories. My decision was in part due to data availability; although the number of completions is available for minority students, it is not available in IPEDS over the length of the panel by family income or by age.[5] But a more important factor in my decision was that the full effect of performance

funding on degree completions may take six or more years for four-year colleges to allow for changes in admissions practices and give students time to graduate (Tandberg & Hillman, 2014). Because most at-risk provisions in PBF policies are quite new, there are insufficient data to focus on completions at this time. However, any attempts to change the demographic characteristic of the student body to increase the number of completions will show up in enrollment data first, which justifies the value of enrollment data in this paper. The second metric excluded here is other definitions of at-risk enrollment. Some states consider first-generation students and those in developmental education in their performance funding systems (Cielinski & Pham, 2017), but these metrics are not available in comparable formats in federal data and are usually combined with other metrics that are available in my dataset.[6]

The final main limitation of this analysis is that my metrics significantly understate the number of low-income students that certain types of colleges enroll. Prior research estimates that about 20% of students who would be eligible to receive a Pell Grant due to their family income do not file the Free Application for Federal Student Aid (FAFSA) (e.g., Kantrowitz, 2015; Kofoed, 2017). This also represents a limitation to the non-Pell recipient measure that I use, which includes some lower-income families as well as many students from higher-income families. However, this metric is reasonable because most states' PBF systems only count students whose family income statuses are known.

Results

I began by examining the differences between four-year colleges subject to different types of performance funding systems and those colleges that were either not subject to PBF or

subject to a PBF system that did not include an at-risk or underrepresented student provision. Beginning with the metrics available for all undergraduates (Table 3), coefficients were closer to zero and insignificant at the $p<.05$ level when using the typical comparison between colleges subject to any PBF system and those subject to no PBF system. However, the at-risk PBF versus no PBF comparison shows that at-risk systems are associated with a 10.3 percentage point increase in African-American students ($p<.05$), although there was no corresponding increase for underrepresented minority students as a whole. The other two comparisons (at-risk PBF versus other PBF and other PBF versus no PBF) has no statistically significant differences for underrepresented students, although there were negative coefficients for non-Pell students ($p<.10$) and traditional-age students ($p<.05$) in the at-risk PBF versus other PBF comparison.

[Insert Table 3 here]

Turning next to the comparisons using just first-time students, the pattern of results was broadly similar based on family income and race/ethnicity. None of the coefficients across any of the comparisons for family income was statistically significant, while the large and significant coefficient (8.6 percentage points) for African-American students remained in the at-risk PBF versus no PBF comparison. This finding becomes somewhat stronger when excluding institutions that primarily enroll underrepresented minority students (not shown here for the sake of brevity), suggesting that at-risk provisions may help encourage African-American enrollment at predominantly white institutions. There is also a positive and significant relationship between any PBF policy and Hispanic first-time student enrollment (4.4 percentage points).

[Insert Table 4 here]

I then compared less selective and more selective colleges operating under various performance funding regimes, with the results for all undergraduate students shown in Table 5 and the generally similar pattern of results for first-time students only available in Online Appendix 2. More selective colleges operating under any PBF system had a four percentage point decline in Pell Grant enrollment ($p<.01$) compared to than more selective colleges not subject to PBF (the first two columns of results), but this was not associated with greater numbers of non-Pell students. Less-selective colleges facing any PBF system saw a 5.5 percentage point increase in African-American enrollment relative to colleges not subject to PBF ($p<.05$); Hispanic and white/Asian enrollment levels were not significantly different based on PBF status. There were also no significant differences in the numbers of adult or traditional-age students enrolled across either selectivity group.

[Insert Table 5 here]

The other three sets of comparisons provide some insights regarding the findings in the PBF/no PBF analysis, which would otherwise lead one to conclude that PBF provisions as a whole discourage selective colleges from enrolling Pell recipients. When comparing at-risk PBF and no PBF colleges (the second set of two columns of Table 5), more-selective colleges enrolled fewer non-Pell students . Less-selective colleges subject to at-risk PBF had a 14.4 percentage point increase in African-American student enrollment ($p<.05$) compared to colleges not subject to PBF, while there was no associated change in more-selective colleges. This suggests that at-risk PBF policies may have expanded access for African-American students at four-year colleges, but only at less-selective institutions.

In the at-risk versus other PBF comparison (the next two columns of Table 5), less-selective colleges subject to at-risk PBF enrolled significantly fewer non-Pell and traditional-age students (both $p<.01$), while there is marginal evidence that more-selective colleges enrolled more African-American and traditional-age students ($p<.10$). The lack of negative and significant coefficients on any historically underrepresented group does imply that at-risk provisions do not have unintended effects on enrollment relative to PBF without these provisions.

Finally, more selective colleges subject to PBF programs without at-risk components enrolled about five percent fewer Pell recipients and fewer lower- and middle-income students than selective colleges not subject to PBF (the final two columns of Table 5). This matches the finding in the any PBF versus no PBF comparison, while the coefficient for the at-risk versus other PBF comparison was positive yet statistically insignificant. Altogether, these findings suggest that selective colleges that do not have at-risk components built into their PBF systems may be responding in different ways to performance funding systems than less selective colleges that admit nearly all students. There is also some evidence that, the presence of at-risk components appears to reduce incentives to enroll students with a higher probability of completion.

Discussion and Future Work

State performance funding systems have grown in popularity over the last decade, spurred on by frustration among policymakers about colleges' effectiveness and encouraged by national organizations such as the Gates and Lumina Foundations. However, as PBF has grown

in popularity, a number of studies have concluded that basing a portion of state funding on outcomes has encouraged at least some colleges to become more selective in order to gain additional resources (e.g., Dougherty et al., 2016; Kelchen & Stedrak, 2016; Minckler, 2016; Umbricht et al., 2017). In order to guard against that unintended consequence, a growing number of states are including provisions in their PBF systems that provide incentives for enrolling low-income, minority, and other at-risk students. These at-risk provisions are now considered best practices for states considering adopting a PBF system (Lumina Foundation, n.d.; Miller, 2016).

In this study, I examined whether at-risk provisions within PBF systems—as well as PBF systems in general—were effective in increasing low-income and underrepresented minority student enrollment. Across all four-year colleges, it appears that PBF systems in general had no or small positive effects on underrepresented student enrollment—a finding that generally matches the large body of literature on performance funding policies. Yet the null findings across all institutions and PBF systems obscure some important differences when equity provisions are put into place.

One key finding is that PBF systems with any type of an equity provision were associated with a large increase in African-American student enrollment relative to colleges not subject to performance funding. This finding was not present for other racial/ethnic groups or Pell Grant recipients, which is somewhat surprising given the strong correlation between race/ethnicity and family resources among college students. This could potentially be due to the specific provisions of states' PBF policies, but specific details about the types of students included in equity provisions are not always available. More research is needed into the exact provisions of states' at-risk student bonuses under PBF to help provide additional details.

The second key finding is that PBF policies affect less-selective and more-selective colleges in different ways. The relationship between at-risk provisions and African-American student enrollment is mostly driven by less-selective institutions, suggesting that tying some funding to equity may create a modest incentive for broad-access institutions to maintain their traditional mission. More-selective colleges that were subject to PBF systems that did not have at-risk components enrolled fewer Pell recipients than selective colleges not facing PBF, while the presence of at-risk components helped mitigate that pressure. This also suggests that at-risk provisions may at least reduce the prevalence of cream skimming at selective colleges, even if they do not increase institutional diversity.

Therefore, if a state wishes to adopt a performance funding system, it is important to consider provisions to encourage colleges to enroll students whose success is far from guaranteed. States may wish to change their incentive structures under PBF to further reward at-risk student completions, particularly for adult students (who were universally unaffected regardless of the comparison). States may also wish to consider using other mechanisms (such as reducing funding disparities across colleges) in an effort to achieve the same policy goals either alongside PBF or instead of implementing PBF.

It is worth emphasizing that the amount of money at stake in performance funding systems is still a small percentage of institutional budgets in the vast majority of states, so primarily null findings are not terribly surprising. Few states allocate more than one or two percent of total funding based on enrollment and completions of traditionally underrepresented students, so this may not be enough to induce colleges to change their priorities. Further research is certainly needed to examine the amount of additional resources needed to successfully

graduate underrepresented students compared to majority students and to make sure the incentives present in PBF systems match the cost of education.

Even in states with higher percentages of funds tied to performance, the frequent presence of "stop-loss" provisions that restrict how much a college's state appropriations change in a given year effectively limit the amount of funds at stake. PBF systems that reward colleges for at-risk student success could also serve as de facto stop loss provisions to help traditionally underfunded colleges that serve more minority and low-income students. As some states increase the percentage of funds tied to performance and the variation across states increases, researchers and policymakers should consider analyses that use the percentage of funds at stake instead of a binary indicator that reasonably reflects most of today's systems.

It is entirely possible that increasing the amount of money at stake in a performance funding provision could change colleges' recruitment and enrollment priorities, but three conditions must be met in order for this to happen. First, colleges must have the capacity to improve their performance given available financial and human capital resources—a particular concern at two-year and less-selective four-year colleges (e.g., Dougherty et al., 2016). Second, colleges must clearly understand the metrics used to evaluate their performance. Early performance funding systems were sometimes too complicated for colleges to respond to (Dougherty & Natow, 2015), but more straightforward modern systems have generally alleviated this concern. Finally, colleges must feel like they will be rewarded for meeting the performance metrics. There is no guarantee that states will provide the promised bonuses for graduating low-income and/or minority students in the future, which could explain the rather muted responses on at this point. As performance funding systems continue to spread, more research on whether

colleges believe they will be rewarded for meeting stated goals would be useful in examining how colleges respond to the implementation of PBF.

Researchers and policymakers should also pay close attention to how incentives present in performance funding systems may be aligned or in opposition to colleges' strategic goals and the pressures they face from other accountability systems (Kelchen, 2018). Selective public colleges, for example, are increasingly operating in a national and international market as they attempt to recruit top-notch students, faculty, and administrators. These institutions face pressure from many alumni and the largest college rankings providers to become more selective, which typically results in decreased racial/ethnic and socioeconomic diversity. In order to partially counteract these pressures, states must tie a meaningful amount of funding to equity metrics in their performance funding systems. These pressures to become more selective are generally not present at open-access colleges, meaning that colleges may not respond to a generic performance funding system in the same way as a college that has a greater ability to shape its student body.

This interesting set of findings deserves additional attention, and should be examined in additional detail using both qualitative research at colleges subject to at-risk PBF provisions and additional quantitative research in the future that looks at underrepresented student completions and the particular types of at-risk students which are incentivized in state PBF systems. Future research should also expand the analysis to the two-year sector, as there is the possibility that community colleges may respond to at-risk provisions in the same way that four-year colleges appear to have done so.

[1] Because Colorado (which had PBF for part of the panel) does not grant traditional appropriations to its public colleges, I ran models including and excluding the state. Results excluding Colorado are substantively similar and are available upon request from the author.

[2] The number of states participating in the SHEEO surveys varied from 35 in 2012-13 to 50 in 2005-06.

[3] For state appropriations, I added 1 to the dollar values before doing the logarithmic transformation so the smallest logged value was zero in the case of colleges with no appropriations in a given year.

[4] I used the 2010 Carnegie classifications classify all associate and baccalaureate/associate colleges as two-year colleges although IPEDS classified them as four-year colleges. This excluded community colleges offering a small number of bachelor's degrees.

[5] The number of Pell completions was added to IPEDS in October 2017, but there is only one year of data available as of late 2017.

[6] The College Scorecard has the percentage of FAFSA filers who are first-generation students, but it is not possible to get the number of first-generation students from that information. Additionally, states do not appear to use consistent definitions of "first-generation," making analyses difficult.

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Table 1: Summary of PBF policies affecting four-year colleges by state and year, 2004-05 to 2015-16.

State	Any PBF (years)	Provisions for at-risk students (years)
Arizona	2012--	
Arkansas	2007-09, 2012--	2013--
Colorado	2004-06, 2011--	
Florida	2004-07, 2013--	2013--
Georgia	2006-08, 2015--	
Illinois	2011--	2011--
Indiana	2004--	2004--
Kansas	2004-2008, 2011--	
Louisiana	2014--	
Maine	2013--	2014--
Massachusetts	2014--	2014--
Michigan	2012--	2014--
Minnesota	2007-08, 2011--	2011--
Mississippi	2013--	2013--
Missouri	2013--	2013--
Montana	2013--	
Nevada	2013--	
New Mexico	2004--	2012--
North Carolina	2014--	
North Dakota	2013--	
Ohio	2004--	2008--
Oklahoma	2004--	2012--
Oregon	2007--	
Pennsylvania	2004-- (PASSHE only)	2011-- (PASSHE only)
South Dakota	2004--	
Tennessee	2004--	2004--
Utah	2013--	
Virginia	2005--	2014--

Sources: State higher education websites; Dougherty & Natow, 2015; Gorbunov, 2013; National Conference of State Legislatures, 2015; Synder & Fox, 2016; Tandberg & Hillman, 2014.

Note: The year listed refers to the fall of the academic year (i.e., 2012 for 2012-13).

Table 2: Summary statistics of the institutions in the dataset (2014-15 academic year).

Characteristic	At-risk PBF	Other PBF	No PBF	Source
More selective college (pct)	20.9	23.9	25.3	Barron's
Student characteristics (all undergraduates)				
Pell recipients	3,675	3,766	4.082	IPEDS (2007-08 on)
Non-Pell students	7,161	7,857	6,990	IPEDS (2007-08 on)
Underrepresented minority students	2,808	2,496	3,599	IPEDS
African-American students	1,295	1,074	1,193	IPEDS
Hispanic students	1,085	929	1,978	IPEDS
White/Asian students	7,327	8,168	6,662	IPEDS
Students age 25 or older	1,772	2,077	1,858	IPEDS
Students age 24 or younger	9,085	9,555	9,234	IPEDS
Student characteristics (first-time, full-time undergraduates)				
Federal grant aid recipients	641	627	689	IPEDS
Family income below $30k	290	281	347	IPEDS (2008-09 on)
Family income $30k-$75k	338	319	335	IPEDS (2008-09 on)
Student characteristics (first-time undergraduates)				
Underrepresented minority students	499	479	636	IPEDS
African-American students	230	190	197	IPEDS
Hispanic students	182	186	358	IPEDS
White/Asian students	1,294	1,410	1,161	IPEDS
State characteristics				
Per-FTE appropriations ($)	7,922	6,778	8,801	IPEDS
Grant aid per 18-24 year old ($)	310	208	381	NASSGAP, Census
State grant aid based on need (pct)	72.6	69.3	81.0	NASSGAP
State tuition cap or curb (pct)	32.1	68.5	48.4	SHEEO surveys
State fee cap or curb (pct)	21.2	31.5	23.4	SHEEO surveys
Gov/legislature sets tuition (pct)	17.3	12.6	15.2	SHEEO surveys
Coordinating board sets tuition (pct)	67.3	62.2	84.8	SHEEO surveys
Per-capita state income ($)	44,860	43,087	47,592	BEA
State poverty rate (pct)	14.8	14.7	14.3	Census Bureau
State unemployment rate (pct)	5.9	5.8	6.2	BLS
Republican governor (pct)	62.2	65.8	52.3	Klarner (2015), NCSL
Republican Senate control (pct)	69.2	80.2	51.6	Klarner (2015), NCSL
Republican House control (pct)	69.2	80.2	47.7	Klarner (2015), NCSL
Number of observations	156	111	256	

Notes:
(1) The acronyms are the following: IPEDS=Integrated Postsecondary Education Data System, NASSGAP=National Association of State Student Grant Aid Programs, SHEEO=State Higher Education Executive Officers, BEA=Bureau of Economic Analysis, BLS=Bureau of Labor Statistics, NCSL=National Conference of State Legislatures.

(2) The number of students by family income metrics are only for first-time, full-time students who are also state residents.

(3) "Other PBF" refers to a college subject to a PBF system without a provision for enrolling or graduating at-risk students.

Table 3: Relationship between PBF and at-risk student enrollment (all undergraduates).

Characteristic (pct change)	Any PBF vs. no PBF	At-risk vs. no PBF	At-risk vs. other PBF	Other PBF vs. no PBF
Pell recipients	-2.2	-1.9	-1.3	-0.9
	(1.7)	(3.2)	(2.0)	(2.0)
Non-Pell students	-1.0	-3.8	-2.9*	0.2
	(1.5)	(3.2)	(1.4)	(1.1)
Underrepresented minority students	2.8	2.6	-0.8	2.5
	(2.1)	(4.5)	(4.1)	(2.6)
African-American students	2.6	10.3**	3.7	0.0
	(2.8)	(4.2)	(3.2)	(3.0)
Hispanic students	1.9	3.7	-2.2	1.4
	(2.4)	(4.3)	(4.3)	(2.6)
White/Asian students	-0.5	-1.8	-1.8	0.4
	(1.7)	(3.3)	(1.3)	(1.4)
Students age 25 or older	1.0	0.2	1.8	1.1
	(1.7)	(2.8)	(3.0)	(1.9)
Students age 24 or younger	-0.7	-2.5	-4.9**	0.3
	(1.4)	(2.9)	(1.8)	(1.0)
Maximum number of colleges	526	507	284	503

Sources and years covered: See Table 2.

Notes:

(1) Standard errors (clustered at the state level) are listed below the point estimates.

(2) * signifies p<.10, ** signifies p<.05, and *** signifies p<.01.

(3) Each coefficient is the result of a separate regression with the control variables noted in Table 2.

(4) "Other PBF" refers to a college subject to a PBF system without a provision for enrolling or graduating at-risk students.

(5) The results presented here use the one-year lag. Results with other lags can be found in Online Appendix 1.

Table 4: Relationship between PBF and at-risk student enrollment (first-time students).

Characteristic (pct change)	Any PBF vs. no PBF	At-risk vs. no PBF	At-risk vs. other PBF	Other PBF vs. no PBF
First-time, full-time FAFSA filers				
Federal grant aid recipients	-1.2	-2.2	0.6	-1.1
	(1.6)	(3.7)	(2.7)	(1.9)
Family income below $30k	-1.4	-1.1	4.2*	-2.7
	(2.2)	(5.0)	(2.3)	(2.4)
Family income $30k-$75k	0.6	-8.5	-6.1	4.1
	(3.1)	(5.6)	(6.1)	(3.3)
First-time, degree-seeking students				
Underrepresented minority students	3.7	4.7	-1.4	2.7
	(2.3)	(4.5)	(4.7)	(3.0)
African-American students	1.4	8.6**	3.0	-1.7
	(2.8)	(3.6)	(5.0)	(3.0)
Hispanic students	4.4**	5.5	-3.0	3.3
	(2.2)	(4.0)	(3.5)	(2.5)
White/Asian students	-3.1	-4.9	-0.2	-2.0
	(2.0)	(3.4)	(2.1)	(1.8)
Maximum number of colleges	526	507	284	503

Sources and years covered: See Table 2.

Notes:

(1) Standard errors (clustered at the state level) are listed below the point estimates.

(2) * signifies p<.10, ** signifies p<.05, and *** signifies p<.01.

(3) Each coefficient is the result of a separate regression with the control variables noted in Table 2.

(4) "Other PBF" refers to a college subject to a PBF system without a provision for enrolling or graduating at-risk students.

(5) The results presented here use the one-year lag. Results with other lags can be found in Online Appendix 1.

Table 5: Relationship between PBF and at-risk student enrollment by institutional selectivity (all undergraduates).

	Any vs. no PBF		At-risk vs. no PBF		At-risk vs. other PBF		Other vs. no PBF	
Characteristic (pct change)	Less	More	Less	More	Less	More	Less	More
Pell recipients	1.7	-4.0***	-1.1	-3.5	-2.5	5.4	1.2	-4.7**
	(1.8)	(1.5)	(3.9)	(2.6)	(2.4)	(4.4)	(2.0)	(1.7)
Non-Pell students	-0.7	0.0	-4.3	-3.9**	-4.1***	7.4	0.7	1.1
	(2.1)	(1.3)	(3.8)	(1.7)	(1.2)	(4.6)	(1.7)	(1.5)
Underrepresented minority students	4.4	-0.2	4.1	-5.8	-1.6	2.9	3.7	0.9
	(2.9)	(1.6)	(5.2)	(4.1)	(5.2)	(2.7)	(3.5)	(2.2)
African-American students	5.5**	-2.1	14.4**	-0.9	3.9	9.1*	2.2	-2.5
	(2.7)	(1.8)	(5.3)	(2.7)	(3.6)	(4.4)	(2.6)	(2.0)
Hispanic students	2.8	0.8	5.0	-2.0	-2.0	2.8	1.4	1.9
	(2.4)	(2.4)	(5.1)	(4.1)	(4.8)	(4.7)	(2.5)	(3.1)
White/Asian students	-0.1	0.2	-0.8	-4.3*	-2.9	3.8	0.5	1.7
	(1.7)	(1.6)	(3.9)	(2.3)	(1.9)	(3.4)	(1.1)	(1.8)
Students age 25 or older	1.6	-0.5	2.6	-6.1	3.6	-3.9	1.2	0.3
	(1.8)	(1.6)	(3.8)	(4.1)	(3.5)	(5.7)	(1.9)	(1.8)
Students age 24 or younger	-0.4	-0.1	-2.6	-2.6	-6.2***	3.9*	0.5	0.6
	(1.6)	(1.1)	(3.3)	(1.7)	(2.1)	(2.1)	(1.1)	(1.1)
Number of colleges	390	121	374	119	214	64	371	117

Sources and years covered: See Table 2.

Notes:

(1) Standard errors (clustered at the state level) are listed below the point estimates.

(2) * signifies p<.10, ** signifies p<.05, and *** signifies p<.01.

(3) Selectivity is defined by Barron's (2009) competitiveness ratings, with colleges listed as "very competitive" or above being designed as more selective and all others as less selective.

(4) Each coefficient is the result of a separate regression with the control variables noted in Table 2.

(5) "Other PBF" refers to a college subject to a PBF system without a provision for enrolling or graduating at-risk students.

(6) For the sake of brevity, results are only shown using a one-year lag. Other lags are available upon request.

Appendix 1: Falsification tests for the relationship between PBF and at-risk student enrollment.

Characteristic (pct change)	Any PBF vs. no PBF	At-risk vs. no PBF	At-risk vs. other PBF	Other PBF vs. no PBF
All undergraduates				
Pell recipients	0.1	4.9**	-1.8	-2.5
	(3.8)	(2.4)	(2.7)	(5.0)
Non-Pell students	-0.4	-0.6	-0.4	0.7
	(1.8)	(3.7)	(1.4)	(1.3)
Underrepresented minority students	3.1	4.5	-1.4	2.8
	(2.4)	(6.0)	(3.7)	(2.4)
African-American students	3.0	8.9*	2.0	1.3
	(2.7)	(5.0)	(2.5)	(2.6)
Hispanic students	-0.3	6.7	-1.6	-1.8
	(3.3)	(6.7)	(4.1)	(3.3)
White/Asian students	0.5	0.8	-1.4	1.1
	(1.3)	(2.8)	(1.4)	(1.1)
Students age 25 or older	2.0	3.0	-1.2	2.2
	(1.8)	(2.3)	(3.1)	(2.0)
Students age 24 or younger	-0.9	-2.3	-1.2	0.0
	(1.4)	(2.6)	(1.4)	(1.1)
First-time, full-time FAFSA filers				
Federal grant aid recipients	-1.9	3.2	2.2	-3.2
	(3.2)	(4.6)	(2.4)	(3.7)
Family income below $30k	-1.6	5.6	1.8	-6.5**
	(2.5)	(3.5)	(1.9)	(2.9)
Family income $30k-$75k	4.5	3.8	4.9	4.2
	(4.9)	(6.4)	(3.9)	(6.5)
First-time, degree-seeking students				
Underrepresented minority students	2.2	5.2	-4.2	1.2
	(2.4)	(5.0)	(4.8)	(2.8)
African-American students	1.0	12.8***	-0.1	-2.7
	(2.9)	(3.0)	(5.0)	(3.0)
Hispanic students	-0.4	4.7	-5.7	-1.2
	(3.2)	(4.4)	(3.4)	(3.9)
White/Asian students	-2.0	-1.9	-1.4	-1.4
	(1.8)	(4.0)	(1.8)	(1.5)
Maximum number of colleges	526	507	284	503

Sources and years covered: See Table 2.

Notes:

(1) The falsification test uses PBF status the year after enrollment was measured, a pre-treatment observation.

(2) Standard errors (clustered at the state level) are below the point estimates.

(3) * signifies p<.10, ** signifies p<. 05, and *** signifies p<.01.

(4) "All others" includes colleges subject to a PBF system without an at-risk component, as well as colleges that are not subject to PBF.

(5) Each coefficient is the result of a separate regression with the control variables noted in Table 2.

Online Appendix 1: Relationship between PBF and at-risk student enrollment using different lag periods.

	Any PBF vs. no PBF		At-risk PBF vs. no PBF		At-risk vs. other PBF		Other PBF vs. no PBF	
Characteristic (pct change)	No lag	2-yr lag	No lag	2-yr lag	No lag	2-yr lag	No lag	2-yr lag
All undergraduates								
Pell recipients	0.8	-1.9*	4.2	-3.9	-1.4	-2.2	-1.4	-2.0**
	(2.8)	(1.0)	(2.7)	(3.4)	(2.2)	(2.4)	(3.4)	(1.0)
Non-Pell students	-0.8	-0.7	-2.0	-7.7***	-3.1*	-3.7**	0.8	0.7
	(1.7)	(1.4)	(3.3)	(2.3)	(1.5)	(1.4)	(1.2)	(1.0)
Underrepresented minority students	2.9	3.9	3.7	0.0	-1.3	-2.1	2.7	4.8*
	(2.2)	(2.5)	(5.1)	(5.2)	(4.0)	(4.3)	(2.4)	(2.7)
African-American students	2.8	0.9	10.3**	3.2	2.5	3.5	0.7	0.2
	(2.6)	(2.9)	(4.1)	(5.1)	(2.8)	(4.4)	(2.6)	(3.2)
Hispanic students	0.3	0.8	5.5	-1.4	-1.6	-2.3	-0.5	0.9
	(3.1)	(2.9)	(4.9)	(4.4)	(4.0)	(2.3)	(3.4)	(3.5)
White/Asian students	0.1	-0.5	0.2	-4.4	-2.2	-1.6	0.9	0.6
	(1.5)	(1.6)	(3.1)	(3.4)	(1.6)	(1.3)	(1.2)	(1.1)
Students age 25 or older	1.8	-0.8	1.7	1.6	-1.8	8.4**	2.3	-1.7
	(1.9)	(1.8)	(2.9)	(3.5)	(3.0)	(3.8)	(2.2)	(2.1)
Students age 24 or younger	-0.8	-0.2	-2.1	-1.7	-3.5**	-5.8***	0.0	0.0
	(1.4)	(1.2)	(2.8)	(2.8)	(1.6)	(1.7)	(1.1)	(1.4)
Maximum number of colleges	526		507		284		503	

Online Appendix 1: Relationship between PBF and at-risk student enrollment using different lag periods (continued).

	Any PBF vs. no PBF		At-risk PBF vs. no PBF		At-risk vs. other PBF		Other PBF vs. no PBF	
Characteristic (pct change)	No lag	2-yr lag	No lag	2-yr lag	No lag	2-yr lag	No lag	2-yr lag
First-time, full-time FAFSA filers								
Federal grant aid recipients	-2.6	-1.2	-1.4	-2.2	-0.6	0.6	-3.2	-1.1
	(2.3)	(1.6)	(4.7)	(3.7)	(2.1)	(2.7)	(2.6)	(1.9)
Family income below $30k	0.8	-1.4	2.8	-1.1	0.1	4.2*	-1.6	-2.7
	(2.4)	(2.2)	(4.6)	(5.0)	(2.1)	(2.3)	(2.7)	(2.4)
Family income $30k-$75k	0.8	0.6	-1.8	-8.5	-7.1**	-6.1	1.7	4.0
	(3.2)	(3.1)	(6.0)	(5.6)	(2.9)	(6.1)	(4.1)	(3.3)
First-time, degree-seeking students								
Underrepresented minority students	3.9*	3.7	5.2	4.7	-5.9	-1.4	3.5	2.7
	(2.3)	(2.3)	(4.8)	(4.5)	(4.8)	(4.7)	(2.8)	(3.0)
African-American students	1.5	1.4	12.6***	8.6**	-0.9	3.0	-1.8	-1.7
	(2.7)	(2.8)	(4.5)	(3.6)	(4.8)	(5.0)	(3.0)	(3.0)
Hispanic students	1.7	4.4**	2.9	5.5	-6.3*	-3.0	1.4	3.3
	(2.1)	(2.2)	(3.8)	(4.0)	(3.5)	(3.5)	(2.7)	(2.5)
White/Asian students	-1.9	-3.1	-3.6	-4.9	-1.5	-0.2	-0.7	-2.0
	(1.7)	(2.0)	(3.7)	(3.4)	(1.6)	(2.1)	(1.2)	(1.8)
Maximum number of colleges	526		507		284		503	

Sources and years covered: See Table 2.

Notes:

(1) Standard errors (clustered at the state level) are listed below the point estimates.

(2) * signifies p<.10, ** signifies p<.05, and *** signifies p<.01.

(3) Each coefficient is the result of a separate regression with the control variables noted in Table 2.

(4) "Other PBF" refers to a college subject to a PBF system without a provision for enrolling or graduating at-risk students.

Online Appendix 2: Relationship between PBF and at-risk student enrollment by institutional selectivity (first-time undergraduates).

	Any vs. no PBF		At-risk vs. no PBF		At-risk vs. other PBF		Other vs. no PBF	
Characteristic (pct change)	Less	More	Less	More	Less	More	Less	More
First-time, full-time FAFSA filers								
Federal grant aid recipients	-0.5	-2.1	-3.0	0.0	-0.2	6.0	0.1	-3.3*
	(2.6)	(1.7)	(4.3)	(3.6)	(3.0)	(3.7)	(2.9)	(1.9)
Family income below $30k	2.1	-6.1**	-1.7	0.5	5.6*	1.7	1.8	-9.3**
	(2.5)	(2.8)	(6.2)	(3.7)	(2.7)	(4.9)	(2.6)	(3.5)
Family income $30k-$75k	4.0	-4.1**	-10.3	-5.3	-7.8	3.1	9.6**	-4.9**
	(4.1)	(1.9)	(6.6)	(4.8)	(7.0)	(3.5)	(4.1)	(2.4)
First-time, degree-seeking students								
Underrepresented minority students	5.4	1.1	6.4	-5.8	-2.4	-5.1	3.9	2.2
	(3.8)	(1.9)	(5.4)	(4.1)	(6.0)	(4.4)	(4.7)	(3.1)
African-American students	4.0	-2.5	12.3***	-2.8	2.9	7.0	0.1	-3.0
	(3.5)	(2.9)	(4.1)	(4.8)	(5.5)	(4.8)	(4.1)	(3.5)
Hispanic students	6.3	1.5	8.0	-3.6	-2.1	-0.8	4.4	2.8
	(2.4)	(2.4)	(5.1)	(4.3)	(4.2)	(4.5)	(2.6)	(3.3)
White/Asian students	-2.6	-1.1	-4.3	-6.6**	-1.3	2.9	-1.6	0.7
	(1.9)	(2.3)	(4.0)	(3.1)	(2.2)	(4.7)	(1.5)	(2.7)
Number of colleges	390	121	374	119	214	64	371	117

Sources and years covered: See Table 2.

Notes:

(1) Standard errors (clustered at the state level) are listed below the point estimates.

(2) * signifies p<.10, ** signifies p<.05, and *** signifies p<.01.

(3) Selectivity is defined by Barron's (2009) competitiveness ratings, with colleges listed as "very competitive" or above being designed as more selective and all others as less selective.

(4) Each coefficient is the result of a separate regression with the control variables noted in Table 2.

(5) "Other PBF" refers to a college subject to a PBF system without a provision for enrolling or graduating at-risk students.

(6) For the sake of brevity, results are only shown using a one-year lag. Other lags are available upon request.