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Public College Quality and Higher Education Policies of U.S. States

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Abstract

States differ substantially in higher education policies. Little is known about the effects of state policies on the performance of public colleges and universities, largely because no clear measures of college quality exist. In this paper, I derive a measure of college quality from the early career earnings of individuals receiving a bachelor's degree in the 1992-93 academic year from a public college. Using instrumental variables to correct for individual selection into a state public college system, I find considerable variation in value-added by states' public college systems; relative to a baseline, the value-added ranges from −30% to 50% an average student's annual earnings. Using these measures of performance, I then investigate how various aspects of state higher education policy affect outcomes. I find that states with higher faculty quality and with more quality differentiation among public colleges generate higher value-added to student earnings, whereas more expenditure per student does not appear to promote higher performance.

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1 Introduction

In fiscal year 2000, state expenditure on higher education accounted for 11.4% of total state expenditure, the third largest category following primary-secondary education and medicaid. In 2000, about 50% of high school graduates are enrolled in college; public colleges and universities enrolled 76.8% of all college students and about 2/3 of undergraduate students in 4-year institutions (NASBO [2001], NCES [2002]).

There exits, at the same time, substantial and systematic variation in higher education policies across states, such as appropriations to public higher education institutions, tuition charges, and direct grant aid to college students. Table 1 summarizes some characteristics of state higher education systems for academic year 1988-89, the year when the majority of students in my sample entered college; I focus on 4-year institutions.[1]

First, states show varying degrees of generosity in their in-kind support to public colleges and universities. This disparity is reflected in differences in state appropriations to and tuition charges for public colleges; the differences can be as large as fourfold. There is also a strong geographical pattern, with northeastern states spending the lowest amount and charging the highest tuition, and the western states at the opposite end. For example, Vermont allocates about $2,600 per student, the lowest in the nation, and an average student in Vermont pays about $3,500 in tuition for attending a public college, the highest in the nation. On the other hand, California appropriates more than $9,000 per student, and an average student in California pays a mere $1,000 in tuition.[2] Since more than 50% of the revenue of public colleges comes from state appropriation and tuition (NCES [2002]), expenditure per student also exhibits significant differences across state. Another relevant measure of states' generosity is how many openings are available each year for college-age population. This again differs remarkably across states, with North Dakota and Montana at the very high end, and Florida, California, and New Jersey

[1]The similar variation persists over time; Table A1 in the Appendix provides statistics for academic year 2000-2001.

[2]This geographical pattern is probably history dependent. See Quigley and Rubinfeld [1993], Goldin and Katz [1996] for discussions of how historical factors influenced the development of public higher education sector.

at the low end.

Second, states differ considerably in how they allocate resources over different types of institutions. Some states, such as Kansas, Mississippi, and Montana, spend quite evenly over all public colleges, while in some other states, the standard deviation of expenditure per student over different public colleges can be as high as $9,000, as in Washington and California. Also noticeable is the variation in states' support for research universities: some states, such as Iowa and New Mexico, can have as high as about 80% of undergraduate students in research I universities,[3] while some other states, such as Louisiana and Missouri, have only about 20%.

Finally, grant aid to undergraduate students display even larger variation across states. Data on need-based aid shows differences as large as sixty-fold; New York, Illinois, and New Jersey are among the most generous states, whereas Wyoming, Idaho, and Alaska the least. Since grant aid is fungible, this difference shows how divergent states are in their willingness to support students' college choice with tax revenue.[4]

Given that the state government has such a large stake in higher education, a question of great interest to both the public and the policy makers is whether states subsidize higher education in an efficient manner. In other words, what are the impacts of higher education policies on the performance of public colleges and universities, and do different state policies lead to different student outcome? This paper sheds some light on these questions by first deriving quality measures of state public college systems from individual earnings data and then examining how these quality measures are affected by various aspects of state policies.

The quality of a state public college system is defined as its value-added to the earnings of college graduates, relative to a benchmark state. Following the literature on estimating

[3]Research I universities, defined by Carnegie Classification of Institutions of Higher Education, are institutions that offer a wide range of baccalaureate programs, and are committed to graduate education through the doctorate. They typically award 50 or more doctoral degrees per year across at least 15 disciplines.

[4]The variations in dollar values across states might be due to differences in cost of living. However, when dollar values are normalized by state median income, all the variations are still present and in the similar relative magnitude.

value-added by schools, the paper estimates the value-added by state public college systems by controlling for both students' precollege achievement and their labor market experience. Using the Baccalaureate and Beyond survey data and controlling for individual ability, selection into a state public college system, and selective migration to a regional labor market, I find that for individuals receiving a bachelor's degree in the 1992-93 academic year from a public college, relative to the baseline state Alabama, value-added by a state public college system ranges from -30% to 50% of their 1997 annual earnings. Moreover, traditional college quality measures based on Barron's selectivity index do not reflect college performance.[5] Using this estimated value-added as a quality measure, I further find that better quality can be attributed to higher faculty quality and more quality differentiation among public colleges, whereas more expenditure per student does not appear to promote higher performance. The overall results suggest that for efficiency purposes, states should support more quality-differentiated colleges, hence giving students more choices and permitting better matching of students with college styles.

The paper is organized as follows. Section 2 briefly reviews the related literature and summarizes contributions of this paper. Section 3 describes the data. Section 4 sets up the model for estimating the state college qualities and presents the estimation results. Section 5 analyzes the effects of state policies on college qualities. Section 6 concludes.

2 Related Literature

Economic studies of higher education policies abound; almost all of them have been concerned with how different aspects of higher education policies by federal and state governments affect access and costs faced by different groups and their attendance decisions. McPherson et al [1993] and Dynarski [2002] review many studies on how federal and state aid policies affect college access and choice. Kane [1994] finds that increases in tuition have driven enrollment rates by blacks downward throughout the 80s, and Fortin [2003] finds that, at state level, higher average tuition in public colleges leads to lower enrollment rates in public colleges from the 70s

[5] Barron's selectivity index is described with more detail in Section 3.

to the 90s. Long [2003] looks at how the format of state subsidies to higher education affects students' choice. She finds that large in-kind subsidies induce students to choose public four-year over private four-year colleges, whereas grant aid has the opposite effect.

Given that the lion's share of public expenditure on higher education is paid by state governments on existing public colleges that take in the majority of college students, it is surprising that little is known about the performance of public colleges and how the performance of public colleges are affected by state policies, which, in the first place, shape the goals and operations of public colleges. The difficulty arises largely from the fact that the value-added by higher education institutions is not readily measurable. In addition, when efforts are taken to derive a measure of value-added based on individual earnings, the derived value-added is never associated with higher education policies.

The output of higher education is multidimensional, with students, parents, colleges, and society valuing different aspects of the output. Even when we focus on future earnings as the measure of college output, earnings itself is a measure gross of precollege academic preparation, family influence, and labor market experiences. To obtain the value-added by colleges net of the influences of these factors, adequate controls are indispensable. One particular difficulty is to control for unmeasured individual characteristics that affect both the college choice and future earnings in the labor market. Simply put, those who choose "better" colleges tend to have certain unmeasured characteristics that will lead to higher earnings in the labor market, irrespective of the college they attend. This may lead to upward bias in estimated effect of colleges; in other words, a portion of the observed association between earnings and college characteristics is due to unobserved factors that are jointly correlated with both variables.

Brewer and Ehrenberg [1996] review 15 studies on colleges' contribution to future earnings; none of them have attempted to control for this self-selection issue.[6] Several recent studies have attempted different methods to control for the self-selection issue, but they have their own

[6] James and Alsalam [1993] is probably an exception, since they use instrumental variables to control for self-selection in one of their specifications. Unfortunately, the paper is not clear about what instruments are used; thus it is hard to judge how good their correction is.

problems. In Behrman et al [1996], Brewer and Ehrenberg [1996], and Brewer et al [1999], colleges are grouped into a few categories based on either the median SAT score of the entering class or the widely-used Barron's selectivity index. They find that more selective colleges have higher value-added to future earnings, and this value-added is smaller when self-selection is controlled for. There are two problems with these studies. First, grouping colleges into a few categories conceals the tremendous heterogeneity across colleges within each category, and they may not be the right units to compare. Table A2 in the Appendix illustrates some cross-state differences within Barron's categories of "very competitive" and "competitive" public colleges, used in Brewer et al. Second, selectivity index represents perhaps only one of many college characteristics: peer group quality, while other college characteristics, such as resources and how different resources are combined, can potentially contribute to students' learning and future earnings as well. We hardly learn anything about how these other characteristics contribute to students' future earnings. Dale and Krueger [2002] examine directly the roles of the peer quality, tuition net of aid, and expenditure per student; they find that peer quality does not affect future earnings, while tuition and expenditure per student appear to have a positive effect on future earnings. However, their sample, which contains 30 highly selective colleges and universities, is far from representative. Moreover, probably due to data limitation, none of the previous studies have been able to control for influences of local labor markets; therefore, it is not clear how much of the college effect is due to variations in local labor market conditions. Last, but not the least, all these previous studies lump private and public colleges, making any of the implications less relevant to state policies.

This paper is the first attempt to derive value-added measures of state public college systems and to understand the impacts of various aspects of state higher education policies on these measures. I derive the state average value-added from individual level data. In this process, I use instrumental variable method to correct for individual selection into different state systems based on unmeasured characteristics. This step addresses the major concern of selection bias. This value-added estimate is linked to features of state public colleges. Since a state public college system consists of multiple campuses of varying features, aggregating to state level masks differences within a state. I therefore use variables to control for variations in within state heterogeneity of public colleges, which turn out to be of great importance. Since I directly relate college outcome to various aspects of state policies, the findings of this paper provide direct policy implications.

3 Data

Several data sources provide the necessary individual, institutional, and state-level data. First, the Baccalaureate and Beyond (BB) Longitudinal Study provides individual level information concerning education and working experience after completion of the bachelor's degree. The base year survey includes a national sample of about 11,000 students who completed their bachelor's degree in the 1992-93 academic year; most of them started college in 1988 or 1989. The first follow-up was conducted in 1994, and the second follow-up took place in 1997. The base year survey reports information on students' demographic characteristics, college admission test scores, college GPA, as well as information on parental schooling and family income. The two follow-ups contain information on employment history and earnings after degree completion. The BB data set suits particularly well the present study since it contains complete information on individuals' geographic locations at high school, college, and employment, allowing me to isolate different state fixed effects.

Second, the Integrated Postsecondary Education Data System(IPEDS) provides extensive information on postsecondary institutions within the United States, including financial revenues and expenditures, tuition cost, enrollment, and faculty salary. I construct institution level data sets from IPEDS surveys conducted in academic year 1988-89.[7] These data sets are supplemented by the Carnegie classification indices of colleges, and by information on college competitiveness, the median test scores of the entering class, and a measure of faculty quality

[7]Since the IPEDS faculty salary survey is conducted biannually, the information on faculty salary, is obtained from the survey conducted in 1989-90 academic year.

(percentage of the faculty with a doctoral degree) obtained from Barron's [1988]. This particular edition of Barron's is used since most of students in the sample entered college at the end of the 1980s.

I obtain state level information from various sources. Information on state population, income, and geography is obtained from the U.S. Census Bureau. Information on characteristics of the state primary and secondary education system is obtained from NCES [1998]. Information on state higher education characteristics is obtained by aggregating the institution level data and from NASSGAP [1995].

I construct two selectivity measures based on the widely used Barron's index of college selectivity [1988]. Barron's rated all colleges as belonging to one of the 6 categories: most competitive, highly competitive, very competitive, competitive, less competitive, and noncompetitive.[8] I assign a numerical value to each of the 6 categories, with 1 denoting noncompetitive and 6 most competitive. The first measure is the state average selectivity index, calculated as the full-time equivalent (FTE) undergraduate students weighted average of the Barron's indices of public colleges in a state. Second, I divide public colleges in each state into two categories: high quality, including colleges rated as most competitive, highly competitive, and very competitive; and low quality, including colleges rated as competitive, less competitive, and noncompetitive. Twenty of the 51 states did not have high quality colleges thus defined. The second measure is the percentage of FTE undergraduate students in high quality public colleges out of total FTE undergraduate students in public colleges in a state. These two variables represent the traditional measures of college quality and are used as benchmarks.

Included in the first-stage regression analysis are individuals who participated in at least

[8] The factors used in determining the category for each college are: median entrance examination score for freshman class; percentages of freshman scoring above 500 and 600 on both math and verbal sections of the SAT; percentages freshman scoring above 21 and 25 on the ACT; percentages of freshman who ranked in the upper fifth and two-fifths of their high school class; minimum class rank and GPA required for admission; and percentage of applicants accepted. In other words, the Barron's index measures the academic preparation of a college's student body.

both the base year and the second follow-up surveys; who went to school, college, and worked in the 51 states of the U.S.; who, in 1997, were between the ages of 24 and 35, were not full time students, and had annual earnings greater than $5,000.[9] The sample includes about 6,000 students, with about 4,000 attending public colleges. Of those attending a public college, close to 80% went to one within their high school state, and more than 90% went to one within the census region of their high school. Of those attending a private college, more than 60% went to one within their high school state, and close to 80% went to one within their high school region. 20% of individuals attending public colleges moved to a different region after graduation, and 30% to a different state.

Table 2A presents mean values for some of the individual characteristics by institution types. Individuals who attended private colleges tend to have higher SAT scores, rank higher in their respective college states, travel longer distance to their current residence localities, be from wealthier families, and have more educated parents. All of these are factors favorable in the labor market, and they appear to be associated with higher earnings. Somewhat stronger differences are present between individuals who attended public colleges outside their home states and those attending in-state public colleges. These statistics suggest that unmeasured characteristics of public college students might differ across states for two reasons. First, some states' public colleges might be more attractive to out-of-state students than others'. Second, compared with private colleges, some states' public colleges might be more attractive to in-state students than others'; this difference matters since the majority of students go to college within their home states. Therefore, it is necessary to deal with students' selection into a state public college system based on unmeasured characteristics. Table 2B shows the gender and race distribution of college graduates: there are more female graduates, and blacks are much under-represented among college graduates.

[9]Some individuals were still full time graduate students in 1997; as such, a sample selection issue might be present if the type and location of colleges have an impact on individuals' graduate school decisions.

4 Estimation of College Quality

The goal of the empirical analysis is to derive a value-added measure of state public college systems from individual earnings data and to relate this measure to the characteristics of the state public college system. A two stage estimation framework is employed. In this section, I estimate the average value-added by state college systems from individual earnings data; in the next section, I estimate the effects of state higher education policies on this quality measure.[10]

4.1 Empirical Framework

Following the literature on estimating the value-added by schools (see, for example, Aitkin and Longford [1986] and Hanushek [1979]), to isolate the contribution of state of college to earnings, it is important to adequately control for differences in both the pre-college achievement and the labor market experience. I model the relationship between earnings and individual characteristics and state college system as

$$y_{ijkl} = \beta_0 + X_{ijkl} \cdot \beta_1 + F_{ij} \cdot \beta_2 + S_{ik} \cdot \beta_3 + R_{il} \cdot \beta_4 + \epsilon_{ijkl}, \tag{1}$$

where y_{ijkl} is the natural log of annual earnings of individual i, who went to school in state j, went to college in state k and currently lived in region l; X_{ijkl} is a vector of individual and family characteristics; F_{ij} is a vector of high school state primary and secondary school characteristics to further control for pre-college differences; S_{ik} is a complete set of dummy variables for states of college; R_{il} is a complete set of dummy variables for regions of current residence; and ϵ_{ijkl} is a stochastic error term. Including these dummy variables in the regression equation thus allows observed earnings to vary due both to differences in the return to college education across different regional labor markets (β_4) and to differences in the value-added by state public college systems (β_3).

[10] The same approach was used in Card and Krueger [1992] in studying the impact of public primary and secondary school characteristics on returns to education in the United States. Borjas [1987] applied a similar strategy to study the impact of political and economic conditions in the countries of origin on the U.S. earnings of immigrants.

I seek to identify the coefficient estimates of vector β_3, the state-of-college specific value-added to earnings of college graduates. It is identified by individuals with identical observable characteristics who work in the same region but have attended college in different states; the difference between the earnings of these individuals represents the difference between the value-added by their states of college. To fully control for individual heterogeneity, I make special efforts to control for individual selection into a state public college system and selective migration into a regional labor market after graduation based on unmeasured factors. These steps are necessary since in general, if there are variables unobservable to economists that affect both individual college and migration decisions and future earnings, then the estimated impact of state college systems on earnings will be biased.

4.1.1 Selection into a State's Public College System

The OLS estimates of β_3 in Equation (1) will not be a consistent measure of state college quality if public college students in different states have different underlying distributions in unmeasured characteristics that also affect earnings. In this case, conditional on measured factors, a state public college system could appear better (display higher value-added) not because it is better by itself, but because it attracts students with better unmeasured characteristics, who will earn more regardless which college they go to, and vice versa.

Students make two simultaneous college decisions: whether to go to private or public college and in which state to go to public college. To thoroughly understand how these choices interact with future earnings, a full nonlinear simultaneous equation system is necessary. Given the small sample size, however, I here assume that students' college type is exogenous, and I focus on public college students and their choice of in which state to go to college. This is a reasonable simplification, since, as discussed above, the difference between public college students from out of state and from in-state appear even stronger than the difference between public and private college students, suggesting that selection of college state might be of first-order importance. In later sections, I will discuss selection between private and public colleges, as well as selection of both college type and college state.

In the wage equation, the state of college dummy variables will be correlated with the error term if unmeasured factors that determine earnings are correlated with actual college location. For example, students who actively participated in extracurricular activities may be more ambitious and have more leadership quality; these qualities are likely to help them get into good colleges. Meanwhile, these qualities could also help them succeed in their careers regardless of the college they have attended. I use instrumental variables (IV) to account for this endogeneity. The instruments used are distances between the capitals of a student's state of high school and each of the 51 potential college states; to explore individual level variation, I also include interactive terms between the distances and individual SAT score and parental income. These variables are uncorrelated with the unexplained part of the earnings, and they are also reasonably powerful predictors of actual college location: in a conditional logit model where each individual chooses to go to college in one of the 51 states, distance and the two interactive terms jointly explain about 70% of the variation in the dependent variable.

4.1.2 Selective Migration

College graduates from different states choose where to work and live based in part on their comparative advantage in different regional labor markets. Therefore, in any given local labor market, the underlying distributions of college graduates from different states are different, and the differences are correlated with individual earnings. Without adequate control for these heterogeneities, value-added estimates will be inconsistent.[11]

Formally, after controlling for individual characteristics, the earnings of an average individual educated in state k and working in region l can be decomposed to

$$\bar{y}_{kl} = \mu + \beta_{3_k} + \beta_{4_l} + \delta_{kl}, \tag{2}$$

i.e., into a state of college fixed effect, a region of residence fixed effect, and an interactive term

[11] Non-random migration has posed a serious issue in estimating returns to education in different labor markets, see, for example, Borjas et al [1992] and Dahl [2002].

that captures all unmeasured factors influencing both earnings and migration decision. $\delta_{kl} = 0$ when selective migration is absent. Normalize $\beta_{3_1} = 0$, the value added by state k is

$$\beta_{3_k} = (\bar{y}_{kl} - \bar{y}_{1l}) - (\delta_{kl} - \delta_{1l}).$$

Thus, β_{3_k} is identifiable from the OLS estimation of Equation (1) if all the interactive terms are zero. When $\delta_{kl} \neq 0$, the estimated value-added by state k is confounded by the selective migration factors. The direction of the bias can go either way. Heckman et al [1996] provide a comprehensive discussion of this selective migration issue.

In the regression analysis, I use two variables to control for individual heterogeneities due to selective migration. The first is an individual's college GPA ranking within one's state of college. GPA may be interpreted as a signal for both observable human capital and unobservable characteristics such as ability combined with inputs of time and effort. Students with high GPA are likely to find good job opportunities anywhere, and are also likely more productive at work. On the contrary, students with low GPA might only have job opportunities at limited locations and be less productive at work. Since I use GPA ranking normalized within states, its inclusion does not affect the level estimates of the state fixed effect.

Individuals differ in other dimensions, such as personal connection, which could affect both job search and earnings. I use the distance between the capitals of one's state of college and state of current residence to control for all the other heterogeneities. Since travelling longer distance is usually associated with higher costs of migration, both physically and psychologically, only those expecting a larger earnings gain will travel longer distance.

4.2 Estimation of State College Quality

4.2.1 IV estimation

In the wage equation, to control for differences in pre-college achievement, I include as an explanatory variable the SAT score. Since education goes on both at school and at home, parents may have a profound impact on children's ambition and learning behavior, hence future outcome;[12] this impact is probably unlikely captured by any single test score. I therefore include a vector of family background variables to control for this unobservable impact, including race, gender, parents' education, and family income. Moreover, to control for common effects by state of high school, I use a vector of home state k-12 education quality measures, including state's NAEP math score for 8th graders in 1990,[13] pupil-teacher ratio, per student expenditure, and average teacher salary. Also included is state average income.[14]

To control for differences in labor market characteristics, besides GPA ranking within the state of college and distance between state of college and state of residence as discussed above,[15] I include experience, experience squared, and 8 dummy variables for regions of residence, with New England the omitted category.

Table 3 displays the IV estimates of the wage equation. Dummy variables for 46 states are included in the wage equation: Alabama is the omitted category, and the sample does not contain individuals going to public colleges in Arkansas, North Dakota, Rhode Island, and Wyoming. Signs of almost all of the control variables are consistent with expectations. Individuals having higher SAT score, higher parental income, more work experience, and having travelled longer distance to a labor market earn significantly more than otherwise identical individuals. College

[12]Family background might also affect individuals' access to labor market information.

[13]NAEP, National Assessment of Educational Progress, is the only nationally representative and continuing assessment of what America' students know and can do in various subject areas at grades 4, 8, and 12. The program started in 1969; however, state level NAEP scores have only been reported since 1990. Since available state scores for years 1990, 1992, 1996, and 2000 are highly correlated, I use the scores for 1990 to approximate state k-12 education quality for the mid and late 1980s.

[14]The purpose of including these variables is to control for any pre-college school and family influence, rather than to identify the effect of each of them. These variables might be highly correlated with each other, and not all of them may be included in the regression reported below.

[15]The distance between state capitals in thousand miles is used. It is calculated using the "Great Circle" formula:

$$distance = arccos\{[sin(Lat_k)sin(Lat_l)] + [cos(Lat_k)cos(Lat_l)cos(Lon_k - Lon_l)]\} \times M/1000,$$

where Lat_k and Lon_k are the latitude and longitude of capital k respectively, and $M = 69.16$ miles, the average value of a degree.

GPA ranking has a positive effect on earnings, but the effect is not highly precisely estimated. Note that black college graduates are not disadvantaged compared to their white counterparts; this could be explained by the fact that only about 5% of college graduates in the sample are black, while about 15% of the population of the same age group are black. Thus blacks in the sample are not representative of the black population; rather, they represent the most accomplished portion of the black population. Coefficients on the region dummies are not precisely estimated; however, there is some evidence suggesting that college graduates have the lowest earnings in the Mountain region and the highest earnings in the East-South Central region, consistent with Card and Krueger [1992].

The coefficients on state-of-college dummies are estimated with various degrees of precision, largely because the numbers of observations for states vary. The results suggest that on average, relative to the baseline state, Alabama, going to a public college in the majority of states increases the earnings of an average individual by a significant fraction. For example, going to a public college in California increases one's early career annual earnings by almost 45% relative to Alabama. The value-added ranges from about −30% by Kentucky and Maine to more than 50% by Maryland and New Jersey. A wald test of equality of value-added by different state public college systems can be rejected at the 1% significance level.

4.2.2 Other model specifications

Since the majority of students go to college within their home states, another way to approach the issue of college selection based on unmeasured individual characteristics is to assume that students' college locations are exogenous, but they choose between public and private colleges. Since states differ substantially in in-kind subsidies to higher education, grant aid to college students, and attributes of private colleges, observably identical students in different states could face considerably different choice sets and costs of colleges and make different choices between these two types of colleges. This could lead to variations in the underlying distribution of public college students across states.

To correct the bias caused by individuals' self-selection into the public sector, I apply Heckman's [1979] two-step method by first estimating a probit choice equation between public and private colleges and then estimating the wage equation augmented with the estimated inverse Mill'e ratio. The choice is based on comparing expected net benefits obtained from attending public and private colleges, which in turn depends on individuals' expected future earnings and expected cost of attending both types of colleges. The necessary conditions to identify the coefficients of the augmented wage equation are the functional form and the inclusion of supply-side variables that determine the expected cost of attending a particular type of college, such as average tuitions of public and private colleges in one's high school state, average state need-based aid to undergraduate students, and percentages of freshman as college-age population in public and private colleges.[16] In doing this, I assume that college costs affect the selection of college type but do not directly affect labor market outcomes.[17]

In the third specification, I deal with individual decision of whether to go to public or private college and in which state to go to public college simultaneously. Conceptually, I first deal with the choice between college types as if students all go to in-state college; then, focusing on public college students, I deal with their choice of college location. Technically, I apply IV estimation on the wage equation augmented with the estimated inverse Mill's ratio. The IV procedure produces consistent estimates of value-added under the assumption that the error term in the probit selection equation is uncorrelated with the state-of-college dummy variables; otherwise, the augmented wage equation is nonlinear, and IV estimates are inconsistent.

To facilitate comparison, I also estimate the wage equation with OLS. Correlation coefficients between each pair of value-added estimates are reported in Table 4. In addition, I calculate correlation coefficients between these value-added estimates and the two traditional quality measures based on Barron's selectivity index. First, all the value-added estimates are highly correlated with each other; independence between each pair is rejected at 0.001 significance

[16] I also estimate the model using tuitions and college slots for students' region of high school; the results are very similar.

[17] See Willis and Rosen [1979] for an excellent explanation of the identification conditions.

level. This suggests that, despite the imperfect nature of the data, the estimates capture the fundamental pattern of the value-added by state college systems. Second, the OLS estimates are more correlated with estimates from Heckman two-step method, suggesting that selection between college types might not be a serious issue in this context or that better model is needed to deal with this problem. Third, value-added estimates are not highly correlated with traditional quality measures based on Barron's. This suggests that traditional measures do not reflect the performance of colleges, probably because they are mainly based on students' characteristics, rather than on the college production relationship. Using Barron's selectivity index to gauge college performance could be misleading.

4.3 Nonparametric Tests of Selective Migration Concern

We are concerned that the migration decision is not adequately accounted for by regressors in the wage equation, in particular, college GPA ranking and distance. If severe selective migration is present, then the value-added estimates are likely much contaminated by interactive terms between state of college and state of residence.

I conduct two nonparametric tests to show that coefficient estimates of state of college dummies do indeed capture primarily the value-added by state colleges. This is done by examining whether individuals going to public colleges in the same state tend to have the same relative rank in wage distributions in all the regional labor markets. Absent interactions between state of college and region of residence, the state of college wage rankings will be invariant across all regional labor markets. On the other hand, lack of consistency in wage ordering could point to either that state of college does not matter, or that interactions are a severe issue, or both. In the latter case, results from the regression analysis above would not have a clear interpretation. In the analysis, to control for individual heterogeneity, I use as wage measures the residuals from an OLS estimation of the wage equation, controlling for individual characteristics.[18] Due

[18] The regression includes all the variables from the wage equation except for the state of college and region of residence dummies.

to data limitation, I compare state-of-college wage rankings in four big regional labor markets: Northeast, South, Midwest, and West.

First, I calculate Kendall's coefficient of concordance for state-of-college wage rankings over the 4 regional labor markets(W), and the p-value that indicates the significance level at which the null hypothesis, $W = 0$, can be rejected.[19] For the 17 states that "send" at least 2 graduates to all 4 labor markets, $W = 0.38$ and $p = 0.09$. For the 10 states that "send" at least 3 graduates to all 4 labor markets, $W = 0.46$ and $p = 0.075$. For the 7 states that "send" at least 4 graduates to all 4 labor markets, $W = 0.5$ and $p = 0.06$. The low p-values indicate that the stability of state-of-college wage rankings across labor markets is not likely a result of chance. In addition, with larger sample size for each state, the concordance coefficient is larger, and the null hypothesis is more likely rejected. Due to the small sample size, the test does not give a conclusive statement of this stability, but it is highly suggestive that the disturbance due to interactions between state of college and region of residence is small, and the coefficient estimates of state of college dummies capture primarily the value-added by state colleges.

Second, I calculate the Pearson bivariate correlation coefficients for mean residual earnings of individuals educated in the same state over each pair of the 4 labor markets.[20] The correlation coefficients and their significance levels are reported in Table 5. For example, for the 19 states that have at least 40 students in the sample and "send" at least 2 students to both the South and the Northeast, the correlation between mean residual earnings of individuals educated in

[19]Kendall's coefficient of concordance: correlation between $k \geq 3$ (k regional labor markets) sets of n (n states of college) ranks of mean residual earnings.

$$W = \frac{\sum_{i=1}^{n} \left[R_i - \frac{k(n+1)}{2}\right]^2}{\sum_{i=1}^{n} \left[ik - \frac{k(n+1)}{2}\right]^2} \in [0,1], \quad \text{and} \quad k(n-1)W \sim \chi^2(n-1),$$

where $R_i = \sum_{j=1}^{k} r_{ij}$ and r_{ij} is state i's rank in region j. $W = 1$ if perfect concordance, $W = 0$ if no concordance.

[20]Pearson bivariate correlation coefficient is defined as:

$$W = \frac{cov(y_l, y_{l'})}{\sigma_{y_l}\sigma_{y_{l'}}} \in [-1,1], \quad \text{and} \quad \frac{W\sqrt{n-2}}{\sqrt{1-W^2}} \sim t(n-2)$$

, where y_l is an $n \times 1$ vector of mean residual earnings of individuals educated in each of the n states and working in region l.

the same state but working in different labor markets is 0.42, which is statistically different from zero at 0.08 significance level.[21] Again, this provides evidence that the coefficient estimates do reflect primarily the value-added by state colleges.

5 College Quality and State Policies

I now turn to investigating how various aspects of state higher education policies affect the outcome of public colleges and universities. As in any firm, the outcome of higher education is produced by combining various inputs in different manners. In public colleges, input factors are largely influenced by state higher education policies approved by the state legislature. I hypothesize that state-of-college specific value-added depends on various input factors in a linear way,

$$\beta_{3_k} = \gamma_0 + Q_k \cdot \gamma_1 + \eta_k, \tag{3}$$

where Q_k is a vector specifying features of state k's public higher education system.

The peculiarity of college production, however, is that, besides inputs of faculty and physical facilities, there are two important inputs in the production of college training: the quality of individual student and the quality of the fellow students, or the peer group. First, quantity and quality of faculty and other inputs are in general subject to budget constraint, more than 50% of which is at the discretion of the state legislature. Second, one of the goals of the state higher education policy is to provide fair and reasonable access to higher education for all citizens of the state. To that end, a state legislature often establishes an enrollment target that is higher than what a private selective college would choose. Thus public colleges do not usually have the option of admitting fewer students in order to raise student quality. Other state policies, such as the "admission window," i.e., the percentage of students admitted who are below the minimum qualification, to what extent to honor affirmative action in the process of admission, and admission policies toward out-of-state students, will also contribute to shaping the student

[21] Table A3 reports correlation coefficients for states that have at least 40 students in the sample and "send" at least 3 students to the two regions under comparison. The results are almost identical.

body at large.

In the regression analysis below, I use current expenditure per student as an overall resource measure. Included in expenditure are categories mostly relevant for student learning: expenditures on instruction, academic support, and student services. Peer group quality is measured by the average of the median SAT scores of the entering class of state public colleges; differences in states' average SAT scores can be as large as more than 150 points, with Virginia, Florida, and Iowa in the lead, and Oklahoma, South Carolina, and West Virginia lagging far behind. Quality of individual students is already controlled in the first stage regression.

As documented in the Introduction section, states differ not only in the level of their support to higher education, but also in how they allocate resources to different types of colleges, or how diverse their colleges are. Diversity is expected to have a positive effect on college performance since it could provide meaningful choices to those planning to attend college, hence better match between students and institutions (Hoenack and Collins [1990]). This diversity of college provision is measured by the standard deviation of per student expenditure of public colleges within a state. I also include the percentage of undergraduates in research I universities to tests the possibility that undergraduate learning may be influenced by the presence of faculty research and doctoral students. On the one hand, this could mean diversion of resources and detraction of faculty effort from undergraduate teaching; on the other hand, this can also mean available cheap labor to teach undergraduates and more vigorous academic environment conducive to learning in general.

The second stage regression relates state college performance to state policy variables, as symbolized by Equation (3). However, the actual state performance is not observed; instead we obtain from the first stage regression an estimated performance measure. Using the first stage estimates implies an additional error to the second stage regression because of sampling error:

$$\hat{\beta}_{3_k} = \beta_{3_k} + \mu_k.$$

Thus, the second stage regression becomes:

$$\hat{\beta}_{3_k} = \gamma_0 + Q_k \cdot \gamma_1 + \eta_k + \mu_k. \quad (4)$$

Because the sampling variances of the estimated performance differ across states, μ_k is heteroskedastic. I assume that the variance of μ_k is proportional to the first stage sampling variance of β_{3_k} and apply generalized least squares (GLS) in the second stage. I first estimate Equation (4) using ordinary least squares (OLS). Next, I regress the square of the residuals from the OLS on the sampling variance of the state performance estimates. Finally, I use the inverse of the predicted square of the residuals from this auxiliary regression as the weight in the GLS estimation of Equation (4).

Table 6 presents regression results of the GLS estimation of Equation (4). A series of model specifications are estimated. The first specification is the crudest one, including only peer quality and overall expenditure per student. Peer quality appears to have a strong positive effect on college performance: a 100-point increase in peer's SAT score would increase the state value-added by about 19%. However, more expenditure does not appear to affect performance. In the following two specifications, I look at the effects of faculty quality and physical facilities separately. The expenditure measure is thus the non-salary expenditure per student. Faculty inputs are jointly measured by average faculty salary, faculty student ratio, and percentage of faculty members with a doctoral degree.[22] State colleges in Florida, Arizona, and California have the most Ph.Ds among faculty members, whereas Hawaii, West Virginia, and Maine have the least; the difference can be as large as more than 35%. In the last specification, the measures of college diversity and research university scope are included.

Several points are noteworthy. First, once expenditures on faculty and facilities are separated, expenditures on physical facilities appear to have a negative effect on college performance. This is quite unexpected and appears puzzling. Since the expenditure includes the part spent on graduate education, it is hard to know how much is actually contributed to undergraduate

[22] Salary also includes compensation to support staffs; faculty student ratio is the ratio between total number of faculties and total number of FTE students, including graduate students.

education. Moreover, even though the included categories are most relevant to student learning, the expenditure variable still includes items for purposes other than improving students' future labor market productivity, which could be essential components of the college education. There is also the possibility that state colleges simply do not spend money efficiently. To better understand the impact of expenditure on future earnings, more detailed information on expenditure is needed; this type of information is not currently available. Second, faculty quality has a positive effect on college performance; this is primarily reflected by the coefficient on Ph.D. percentage. A 10% increase in faculty members with a doctoral degree would increase the value-added by about 8%. Also note that when Ph.D. percentage is included, peer effect gets smaller and less precisely measured, presumably as a result of multicollinearity between peer quality and Ph.D. percentage; the correlation between the two variables is 0.48, different from zero at 0.001 significance level. Third, more diversity in state public colleges is beneficial to college students at large, while the effect of research universities is not clear.

One might be concerned that expenditure per student and faculty salary are both correlated with state average income, hence the estimated relationship being spurious. To test the robustness of the above results, I use the values of these variables relative to state income as regressors instead. The GLS estimation results are qualitatively identical, and they are reported in Appendix Table A4. Using as dependent variables the value-added estimates from Heckman two-step method, IV on augmented wage equation, and OLS, the second stage regressions all generate very similar results. Thus, we are reassured that the estimates capture, to a large extent, the relationship between value-added and state policies.

One precaution in interpreting the above results is the presence of bias caused by omitted state level variables. More specifically, with a single cross-section data, it is impossible to control for state fixed effects (such as weather), which might have a strong impact on public college qualities. Moreover, information for certain other relevant variables (such as college governance structure) might be unavailable; thus it is not possible to identify the impacts of these variables on the performance. If the omitted variables are correlated with the included variables, the coefficient estimates of these variables are biased. In this case, as discussed at length in Hanushek et al [1996], the estimated effects are usually stronger than what they really are. Without information for other cohorts, this problem might be hard to solve.

6 Conclusion

This paper represents a first attempt to investigate differences in the performance of state public college systems and to understand what aspects of state higher education policies may cause any estimated differences. Controlling for individual selection into a state public college system, I find, despite the imperfect nature of the data, considerable variation in value-added by state public college systems. This variation is not reflected by traditional measures of college quality based on Barron's selectivity index. Moreover, higher faculty quality and more quality differentiation in public colleges appear to lead to better performance of state public colleges. The results suggest that, states can improve the overall college quality more efficiently by providing more differentiated public colleges, thus giving students more choices among colleges and permitting better matching of students with colleges. More differentiation also means that resources could be more concentrated; thus states could capture the gains from economics of scale by eliminating wasteful duplications. A complementary policy suggestion could be that states should encourage resource sharing among colleges, thus students in less resourceful colleges could also have the opportunity to benefit.

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Table 1
Characteristics of State 4-Year Colleges and Universities in 1988-89

	Mean	*Median*	*Std Dev*	*Minimum*	*Maximum*
State appropriation to public universities per FTE[1]	$5,698	$5,599	$1,654	$2,625	$10,125
FTE undergraduates weighted average tuition in public universities	$1,621	$1,540	$565	$650	$3,349
Expenditure per FTE[2]	$6,046	$5,942	$1,173	$3,870	$9,495
% Freshman in public colleges as population of 17-year old	36.8%	34.6%	12.8%	13.0%	77.8%
Standard deviation of expenditure per FTE[2]	$2,198	$1,858	$1,488	0	$8,889
% Undergraduates in research I universities[3]	49%	47%	18%	20%	89%
Need based aid to undergraduates per FTE[4]	$122	$63	$136	$10	$592

Source: Author's calculation, based on IPEDS, NASSGAP, and census data.
[1]Not including District of Columbia, for which the value is 0.
[2]Included in the expenditure measure are expenditures on instruction, academic support, and student services.
[3]Based on 45 states: Alaska, District of Columbia, Montana, North Dakota, and South Dakota do not have research I universities, and the percentage for Wyoming is 1 since it has only one public university which is in the research I category.
[4]FTE measure includes all undergraduate students in a state: both 2-year and 4-year, public and private.

Table 2A
Mean Values of Individual Characteristics by Institution Type[1]

	Private	*Public*	*Public Out-of-state*	*Public In-state*
1997 annual salary	$32,525	$32,102	$33,520	$31,753
SAT percentile	63%	60%	61%	59%
1990 parental income	$44,166	$35,000	$50,000	$30,489
Distance between state of college and state of residence (miles)[2]	331	198	450	136
College GPA ranking within state of college[3]	1.006	0.973	0.976	0.971
Father's education[4]	16	15	16	13
Mother's education[4]	13	13	15	13

Source: Baccalaureate and Beyond survey data.
[1]There are 5824 observations, of which 3997 (69%) are in public institutions, and 1827 (31%) are in private institutions. Of those in public institutions, 3206 (80%) are from within state, and 791 (20%) are from out of state.
[2]Based on students who migrated between continental states.
[3]College GPA ranking is the ratio between own GPA and the median GPA of state of college.
[4]Years of Education

Table 2B
Gender and Race Distributions by Institution Type

	all	*public*	*private*
Observations	5824	3997	1827
female	55%	54.4%	57.1%
male	45%	45.6%	42.9%
Asian	3.2%	3.7%	2.3%
Black	5.6%	5.3%	6.2%
Hispanic	4%	4.0%	4.2%
Other	3.5%	4.0%	2.4%
White	83.7%	83.0%	84.9%

Table 3
Wage Equation: IV Regression

Constant	6.989	[4.161]+	Hawaii	0.342	[0.384]
Female	-0.206	[0.015]**	Idaho	-0.214	[0.209]
Black	0.030	[0.034]	Illinois	0.283	[0.174]+
Hispanic	-0.050	[0.037]	Indiana	0.089	[0.160]
Asian	0.079	[0.041]+	Iowa	0.064	[0.240]
Other	0.042	[0.039]	Kansas	0.227	[0.231]
SAT/ACT percentile	0.307	[0.073]**	Kentucky	-0.318	[0.118]**
No SAT/ACT score	0.160	[0.050]**	Louisiana	0.416	[0.218]+
Ln(parent income)[1]	0.022	[0.007]**	Maine	-0.380	[0.310]
Age	0.011	[0.004]*	Maryland	0.511	[0.270]+
Experience	0.091	[0.011]**	Massachusetts	0.251	[0.292]
Experience squared	-0.006	[0.001]**	Michigan	0.260	[0.190]
Distance (residence state & Col state)	0.064	[0.021]*	Minnesota	0.140	[0.235]
Col GPA ranking in state of college	0.076	[0.050]	Mississippi	-0.013	[0.177]
HS state NAEP math, 8th graders 1990	0.650	[0.800]	Missouri	0.207	[0.186]
Ln (HS state median HH income)	0.129	[0.287]	Montana	0.204	[0.264]
HS state k-12 pupil-teacher ratio	-0.037	[0.042]	Nebraska	0.385	[0.260]
HS state k-12 exp per student[1]	-6.285	[3.400]+	Nevada	0.376	[0.243]
HS state k-12 average teacher salary[1]	0.871	[0.732]	New Hampshire	-0.048	[0.347]
Middle Atlantic	-0.027	[0.081]	New Jersey	0.527	[0.331]+
South Atlantic	-0.081	[0.074]	New Mexico	0.429	[0.170]*
East South Central	0.126	[0.103]	New York	0.519	[0.286]+
West South Central	0.035	[0.085]	North Carolina	0.248	[0.161]
East North Central	-0.018	[0.084]	Ohio	0.130	[0.153]
West North Central	-0.119	[0.088]	Oklahoma	0.114	[0.151]
Mountain	-0.152	[0.083]+	Oregon	-0.013	[0.234]
Pacific	-0.015	[0.084]	Pennsylvania	0.252	[0.208]
State of college			South Carolina	0.258	[0.169]
Alaska	-0.171	[0.569]	South Dakota	0.296	[0.234]
Arizona	0.303	[0.144]*	Tennessee	0.067	[0.117]
California	0.453	[0.243]+	Texas	0.142	[0.141]
Colorado	0.370	[0.208]+	Utah	0.254	[0.297]
Connecticut	0.311	[0.353]	Vermont	0.046	[0.309]
Delaware	-0.039	[0.342]	Virginia	0.290	[0.244]
DC	0.539	[0.559]	Washington	0.289	[0.251]
Florida	0.451	[0.208]*	West Virginia	0.383	[0.224]+
Georgia	0.298	[0.172]+	Wisconsin	0.107	[0.212]

[1]Values are ratios relative to median household income of high school state.

Instrumental variables for states of college are distances between high school state and states of college, and interactive terms between these distances and parental income and SAT percentile.
Alabama is the omitted category; sample has no observations for Arkansas, North Dakota, Rhode Island, and Wyoming.
Standard errors in brackets; + significant at 10%; * significant at 5%; ** significant at 1%
There are 3997 observations. The adjusted R^2 for the wage equation is 0.09.

Table 4
Correlation between Quality Measures

	Quality 1	Quality 2	Quality 3	Quality 4	FTE weighted average Barron's index for public colleges	% of undergrad in high quality public colleges
Quality 1	1	0.999**	0.523**	0.591**	0.159	0.129
Quality 2		1	0.529**	0.592**	0.178	0.145
Quality 3			1	0.964**	0.303*	0.276+
Quality 4				1	0.217	0.219
FTE weighted average Barron's index for public colleges					1	0.67**
% of undergraduates in high quality public colleges						1

+ significant at 10%; * significant at 5%; ** significant at 0.1%
Quality 1: IV estimates.
Quality 2: IV estimates, wage equation augmented by estimated inverse Mill's ratio.
Quality 3: Estimates from the Heckman two-step method.
Quality 4: Estimates from OLS.

Table 5
Pearson Correlation Coefficients of State-of-College Wages
across Region-of-Residence[1]

States that have at least 40 students in the sample and send at least 2 students to the 2 regions under comparison

	Northeast	South	Midwest	West
Northeast	1	0.42*	0.49**	0.04
		[19]	[17]	[19]
South		1	0.28+	0.40**
			[24]	[24]
Midwest			1	0.32*
				[24]
West				1

Numbers in each cell are correlation coefficient and number of states respectively.
+ significant at 15%; * significant at 10%; ** significant at 5%.
[1]Correlations based on mean residual earnings from the OLS regression of the wage equation, controlling for race, gender, age, parental income, ability, experience, experience squared, distance between state of college and state of residence, college GPA ranking in state of college, and state of high school variables.

Table 6
College Quality and State Policies: GLS estimation
Dependent variable: IV estimates of state college performance

	(1)	*(2)*	*(3)*	*(4)*
State average SAT/100 (peer quality)	0.187	0.162	0.103	0.176
	[0.089]*	[0.092]+	[0.095]	[0.097]+
Expenditure per FTE/1000	-0.023	-0.128	-0.161	-0.169
	[0.030]	[0.063]*	[0.066]*	[0.067]*
Average faculty salary/1000		0.007	0.004	0.003
		[0.005]	[0.006]	[0.005]
Faculty student ratio		0.462	0.829	0.950
		[4.394]	[4.292]	[4.262]
% Faculty with doctoral degree			0.802	0.616
			[0.486]+	[0.469]
% Undergraduates in research I universities				-0.034
				[0.153]
Standard deviation in exp per FTE				0.050
				[0.026]+
Constant	-1.397	-1.306	-1.158	-1.752
	[0.790]+	[0.853]	[0.833]	[0.868]+
Observations	46	46	46	46
Adjusted R^2	0.05	0.12	0.16	0.19

Standard errors in brackets; + significant at 10%; * significant at 5%; ** significant at 1%
Column (2), (3), and (4): expenditure per student does not include salary payment, but standard deviation does.

APPENDIX

Table A1
Characteristics of State 4-year Colleges and Universities in 2000-2001[1]

	Mean	*Median*	*Std Dev*	*Minimum*	*Maximum*
State appropriation to public universities per FTE	$7,408	$7,386	$1,853	$3,264	$11,282
FTE undergraduates weighted average tuition in public universities	$3,554	$3,091	$1,128	$2,231	$7,144
Expenditure per FTE[2]	$9,301	$9,264	$1,589	$6,036	$14,239
% of freshman in public colleges as population of 17-year old	22.7%	21.8%	7.5%	11.8%	42.7%
Standard deviation of expenditure per FTE[2]	$3,514	$3,151	$2,129	0	$10,205
% of undergraduates in research I universities[3]	46.3%	44.5%	16.9%	20.5%	86.1%
Need based aid to undergraduates per FTE[4]	$253	$196	$240	0	$930

Source: Author's calculation, based on IPEDS, NASSGAP, and census data.

[1]Not including District of Columbia.

[2]Included in the expenditure measure are expenditures on instruction, academic support, and student services.

[3]Based on 45 states: Alaska, District of Columbia, Montana, North Dakota, and South Dakota do not have research I universities, and the percentage for Wyoming is 1 since it has only one public university which is in the research I category.

[4]FTE measure includes all undergraduate students in a state: both 2-year and 4-year, public and private.

Table A2
Characteristics of Public Colleges Rated as Competitive
and Very Competitive by Barron's [1988]

	Mean	*Median*	*Std*	*Minimum*	*Maximum*
State appropriation to public universities per FTE	$5,610	$5,598	$1,518	$2,625	$10,093
FTE weighted average tuition in public universities	$1,683	$1,615	$553	$904	$3,350
Expenditure per FTE[1]	$5,960	$5,937	$1,009	$3,870	$8,318
Standard deviation of expenditure per FTE[1]	$2,296	$1,931	$1,508	$379	$8,889
% Undergraduates in research I universities	59%	60%	18%	18%	95%
% Freshman in public colleges as population of 17-year old	29%	28%	8%	15%	59%
Dollar values normalized by state median income					
State appropriation to public universities per FTE	16%	15%	4.4%	6%	25%
FTE weighted average tuition in public universities	4.8%	4.6%	1.4%	2.4%	9.1%
Expenditure per FTE[1]	17%	17%	2.9%	10%	23%
Standard deviation of expenditure per FTE[1]	6.8%	5.4%	5.4%	0.9%	34%

Source: Author's calculation, based on IPEDS, NASSGAP, and census data.
[1]Included in the expenditure measure are expenditures on instruction, academic support, and student services.

Table A3

Pearson Correlation Coefficients of State-of-College Wages across Region-of-Residence

States that have at least 40 students in the sample and send at least 3 students to the 2 regions under comparison

	Northeast	South	Midwest	West
Northeast	1	0.42*	0.50*	-0.09
		[15]	[11]	[15]
South		1	0.47*	0.33+
			[14]	[19]
Midwest			1	0.33+
				[18]
West				1

See notes for Table 5.

Table A4

College Quality and State Policies: GLS estimation

Dependent variable: IV estimates of state college performance

Dollar values are normalized by state median income

	(1)	*(2)*	*(3)*	*(4)*
State average SAT/100 (peer quality)	0.156	0.171	0.076	0.141
	[0.079]+	[0.080]*	[0.087]	[0.093]
Expenditure per FTE	-2.507	-6.684	-7.291	-7.571
	[0.999]*	[2.106]**	[2.046]**	[2.180]**
Average faculty salary		0.122	0.017	-0.001
		[0.204]	[0.201]	[0.202]
Faculty student ratio		1.381	1.982	1.447
		[4.216]	[4.012]	[4.048]
% Faculty with doctoral degree			0.877	0.753
			[0.404]*	[0.405]+
% Undergraduates in research I universities				-0.028
				[0.151]
Standard deviation in exp per FTE				1.387
				[0.826]+
Constant	-0.816	-1.188	-0.824	-1.357
	[0.746]	[0.800]	[0.781]	[0.841]
Observations	46	46	46	46
Adjusted R^2	0.15	0.19	0.27	0.25

See notes for Table 6.