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Crowded Colleges and College Crowd-Out: The Impact of Public Subsidies on the Two-Year College Market †

By Stephanie Riegg Cellini*

This study assesses the impact of an increase in funding for public community colleges on the market for two-year college education, considering both the effect on community college enrollments and on the number of proprietary schools in a market. I draw on a new administrative dataset of for-profit colleges in California and votes on local community college bond referenda to implement a unique regression discontinuity design. The results suggest that bond passage diverts students from the private to the public sector and causes a corresponding decline in the number of proprietary schools in the market. (*JEL* H75, I22, I23)

Two-year colleges enroll 41 percent of first-time freshmen and more than 6.6 million students every year (National Center for Education Statistics 2007),[1] yet surprisingly little is known about these institutions and their students. While a number of economists have studied public two-year colleges—more commonly known as community or junior colleges[2]—few have devoted attention to their private counterparts or to the interaction of the public and private sectors.[3] Private two-year colleges, often called proprietary schools, trade schools, vocational institutes, or for-profits, have been particularly difficult to study due to a lack of reliable data. This article begins to fill this gap. Using a new dataset of California proprietary schools and a unique identification strategy, I assess the extent of competition between

* George Washington University, Trachtenberg School of Public Policy and Public Administration, 805 21st Street, NW, 601M, Washington, DC 20052 (e-mail: scellini@gwu.edu). I am especially grateful to Janet Currie for her thoughtful comments and advice. I thank Moshe Buchinsky, Tom Kane, Ken Sokoloff, Bill Zame, Jean-Laurent Rosenthal, Dan Ackerberg, Enrico Moretti, Joe Hotz, Michael Rothschild, Jesse Rothstein, Bob Lerman, Leah Brooks, Latika Chaudhary, Wes Hartmann, and Matt Wiswall, as well as seminar participants in National Bureau of Economic Research (NBER) Economics of Education Working Group Meeting, University of California at Los Angeles (UCLA) Applied Microeconomics Seminar, and CeMENT's Public Economics group for helpful comments. I am grateful for financial support from the UCLA Center on Education Policy and Evaluation and the ASHE/Lumina Foundation for Education. A previous version of this paper was titled, "Funding Schools or Financing Students: Public Subsidies and the Market for Two-Year College Education."

† To comment on this article in the online discussion forum, or to view additional materials, visit the articles page at: http://www.aeaweb.org/articles.php?doi=10.1257/pol.1.2.1.

[1] In Cellini (2005), I show that this figure, based on data from the Integrated Postsecondary Education Data System (IPEDS), is likely to underestimate the number of sub-baccalaureate students in the country.

[2] See, for example, Thomas J. Kane and Cecilia Elena Rouse (1995, 1999); W. Norton Grubb (1993, 1995), Rouse (1995); Louis Jacobson, Robert LaLonde, and Daniel G. Sullivan (2005).

[3] A notable exception is a recent volume on for-profit education edited by David W. Breneman, Brian Pusser, and Sarah E. Turner (2006), but it focuses more heavily on four-year colleges. See Richard N. Apling (1993).

private and public sub-baccalaureate colleges, asking whether public funding for community colleges crowds private schools out of the market.

To address issues of endogeneity in the relationship between public subsidies, community college enrollment, and the number of proprietary schools in the market, I exploit a sharp discontinuity in public funding brought about by the passage of a local community college bond measure. I focus on counties in which these bond measures passed or failed by exceedingly narrow margins. For these marginal counties, I find that an increase of $100 million in funding for a local community college causes approximately 700 students per county, or about 2 percent of sub-baccalaureate students, to switch from the private to the public sector in the first year after bond passage, crowding out two proprietary schools in that county. These results suggest that students consider public community colleges and proprietary schools substitutes, particularly in vocational fields where course offerings exhibit the greatest overlap. In the short run, before bond-related infrastructure improvements are realized, public funding appears to contribute to crowded classrooms in the public sector while crowding-out private providers.

Effects in the medium-run, two to three years after bond passage, are more difficult to discern. Though weak, the results suggest further crowd-out of private institutions, but little, if any, enrollment gain in public institutions. It may be the case that public sector enrollment stagnates, or even declines, in the medium-term as colleges face constraints on physical space as they renovate. Although data limitations preclude analyses of longer-term effects, it is quite possible that community colleges will see enrollment gains five to ten years after bond passage as large-scale infrastructure improvements are completed.

Assessing crowd-out in the two-year college market is not only vitally important to the development of policies relating to community college expansion, student access to postsecondary education and training, and the regulation of for-profit colleges, but it can also inform broader debates. Issues of public-private crowd-out and competition arise in other educational contexts ranging from preschool[4] to four-year college,[5] and have taken on a central role in debates over charter schools, voucher programs, and other choice policies in K–12 education in recent years.[6] This study also contributes to an expansive body of literature assessing similar questions of public-private crowd-out in markets with substantial government involvement—notably health insurance,[7] medical care,[8] and charitable donations.[9]

[4] Gary T. Henry and Craig S. Gordon (2006), Henry M. Levin and Heather L. Schwartz (2007).

[5] Sam Peltzman (1973), Caroline M. Hoxby (1997).

[6] Thomas A. Downes and Shane Greenstein (1996); Thomas S. Dee (1998); Dennis Epple, David Figlio, and Richard Romano (2004); Kenneth V. Greene and Byung-Goo Kang (2004); Hoxby (1994, 2002); Derek Neal (2002); Robert McMillan (2005); and F. Mikael Sandstrom and Fredrik Bergstrom (2005).

[7] David M. Cutler and Jonathan Gruber (1996a, 1996b), David Card and Lara D. Shore-Sheppard (2004), Cynthia Bansak and Steven Raphael (2007).

[8] Mark Duggan (2000), Frank A. Sloan (2000), Martin Gaynor and William B. Vogt (2003).

[9] Richard S. Steinberg (1987), Bruce Robert Kingma (1989), David C. Ribar and Mark O. Wilhelm (2002), Gruber and Daniel M. Hungerman (2007), Gruber and Kosali Simon (2007).

I. Background

A. *Community Colleges: Public Providers of Two-Year College Education*

Community colleges are public institutions that offer a two-year associate's degree as their highest degree. There are about 1,050 community colleges in the United States serving more than 6 million students each year (National Center for Education Statistics 2007). Although each state's community college system has its own mission statement, virtually all community colleges share two common goals. One goal is to promote the transfer option, where students move seamlessly into their junior year at a four-year college upon the completion of the first two years at a community college. This is the traditional role that community colleges were designed to fulfill when the first so-called "junior college" opened its doors in 1901 (Steven Brint and Jerome Karabel 1989). In the 1970s, however, community colleges sought to increase their vocational offerings to compete with the growing proprietary school sector, establish a niche for themselves outside of the four-year college market, and promote economic growth through increased worker productivity (Brint and Karabel 1989; Craig A. Honick 1995). Today, a second goal of the colleges is to provide vocational training and retraining for the state's labor force through an array of short-term certificate programs (Kane and Rouse 1999).

This study focuses specifically on the market for sub-baccalaureate education in California. While the size and diversity of the state make it an ideal place to undertake a study of this type, it should also be noted that California is distinctive in many ways. Most importantly, California's community college system is by far the strongest in the country. The state's 1960 Master Plan for Higher Education stipulated an important role for community colleges in opening access to postsecondary education, and few other states rely on community colleges to the same extent (Patrick J. Murphy 2004; Cellini 2005). The state is home to 109 community colleges serving 1.1 million full-time equivalent students (or about 2.5 million students total), with an average of about 10,000 full-time equivalent students at each college (California Community Colleges Chancellor's Office (CCCCO) 2005). Tuition for a full-time, full-year student at a California community college is the lowest in the country at just $330 per year in the 2002–2003 academic year (Murphy 2004), reflecting the state's commitment to affordable education.

While the remarkably low tuition at community colleges opens access to education for millions of Californians, it also means that community colleges must rely heavily on public funding, as the cost of education is estimated to be about $4,419 per full-time student (California Postsecondary Education Commission (CPEC) 2003). The balance is covered by state funds, which provide 55 percent of total community college funding, and local property taxes, which comprise 39 percent (CPEC 2003).

Community college districts in California can supplement these funding sources by passing bond measures to provide a stream of income to local colleges over a specified period of time. The bond measures are put on the ballot by local community college boards and voted on by the residents of the county. Funds can range from a few million dollars to several hundred million dollars, and all bonds in

California are earmarked for capital improvements. The text of one typical bond measure reads:

> To provide greater access to the College of the Sequoias' educational opportunities by building two full-service educational centers including a Center for Agricultural Science and Technology, repair and renovate classrooms and facilities, provide handicapped access, give students increased access to computers for job training, build and acquire new classrooms and facilities, build a new Science Center and expand support facilities, shall the College of the Sequoias issue $49.2 million of bonds at interest rates below the legal limit? (Center for California Studies and Institute for Social Research 2005)

As the text of the bond reveals, its passage would increase the quality of the community college's facilities, expand the college's capacity, and perhaps enhance course offerings and career services. At the same time, the bond money frees resources to be used for other services and, therefore, can be treated as a general increase in the college's budget. While individual bond measures differ in wording and size, case studies of five bond measures reveal consistent patterns in community college bond outlays.[10] Bond money is generally scheduled to be used over 10 years, though one college planned to have projects completed in 8 years, and another in 12 years. Moreover, each college spends the money on multiple projects of varying sizes, and these appear to be spread evenly throughout the ten-year timeframe. In all cases, projects ranged from a few thousand dollars (e.g., a winery equipment pad cover) to several million dollars (e.g., a new performing arts center), with larger bond measures resulting in more projects of all types and sizes. As shown in the lower panel of Table 1, 101 community college bond measures were voted on in California counties between 1995 and 2002, ranging from $8 million to $658 million in value. I return to these referenda in the analysis that follows.

B. *Proprietary Schools: Private Providers of Two-Year College Education*

In contrast to community colleges, private sub-baccalaureate institutions are generally much smaller, more expensive, and more focused on vocational training (Cellini 2005). In one typical example, The Realty Institute offers just two certificate programs (real estate salesperson licensing and real estate broker licensing) offering courses in-person at its San Bernardino campus and online. At the opposite extreme, a few proprietary schools are quite large, such as ITT Technical Institute. ITT Tech offers a range of associate's degree and certificate programs in technical fields at more than 100 campuses nationwide.

Surprisingly little is known about these institutions. No publicly available national or state-level dataset has claimed to have a random sample—much less the entire universe of proprietary schools—making research on these institutions difficult at

[10] The colleges were Shasta, Butte, Napa Valley, College of the Desert, and Contra Costa College. All of these colleges provided public information on their Web sites detailing the nature of the bond measure and outlining project budgets and timelines. The amount of the bonds passed in these districts ranged from $34 million to $133 million.

best. Due to this lack of data, classifying these schools is also a daunting task. This study follows the definition of proprietary schools used by the California's Bureau for Private Postsecondary and Vocational Education (BPPVE), the department in charge of licensing these institutions, and the primary source of data for this study. The universe of schools includes for-profit and not-for-profit postsecondary institutions that offer any degrees or certificates lasting two years or less, though they may also offer more advanced degrees.

Most studies that describe private two-year colleges are based on nonrandom subsamples of schools in the 1980s.[11] In a notable exception, Turner (2006) describes state-level geographic variation in the number of for-profit colleges and the types of degrees offered. She finds that among all institutions of higher education, for-profits provide a disproportionate share of two-year associate degrees and less-than-two-year certificates.[12] In Cellini (2005), I survey the literature, assess existing data sources, and compare proprietary schools with community colleges along dimensions where data is available. I find that California's 3,827 proprietary schools are generally quite small, with an average enrollment of 350 students. Moreover, tuition is typically at least an order of magnitude greater than California's public community colleges, with charges generally costing between $3,000 and $10,000 per year.

II. Data

This study draws on a new and unique dataset of all legally operating proprietary schools in California from 1995 to 2003 to estimate the effects of public subsidies on the market for sub-baccalaureate education. I obtained the data from California's BPPVE, an arm of the Bureau of Consumer Affairs charged with registering all private postsecondary institutions that offer degrees or certificates lasting two years or less. The data include detailed information on each institution's opening (the date it received initial approval to operate), closing, location, accreditations, and programs offered, as well as information on religious and other exemptions.[13]

To this data, I add comprehensive data on the location and enrollment of California's public community colleges obtained through the CPEC and the CCCCO. Demographic information is taken from the California Department of Finance's Statistical Abstract, the Rand Corporation's California Statistics, and the US Census Small Area Estimates. Information on local bond referenda comes from the Institute

[11] See, for example, Apling (1993), Xing David Cheng and Bernard H. Levin (1995), and Richard W. Moore (1995).

[12] It is worth noting that this study also uses the IPEDS data (as this is the only national data available on these schools).

[13] Two additional points are worth mentioning. First, the data do not include any colleges accredited by the Western Association of Schools and Colleges (WASC). WASC accreditation is primarily for four-year colleges, though, in some cases (such as the University of Phoenix), these schools may also offer two-year degrees. Second, I exclude religious schools from the sample since these schools are subject to different rules and regulations than other proprietary schools. About 6 percent of the remaining (nonreligious) proprietary schools are considered not-for-profit by the BPPVE. Research on mixed-ownership industries (namely health care), shows that for-profits and nonprofits behave similarly on most dimensions—including efficiency, pricing, and quality (see Sloan 2000 for an excellent review of this literature). Moreover, Duggan (2000) finds that nonprofits that operate in markets with a large share of for-profits behave like pure profit maximizers. In light of these findings, I assume that nonprofit proprietary schools behave the same as their for-profit counterparts in the discussion that follows.

Table 1—Summary Statistics

Variable	Observations	Mean	SD	Min.	Max.
County data 1995–2003					
Number of prop schools per county	522	54	130.54	0	1,044
CC enrollment	522	16,543	37,587	0	305,917
Population	522	580,429	1,350,256	1,140	9,979,600
Population of neighboring county	522	610,724	1,353,861	9,325	9,979,600
Population growth	522	1.3	1.8	−2.8	21.0
Per capita income	522	25,739	8,854	14,476	68,650
Unemployment rate	522	8.6	4.42	1.6	29.4
Poverty rate	522	14.3	5.11	5.1	31.9
Percent white	522	66.9	18.4	18.9	100
Percent black	522	3.9	3.9	0.0	17.7
Percent Hispanic	522	22.6	15.1	3.4	73.9
Percent other	522	8.3	6.5	0.8	33.0
Percent age 0–14	522	22.1	3.7	11.7	30.2
Percent age 15–29	522	20.1	3.5	12.7	31.3
Percent age 30–49	522	30.4	2.8	25.3	42.1
Median home price	522	215,634	103,240	107,480	558,100
Bond vote data 1995–2003					
Year of bond vote	101	2001	2	1996	2002
Bond amount (in millions)	101	145	109	8	685
Bond passed	101	0.52	0.50	0	1
5 percent vote margin	101	0.38	0.49	0	1

Notes: Observations in the top panel are county-years, while observations in the bottom panel are number of bond referenda. "Prop" and "CC" refer to proprietary schools and community college, respectively. All dollar values reported in 2003 dollars.

Sources: Author's tabulations of data from the BPPVE, California Statistical Abstract, California Community Colleges Chancellor's Office, California Postsecondary Education Commission, and the Institute for Social Research.

for Social Research at California State University, Sacramento. Table 1 displays summary statistics of the data.

III. Market Definition

A. *Defining the Product Market*

It is not clear a priori whether we should expect community colleges and proprietary schools to compete in the same product markets. As noted above, the two types of institutions have some important differences and some striking similarities. Table 2 lists the average number of degree programs offered by proprietary schools and community colleges per county in California. In 10 out of 14 fields of study, such as administrative and support, finance and insurance, and technical trades, the difference between the number of programs provided by public and private institutions is indistinguishable from zero—suggesting that neither sector dominates the market in these fields. In these fields, one would indeed expect community colleges and proprietary schools to compete for students. In two fields, however, computers and real estate, proprietary schools offer significantly more programs, while community colleges dominate the food and bar field, and the humanities and arts.

These differences in program offerings speak to the role of each type of institution. Since community colleges offer the option to transfer to four-year colleges,

Table 2—Mean Number of Programs per County in California 2002

Program name	CC	Prop	Difference	*t*-stat
Administrative and support	26	21	5	0.54
Business	22	24	−2	−0.25
Computers	20	70	−50	−1.95
Construction and contracting	8	7	1	0.52
Finance and insurance	5	10	−5	−1.26
Food and bar	5	2	3	2.53
Health and medicine	24	19	5	0.50
Professional services	15	31	−16	−1.48
Real estate	3	18	−15	−2.80
Teaching	6	5	1	0.56
Technical trades	16	26	−10	−1.00
Transportation	13	15	−2	−0.42
Travel and hospitality	3	2	1	0.56
Humanities and arts	74	15	59	2.94

Note: "Prop" and "CC" refer to proprietary schools and community college, respectively.

Source: Author's tabulations of data from the Bureau for Private Postsecondary and Vocational Education and the California Community Colleges Chancellor's Office.

their emphasis on the humanities and arts is expected. Similarly, because of the small size and for-profit nature of proprietary schools, these institutions are likely to respond quickly to demand for training in new and growing industries. These differences suggest that these two types of institutions may cater to students with different needs, with the private sector responding to working students in need of vocational skills and the public sector attracting students interested in pursuing a BA. Still, without data on enrollment by field, it is difficult to assess the relative importance of these differences in program offerings. The data we do have suggest that weekend, evening, and distance-learning courses are essential elements of both types of institutions. About 72 percent of California community college students and 67 percent of proprietary school students enroll part-time or part-year, suggesting that both types of institutions offer flexibly-scheduled classes to meet the needs of working students. In contrast, only about 26 percent of four-year college students enroll part-time (National Center for Educational Statistics 2007).[14]

Finally, one might believe that even in overlapping degree programs, the two types of institutions might offer very different curricula, or different products. Table 3 compares private and public curricula for three different certificate programs. Comparing Alan Hancock Community College's Office Software Support Certificate to Atlas Computer Centers' Office Technician Certificate in the top panel, for example, reveals that both certificates require five courses, three of them with almost identical titles. The other two classes, despite their slightly different names, could easily contain similar content. The similarities continue in other fields, with many geared toward the same examinations or industry certifications, as evidenced in the field of real estate licensing in the bottom panel of Table 3,

[14] Again, this information is based on the IPEDS, but it is the only data available on student characteristics.

Table 3—Examples of Public and Proprietary Programs and Courses

Public CC	Proprietary
Santa Barbara County	
Alan Hancock College	*Atlas Computer Centers*
Office software support certificate Computer concepts and applications or Word processing applications Spreadsheet applications Database applications Internet business applications Presentation design	Office technician certificate Office computer basics Word processing with Microsoft Word XP Spreadsheets with Microsoft Excel Databases with Microsoft Access Intermediate office skills
Stanislaus County	
Modesto Junior College	*Central Valley Opportunity Center*
Maintenance mechanic certificate Introduction to technical industries Basic automotive system Automotive electricity 1 Automotive electricity 2 Automotive transmissions and transaxles Manual transmissions and drive axles Braking systems Steering, suspension and alignment	Automotive service and repair certificate Shop safety Tire repair and maintenance Oil change and lubrication Tune-up fuel systems Engine diagnosis Steering systems inspection and repair Brake service and repair Front-end alignment/suspension
San Bernardino County	
San Bernardino Valley College	*The Realty Institute*
Real estate certificate Real estate principles Real estate practice Real estate appraisal: residential Real estate finance Legal aspects of real estate Real estate economics or Introduction to accounting	TRI salesperson licensing courses Real estate principles Real estate practices Real estate appraisal Real estate finance Property management Real estate office administration
"The Real Estate program is designed to provide students with the course requirements for prequalification for the real estate sales or broker's examination."	"His home study courses have prepared thousands of students to enter the real estate industry, by offering salesperson and broker licensing and continuing education or license renewal courses."

Source: Individual school Web sites.

again suggesting that the two types of institutions might compete in at least some overlapping markets.

B. *Defining the Geographic Market*

While product markets are fairly easy to define, determining the geographic market for a two-year college education is more elusive. For simplicity, and because of the nature of the data, I assume that each county constitutes a separate geographical market. This introduces some measurement error since students may attend a school outside of their county, especially if they live near a county border. However, data from the 2000 National Postsecondary Student Aid Study (NPSAS) indicates that at the median, public community college students attend schools nine miles

from home. Students attending private for-profit institutions typically travel a bit farther, but remain, on average, 14 miles from home (National Center for Education Statistics 2000).[15] Moreover, changes that impact local sub-baccalaureate markets will undoubtedly spill over to neighboring counties. To the extent that spillovers occur, the effects will bias my estimates toward zero, underestimating the impact of any changes.

IV. Theoretical Framework

A. *Student Demand*

Passage of a community college bond measure is expected to strengthen the local community college system by increasing funding over the long term, expanding community college capacity, generating positive publicity for the college, and perhaps increasing the returns to a community college education.[16] As such, one would expect bond passage to generate an increase in community college enrollment, with larger bond values having a stronger influence on enrollment. While some of the enrollment effects of bond passage will take place over the long term as large-scale infrastructure improvements are completed, others may occur immediately as potential students learn about low-cost community college options or anticipate increased returns to their future degree. Further, a rapid enrollment response is made more plausible by the open enrollment policies of California community colleges, allowing students to enroll with no application or waiting time.

Finally, new students may be drawn to the public sector from either the extensive or intensive margins. At the intensive margin are vocational students, who, in the absence of the bond measure, would otherwise have attended proprietary schools. Students at the extensive margin are those who would otherwise not have attended college at all. These students might have been unaware of two-year college options before bond passage. Assessing the impact of bond passage on proprietary schools will help identify students shifting at these margins, revealing whether bond passage generates a net increase in going to college or, simply, a diversion of students from the private to the public sector.

B. *College Supply*

An increase in student demand for a community college education will have a much greater influence on the supply of proprietary schools than the supply of community colleges. Indeed, the number of California community colleges is not likely to respond to short-term fluctuations in student demand at all, since the creation of a new college must be planned more than five years in advance. The process requires the agreement of state voters, legislators, the California Department of Education,

[15] This is an especially small distance when compared to the average size of a California county. Tabulations of data from the California Department of Finance show that average county area is 2,689 miles, or about 52 miles in each direction.

[16] Note that even if returns to a community college education do not increase, as long as students expect their degree to be worth more in the future, enrollment will rise in the short term.

and the Board of Governors, making the addition of a new college rare (Master Plan Survey Team 1960).[17] Public colleges, therefore, adjust to student demand along the margins of enrollment and quality. Their private sector counterparts, on the other hand, also adjust along the margin of entry.

Proprietary school supply is likely to respond quickly to changes in student demand, as these schools are relatively unencumbered by bureaucratic red tape.[18] Drawing loosely on work by Timothy F. Bresnahan and Peter C. Reiss (1987, 1991), potential entrants into the proprietary school market calculate expected market demand for services, $E(Q)$, according to

$$E(Q) = S(\mathrm{CC}(\mathrm{BOND}), \mathbf{Y})\, d(\mathbf{X}). \tag{1}$$

$S(\mathrm{CC}(\mathrm{BOND}), \mathbf{Y})$ represents what the firm perceives to be the number of consumers of proprietary education in the population. CC denotes the strength of the local community college system as reflected in enrollments and is written as a function of bond passage (BOND). $\mathbf{Y}$ is a vector of demographic variables influencing the number of consumers in the market. Following Bresnahan and Reiss (1987, 1991), $\mathbf{Y}$ includes the population of the county, population growth, and the population of neighboring counties (in this case, the county that shares the largest border). $d(\mathbf{X})$ is the demand function of the representative consumer, where $\mathbf{X}$ is a vector of characteristics influencing a student's demand for proprietary school education, such as the poverty rate, the unemployment rate, per capita income, percent minority, and percent of the population in the age groups 0–14 years old, 15–29 years old, and 30–49 years old.

Assuming constant marginal cost,[19] the total costs of the N^{th} firm are

$$TC_N = MC_N(\mathbf{W})Q + FC_N(\mathbf{W}) = AVC_N(Q, \mathbf{W}) + FC_N(\mathbf{W}), \tag{2}$$

where $FC(\mathbf{W})$ = fixed costs, $MC(\mathbf{W})$ = marginal costs, $AVC(Q, \mathbf{W})$ = average variable costs, Q = firm output, and $\mathbf{W}$ is a vector of exogenous variables affecting the costs of the firm. Lacking data on rental rates and instructor salaries, I, again, follow Bresnahan and Reiss (1991) by including the median home price in the county to reflect the price of real property.

Calculating expected profits for the N^{th} firm yields

$$\prod_N = [P - AVC_N(Q, \mathbf{W})][E(Q(\mathrm{CC}(\mathrm{BOND}), \mathbf{Y}, \mathbf{X}))] - FC_N(\mathbf{W}). \tag{3}$$

Under free entry, if we observe N proprietary schools in a competitive equilibrium, it must be the case that the N^{th} entrant into the market makes zero economic

[17] The addition of new programs in an existing community college is more frequent, but colleges must still follow regulations set out in a 35-page book and get approval from the state Chancellor's office, making this process quite lengthy as well (CCCCO 2003).

[18] According to Patrick Dorais at the BPPVE, the licensing process for new schools is generally completed in four to eight weeks (phone interview on September 14, 2005).

[19] The assumption of constant marginal cost makes sense in this context if, for example, teaching comprises a large portion of the cost of education. I use it here for simplicity following Bresnahan and Reiss (1987). See Bresnahan and Reiss (1991) for a similar model assuming U-shaped marginal costs.

profits, and the $N + 1^{st}$ school would make negative profits. The number of proprietary schools observed in each market can, therefore, be represented as a function of CC(BOND), $\mathbf{X}, \mathbf{Y}, \mathbf{W}, P$, and Q.

This model of firm behavior has the advantage of allowing investigation into the factors that determine firm entry in the absence of data on prices and profits. To see this, equation (3) can be rewritten in terms of average variable profits. Letting average variable profits

$$V_N(\text{CC(BOND)}, \mathbf{W}, X_1) = [P - AVC(Q, \mathbf{W})]\, d(X_1), \tag{4}$$

where $X_1 \subset \mathbf{X}$, the profit function in equation (3) can be written as

$$\prod_N = V_N(\mathbf{W}, \mathbf{X}) S(\text{CC(BOND)}, \mathbf{Y}) - FC_N(\mathbf{W}). \tag{5}$$

Because firms enter the market until economic profits are zero, the profit equation can be linearized and rearranged to predict the number of proprietary schools observed in equilibrium as follows:

$$N_{ct} = \beta_0 + \beta_1 \text{CC(BOND)}_{ct} + \beta_2 \mathbf{Y}_{ct} + \beta_3 \mathbf{X}_{ct} + \beta_4 \mathbf{W}_{ct} + d_c + d_t + \varepsilon_{ct}, \tag{6}$$

where N_{ct} is the number of proprietary schools in county c and year t, and d_c and d_t are county and year fixed effects, respectively. As noted above, CC represents community college enrollment as a function of bond passage.

V. Estimation

There are two potential problems with equation (6) that confound causal inference. First, community college enrollment may, itself, be a function of the number of proprietary schools in the market, introducing simultaneity and resulting in inconsistency of ordinary least squares estimates. To mitigate this potential problem, I estimate the effect of bonds on community college enrollments and proprietary schools separately[20] according to

$$\text{CC}_{c,t+i} = \pi_0 + \pi_1 \text{BOND}_{ct} + \pi_2 \mathbf{Y}_{ct} + \pi_3 \mathbf{X}_{ct} + \pi_4 \mathbf{W}_{ct} + d_c + d_t + \xi_{ct} \tag{7}$$

and

$$N_{c,t+j} = \gamma_0 + \gamma_1 \text{BOND}_{ct} + \gamma_2 \mathbf{Y}_{ct} + \gamma_3 \mathbf{X}_{ct} + \gamma_4 \mathbf{W}_{ct} + d_c + d_t + \varepsilon_{ct} \tag{8}$$

[20] I estimate equations (7) and (8) separately to emphasize the impact of the policy on proprietary schools, but one could also estimate these equations jointly treating bond passage as an instrument for enrollment if $E(\text{CC}_{ct}, \text{BOND}_{ct} | \mathbf{W}_{ct}, \mathbf{Y}_{ct}, \mathbf{X}_{ct}, d_c, d_t) \neq 0$ and $E(\varepsilon_{ct}, \text{BOND}_{ct}) = 0$. As described below, the latter assumption is likely to hold only for subsamples of the data where bond passage can be considered exogenous. The resulting IV estimate of the impact of public sector enrollment on proprietary schools ($\hat{\beta}_1$) would be identical to $\hat{\gamma}_1 / \hat{\pi}_1$. For further discussion of the indirect least squares (ILS) approach in IV estimation, see Guido Imbens and Jeffrey Wooldridge (2007). For an excellent example of a similar RD-IV approach, see Joshua D. Angrist and Victor Lavy (1999).

for $i = 0, 1, 2$ and $j = 1, 2, 3$ to allow for lagged effects. The slight difference in timing reflects the idea that community college enrollment may respond more rapidly than proprietary schools, as students have considerable flexibility in enrollment. I explore this point further below. Moreover, because enrollment is measured for the academic year rather than the calendar year, the year of bond passage (academic year t) reflects the academic year that begins in September of the same calendar year and carries through the following June.[21]

As described above, **X** represents characteristics affecting student demand (poverty rate, the unemployment rate, per capita income, percent minority, and percent of the population in the age groups 0–14 years old, 15–29 years old, and 30–49 years old); **Y** represents factors affecting the number of consumers in the market (population of the county, population growth, and the population of neighboring counties); and **W** represents the cost of the firm (median home price). As a robustness check, I also estimate specifications excluding these covariates.

I rely on two different constructions of the BOND variable. First, I set BOND = PASS, where PASS = 1 in year $t \geq$ year of passage, and 0 otherwise. In the second construction, I allow the effect of the treatment to vary with the magnitude of the treatment, or the discounted value of the bond. That is, BOND = PASS $\times$ VALUE, where VALUE = the present discounted value of all bonds in place using a 10 percent discount rate, reflecting the patterns of community college bond spending described in the case studies noted above. Measuring the effects of community college bond measures in this manner also captures the likely reaction of a proprietary school entrepreneur. Because the initial passage of a bond signals a long-term pattern of increased community college quality and capacity, I expect the effect of the bond on the proprietary school market to be strongest initially and diminish in the medium-run: this effect will be stronger in counties with larger bond amounts. PASS $\times$ VALUE further allows me to account for multiple bonds that pass in the same county over the time period studied, by adding the discounted value of all bonds in place in a county at time t.[22]

A second and more significant problem in the equations above, however, is that time-varying omitted variables remain in ε_{ct} and ξ_{ct}, such as voter preferences, proprietary school profits, changes to local tax codes, industry mix, or the average education level of the population. If any of these omitted variables are correlated with bond passage, ordinary least squares estimates of $\hat{\pi}_1$ and $\hat{\gamma}_1$ will be biased. To mitigate this potential source of endogeneity, I draw on discontinuities derived from the bond measure vote shares to identify the effects of bond passage on the market.

[21] For example, if a bond passes in 2002 (elections are held January, March, June, or November), community college enrollment represents the total full-time equivalent enrollment in the 2002–2003 academic year (from September 2002–June 2003).

[22] Note that if multiple bonds passed in the same year, I include only the first bond. If a second or third bond is passed in later years, its present discounted value is added to this sum. For example, consider a county that initially passes a \$100 million bond then passes another \$50 million bond two years later. In this case, BOND = 0 in year $t - i$, 100 million in year t, $100/(1.1)$ in year $t + 1$, then $[100/(1.1)^2] + 50$ in year $t + 2$, etc. I am currently working on a paper that more fully addresses the dynamic nature of bond measure passage in the context of K–12 education (see Cellini, Fernando Ferreira, and Jesse Rothstein 2008). The 10 percent discount rate is adopted to follow the pattern of bond spending found in the five case studies noted in footnote 10. A range of discount rates of 5–25 percent yield very similar results and are available upon request. The mean value of the PASS $\times$ VALUE variable is 40.5 with a standard deviation of 150.

The identification strategy, based on the regression discontinuity approach first made famous by Donald L. Thistlethwaite and Donald T. Campbell (1960) and Campbell (1969), uses bond election vote margins to identify the causal effects of bond passage. I exploit a discontinuity that arises in counties in which bond measures passed or failed by exceedingly narrow margins: for example, by 2 or 5 percentage points. Among these counties, it can be argued that the passage of the bond measure was based on luck, or reasons unrelated to the characteristics of the two-year college market.[23] Unlike counties with "extreme" vote counts (e.g., 90 percent in favor of the bond), where voters are likely to have strong opinions about community colleges and proprietary schools, in "close" counties, the narrow margin of victory or defeat could have been caused by almost anything, such as low voter turnout on a rainy day or the miscounting of ballots. There is no compelling reason to believe that in these cases, bond passage is related to the characteristics of the sub-baccalaureate education market, making the fate of the bond arguably exogenous.

To see this, consider that bond passage is a deterministic function of the vote share, $\text{PASS}_{ct} = 1\{V_{ct} \geq v^*\}$ in a "sharp" discontinuity design (as described by Jinyong Hahn, Petra Todd, and Wilber Van der Klaauw (2001) where V is the vote share, and v^* is the threshold vote share needed for passage. As noted in Imbens and Thomas Lemieux (2007), if we assume that any remaining unobservable county characteristics are continuous functions of v, then, if vote margins in this limited "discontinuity sample" are narrow enough, $\lim_{v \uparrow v^*} E(N_{ct} | V_{ct} = v) - \lim_{v \downarrow v^*} \mathbf{E}(N_{ct} | V_{ct} = v)$ can provide the average causal effect of treatment at the discontinuity point: $\tau = E(N_{ct}(1) - N_{ct}(0) | V_{ct} = v^*)$ according to equation (8).[24] The equivalent argument holds for the impact of bond passage on community college enrollments in equation (7).

I implement the RD estimation on two restricted subsamples of the data using local linear regression.[25] In the first, I limit the sample to counties in which bond measures passed or failed with a margin of victory or defeat within 5 percentage points of the applicable vote threshold required for passage (for simplicity, I refer to this sample as the "5 percent sample" below). Interestingly, in 2000, California voters passed Proposition 39, lowering the vote share needed to pass a bond, v^*, from two-thirds to 55 percent.[26] The 5 percent sample is, therefore, constructed using counties with vote shares in the range of [61.7, 71.7] for elections requiring a two-thirds vote, as well as counties with vote shares in the range of [50, 60] for elections requiring 55 percent approval. The 5 percent window is chosen to allow for a sufficient number

[23] See for example, David S. Lee (2008) and Lee, Enrico Moretti, and Matthew J. Butler (2004) for a similar identification strategy based on elections.

[24] Note that in the specifications where BOND = PASS × VALUE, I obtain an estimate of τ that depends on the magnitude of the bond. I argue that within a narrow window around the vote threshold, there is no difference in bond value among bonds that passed and those that failed. Further, because I use county-year observations, the results reveal the impact of bond passage on the marginal county.

[25] See Imbens and Lemieux (2007), Imbens and Wooldridge (2007), and Lee and Card (2006) for further discussion of this method. For examples of its implementation, see Sandra E. Black (1999), Kane, Riegg, and Douglas O. Staiger (2006).

[26] It is worth noting that it is quite likely that the passage of Proposition 39 was not anticipated by colleges as this vote itself was quite close—just 3.3 percentage points above the threshold needed to pass (smartvoter.org 2007). Only two counties experienced close votes within a 5 percentage point margin under the two-thirds vote threshold requirement.

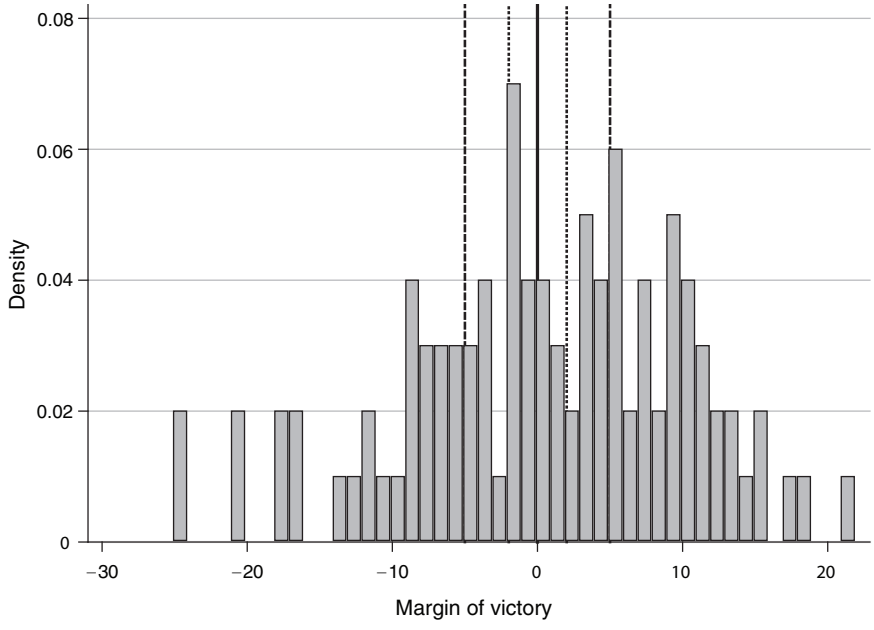

Figure 1. Density of Bond Measures by Margin of Victory

Notes: Votes are aggregated to 1 percentage point bins. Dashed and dotted lines denote ±5 and ±2 percentage points of the threshold needed for passage, respectively.

of observations for power (20 counties and 180 county-year observations) while still plausibly being considered a close election for identification of causal effects.

To better identify the effect of bond passage, the second discontinuity sample is constructed using a narrower window of just 2 percentage points around the relevant threshold (I refer to this as the "2 percent sample" below). That is, I include only the set of counties for which vote shares fell between the [53, 57] for the 55 percent threshold and [64.7, 68.7] for the 66.7 percent threshold. The narrower window, while aiding in identification, introduces quite a bit of noise, as the sample is limited to just 12 counties and 108 observations.

VI. Specification Tests and Graphical Analysis

Figure 1 plots a histogram of the density of community college bond measures by margin of victory, showing sufficient density of observations around the threshold. Further, as Justin McCrary (2008) points out, changes in the density around the cutoff may be indicative of sorting, if counties could somehow push their vote share over the threshold needed for passage. Figure 1 reveals no discontinuity in the density on either side of the threshold, suggesting that endogenous sorting is unlikely to be a problem. The only evidence of a discontinuity appears between bond measures that fail by 2 versus 3 percentage points. However, as there is no gain to a county from losing with 2 percentage points compared to 3 percentage points, this pattern is likely due to chance and the relatively small sample size, rather than

TABLE 4—COMPARISONS OF MEANS FOR COUNTIES WITH AT LEAST ONE FAILED BOND VERSUS COUNTIES IN WHICH ALL BONDS PASSED

	Full sample		± 5 percent sample		± 2 percent sample	
	Pass-fail (1)	*t*-stat (2)	Pass-fail (3)	*t*-stat (4)	Pass-fail (5)	*t*-stat (6)
Population*	−88	−0.44	462	1.79	−627	−1.92
Population of neighboring county*	292	1.21	1,463	2.62	−233	−2.20
Population growth	0.06	0.30	0.13	0.76	−0.14	−0.55
Poverty rate	−2.43	−3.88	0.07	0.08	1.64	0.97
Per capita income*	3.88	3.44	0.67	0.49	−1.93	−0.83
Unemployment rate	−1.54	−3.39	0.17	0.21	1.99	1.48
Percent black	−1.01	−1.84	1.46	1.72	3.23	2.12
Percent Hispanic	−1.22	−0.79	6.20	3.29	2.91	0.81
Percent other	2.69	2.80	3.29	3.30	4.32	2.56
Percent age 0–14	−1.34	−3.04	1.14	2.10	1.28	1.26
Percent age 15–29	−0.02	−0.06	0.57	1.69	0.06	0.11
Percent age 30–49	1.16	3.18	0.20	0.55	−0.54	−0.72
Median home price*	45	3.12	33	1.57	46	1.21
CC enrollment	7	0.13	14,074	1.97	−12,538	−1.43
CC completions	866	1.62	1,960	2.52	−1,455	−1.77
Average apportionment*	−47,000	−1.23	20,000	0.45	−144,000	−2.40
Bond value (in millions)	11.1	0.44	39.1	0.85	−49.7	−1.31

Notes: Fifty-eight counties are included in full sample, 20 counties are included in the ± 5 percent sample, and 12 counties are included in the ± 2 percent sample. County characteristics represent averages over the period of study (1995–2003).

* Denotes variables in thousands.

sorting. Further, no discontinuity is visible between bond measures that fail by 4 or 5 percentage points.

The key identifying assumption of the RD approach is that, within the limited samples, there are no mean differences between the group of counties that passed bonds and those that did not. If bond passage is truly exogenous, then given a large enough sample, the characteristics of the county and its sub-baccalaureate education market should be similar across counties in the 5 percent and 2 percent samples, regardless of bond passage or failure. Table 4 tests this assumption by comparing counties with bond passages and failures in the full and limited samples. For each sample, the left-hand column (columns 1, 3, and 5) lists the difference in means between the group of counties for which all bond votes passed in the time period we observe and those that had at least one bond vote fail. As might be expected, in the full sample, counties with higher income and housing prices, as well as lower poverty rates and unemployment, were more likely to pass community college bonds.[27] In the limited samples, however, the differences in these variables become insignificant, suggesting that the discontinuity approach may indeed decrease the bias over the OLS and fixed effects approaches using the full sample. While a few other observables reveal significant differences in each of the limited samples, only one variable, percent other race/ethnicity, reveals statistically significant differences that are of the same sign in all three samples. Taken together, the comparisons of means

[27] Differences in means were more extreme between the counties in the limited samples and those in the "extreme-vote" counties, where bonds passed or failed by large margins.

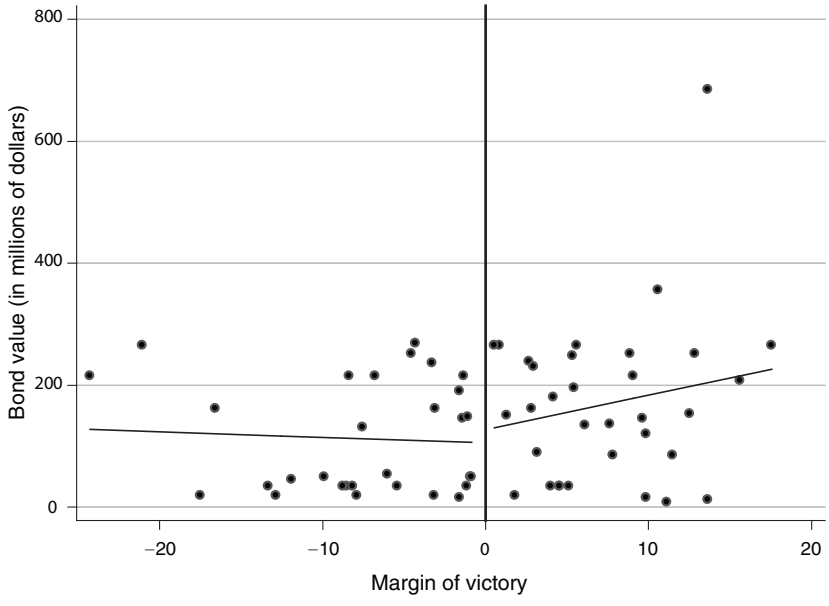

FIGURE 2. BOND VALUE VERSUS MARGIN OF VICTORY

Note: Fitted lines correspond to unconditional OLS regressions estimated separately on each side of the threshold.

suggest that there are few, if any, systematic differences between passing and failing counties near the threshold. Nonetheless, in my preferred specifications, I include the set of exogenous characteristics in the upper panel of Table 4 to gain precision and control for the remaining (nonsystematic) differences between treatment and control groups in the discontinuity sample (Lee 2008; Imbens and Lemieux 2007). As a robustness check, I also estimate specifications excluding these covariates.

One particularly important variable listed in the lower panel of Table 4 is the value of the bond measure, as it is used for identification where BOND $=$ PASS $\times$ VALUE described above. While the treatment-determining variable can be correlated with the outcomes in the overall population, it must be the case that there is no significant difference between average bond values in counties with bond passage and failure in the discontinuity samples (Lee 2008). The bottom row of Table 4 reveals that this is, indeed, the case. Plotting the relationship between bond value and margin of victory graphically in Figure 2 further reveals no discernable discontinuity at the threshold.[28]

Given the nature of community college funding, another variable of concern listed in Table 4 is state apportionments to community colleges. The state may choose to adjust its allocation in response to bond passage, potentially withholding funding from counties that pass bond measures. However, this does not appear to be the case. State apportionments to the colleges are based on a complicated funding

[28] Note that in Figure 2 and in Figures 4 and 5, I use a linear specification to plot the relationship on either side of the threshold. A more flexible control makes little difference.

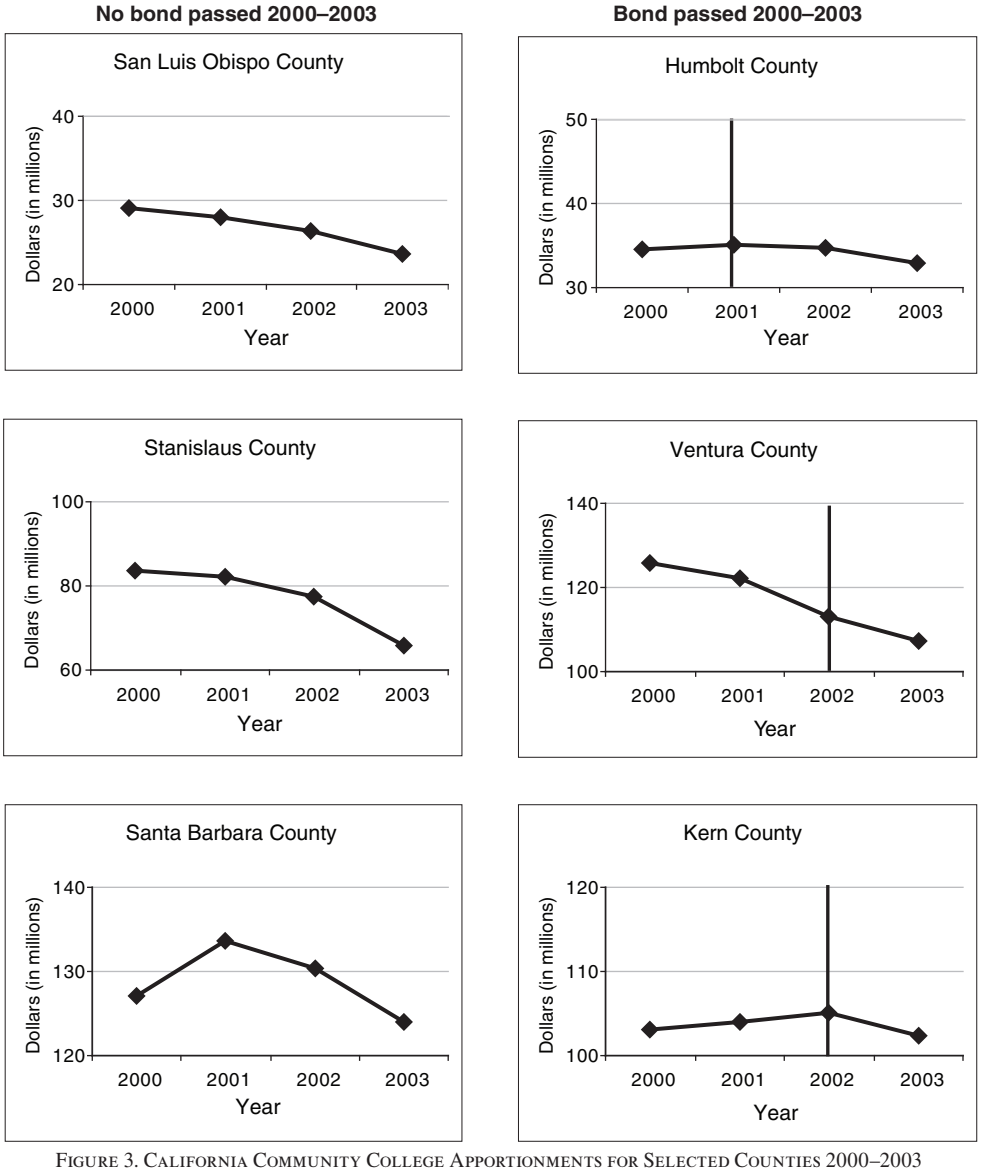

FIGURE 3. CALIFORNIA COMMUNITY COLLEGE APPORTIONMENTS FOR SELECTED COUNTIES 2000–2003

Note: Year of bond passage marked with vertical line.

Source: CCCCO and Institute for Social Research.

formula that takes into account projected student enrollments and local property tax revenues, but it specifically excludes any voter-approved debt in the accounting.[29] While not conclusive, Figure 3 confirms this lack of correlation graphically using apportionment data from 2000 to 2003 (the only years for which data were available) for a handful of counties for which the data were complete. Comparing the left-hand

[29] This information is based on funding formula instructions issued as a memo to county auditors by the California Community College's Chancellor's Office on March 26, 2002 (CCCCO 2005).

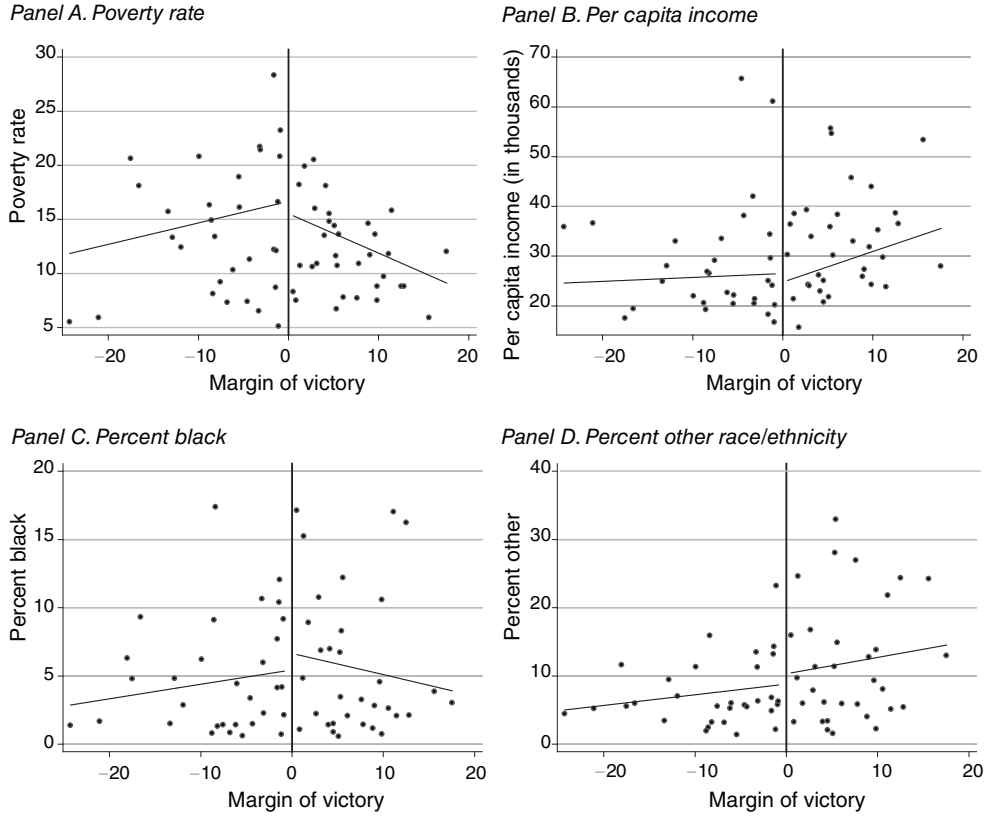

FIGURE 4. SELECTED COVARIATES IN YEAR $t + 1$ BY MARGIN OF VICTORY

Note: Fitted lines correspond to unconditional OLS regressions estimated separately on each side of the threshold.

panels to those on the right reveals no discernable differences in the patterns of state apportionments for counties that passed bonds during this period and those that did not.

Other variables may also confound causal inference if they vary discontinuously among counties that passed and failed bonds in the discontinuity sample. Figures 4A–D plot poverty rates, per capita income, percent black, and percent other race/ethnicity by the margin of victory for all bond measure referenda. In all of these cases, models linear in the covariate plotted separately for passages and failures reveal small or nonexistent jumps at the discontinuity, lending support to the assumption that unobservable characteristics of counties in the limited sample also vary smoothly across the discontinuity.

In contrast, Figure 5A, plotting community college enrollments by margin of victory, indicates a much larger jump at the threshold, potentially allowing identification of π_1 in equation (7). Figure 5B, which plots the raw number of proprietary schools in year $t + 1$ after a bond election against the margin of victory, also suggests that there is a discontinuity for this variable at the point of bond passage. However, the jump at the discontinuity is the reverse of what one would expect. It appears that the

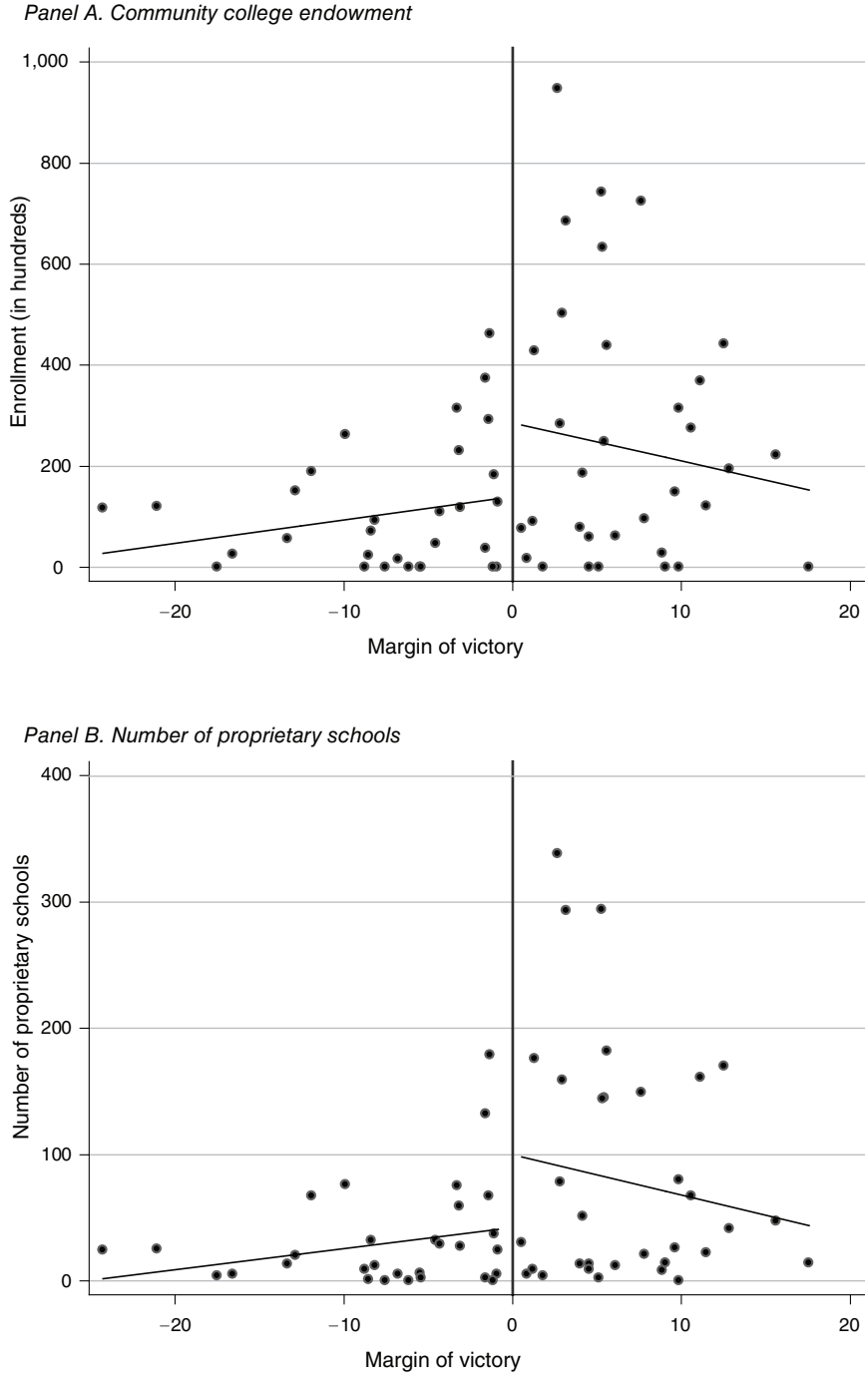

FIGURE 5. OUTCOME VARIABLES IN YEAR $t + 1$ VERSUS MARGIN OF VICTORY

Note: Fitted lines correspond to unconditional OLS regressions estimated separately on each side of the threshold.

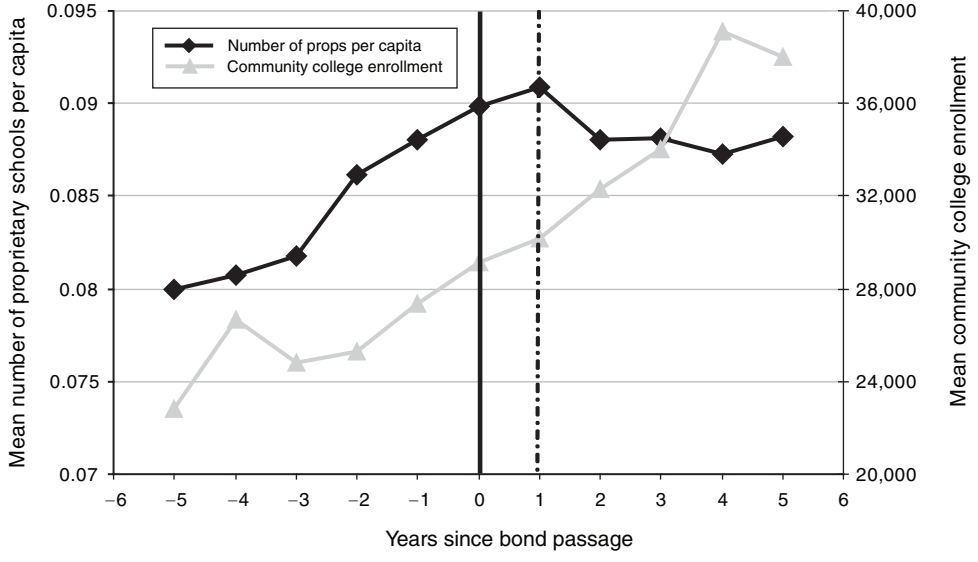

FIGURE 6. AVERAGE NUMBER OF PROPRIETARY SCHOOLS PER CAPITA AND COMMUNITY COLLEGE ENROLLMENT BY YEARS SINCE BOND PASSAGE

number of proprietary schools is generally higher in counties in which bonds passed. This might suggest that community colleges and proprietary schools are complements, rather than substitutes, or more likely, that there are numerous other factors correlated with bond passage and the number of proprietary schools that are not controlled for in the figure.

Exploring this pattern further, Figure 6 plots the mean number of proprietary schools per county per capita and community college enrollments over time for counties in which bond referenda passed, setting $t = 0$ to the year of passage. As the figure shows, the number of proprietary schools per capita appears to grow in the years before bond passage and continues to increase up to year $t + 1$, as seen in Figure 5B above—perhaps reflecting an increase in demand for sub-baccalaureate education. What is more striking, however, is that the number of proprietary schools begins a downward trend in the following year, suggesting a strong lagged proprietary school response. The temporal pattern of community college enrollment, on the other hand, is less obvious. It may be the case that enrollments increase more rapidly after bond passage through year $t + 4$, though this trend is not entirely clear in Figure 6.

VII. Results

Table 5 reports the results of the impact of bond passage (BOND = PASS) on community college enrollment and the number of proprietary schools in the market. The first specification uses OLS with the full set of exogenous covariates (i.e., population, neighboring county population, population growth, poverty rate, per capita income, unemployment rate, percent black, percent Hispanic, percent other, percent age 0–14, percent age 15–29, percent age 30–49, and median home price).

TABLE 5—EFFECTS OF BOND PASSAGE ON COMMUNITY COLLEGE ENROLLMENT AND NUMBER OF PROPRIETARY SCHOOLS

Independent variable:
PASS = *indicator variable for bond in place* (= 1 *in every year after passage*)

	Community college enrollment (in hundreds)			Number of proprietary schools		
Specification	acad. yr t (1)	acad. yr $t+1$ (2)	acad. yr $t+2$ (3)	year $t+1$ (4)	year $t+2$ (5)	year $t+3$ (6)
(1) Full sample cross-sectional OLS	20.621**	7.848	−2.579	0.566	−4.426	−3.069
(SE)	(9.297)	(8.567)	(10.815)	(2.688)	(3.532)	(4.376)
Observations	522	464	406	464	406	348
(2) Full sample fixed effects	15.383	12.069*	6.235	3.011	−3.080	−2.451
(SE)	(11.105)	(6.285)	(11.211)	(3.099)	(3.300)	(2.363)
Counties/observations	58/522	58/464	58/406	58/464	58/406	58/348
(3) 5% Discontinuity sample, conditional	35.525	25.923	25.704*	11.243	−0.240	1.699
(SE)	(34.404)	(20.959)	(13.343)	(7.978)	(5.135)	(2.690)
Counties/observations	20/180	20/160	20/140	20/160	20/140	20/120
(4) 5% Discontinuity sample, unconditional	11.218	4.901	−7.829	3.690	−8.630	−6.687
(SE)	(22.475)	(18.576)	(21.484)	(7.059)	(6.262)	(4.893)
Counties/observations	20/180	20/160	20/140	20/160	20/140	20/120
(5) 2% Discontinuity sample, conditional	48.058	40.167	17.192	13.419	−1.941	−1.515
(SE)	(33.981)	(25.085)	(19.727)	(12.336)	(7.796)	(7.486)
Counties/observations	12/108	12/96	12/84	12/96	12/84	12/72
(6) 2% Discontinuity sample, unconditional	14.363	12.640	−13.938	4.797	−11.832	−8.043
(SE)	(36.031)	(27.100)	(26.362)	(10.433)	(8.160)	(6.638)
Counties/observations	12/108	12/96	12/84	12/96	12/84	12/72

Notes: OLS, Fixed Effects, and Conditional RD specifications include the following variables: poverty rate, per capita income, unemployment rate, population, population of neighboring county, population growth, percent black, percent Hispanic, percent other race/ethnicity, percent of population age 0–14, age 15–29, and age 30–49, median home price, and dummy variables for county and year (in all except specification (1)). Standard errors (in parentheses) are clustered at the county level (except specification (1)).

***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

Specification (2) adds county and year fixed effects to the model. Specifications (3) and (5) include all covariates and fixed effects in the regression discontinuity (RD) specifications, using the 5 percent and 2 percent limited samples, respectively. Finally, as a robustness check, specifications (4) and (6) drop the covariates in the RD specifications.

Focusing first on enrollment in the left-hand panel (columns 1–3), the naïve cross-sectional OLS estimates reported in specification (1) reveal that bond passage is positively correlated with enrollment in the first year after bond passage. The results of the more reliable fixed effects and discontinuity specifications, however, are rarely significant at conventional levels. On the other hand, they are generally positive and large in magnitude, reflecting the increasing enrollments shown in Figure 6.

In the right-hand panel (columns 4–6), the effect of bond passage on the number of proprietary schools is also very imprecisely estimated. Nonetheless, the regression results reveal patterns similar to those depicted graphically in Figures 5B and 6: there may be a positive relationship between the number of proprietary schools in the first year after passage and a negative relationship in later years.

To account for bond size and spending patterns, Table 6 provides estimates of the impact of the second construction of the BOND variable, where BOND

TABLE 6—EFFECTS ON BOND MEASURE AMOUNT ON COMMUNITY COLLEGE ENROLLMENT AND NUMBER OF PROPRIETARY SCHOOLS

Independent variable:
PASS × VALUE = *Present discounted value* (10 *percent discount rate*) *of all bonds in place in year t* (*in millions*)

	Community college enrollment (in hundreds)			Number of proprietary schools		
Specification	acad. yr t (1)	acad. yr $t+1$ (2)	acad. yr $t+2$ (3)	year $t+1$ (4)	year $t+2$ (5)	year $t+3$ (6)
(1) Full sample cross-sectional OLS	0.105***	0.008	0.033	0.000	−0.053***	−0.054**
(SE)	(0.022)	(0.023)	(0.054)	(0.007)	(0.017)	(0.023)
Observations	522	464	406	464	406	348
(2) Full sample fixed effects	0.073***	−0.048	−0.020	−0.011**	−0.027***	−0.010
(SE)	(0.025)	(0.041)	(0.033)	(0.004)	(0.009)	(0.010)
Counties/observations	58/522	58/464	58/406	58/464	58/406	58/348
(3) 5% Discontinuity sample, conditional	0.050	−0.081	0.045	−0.017**	−0.017	0.025
(SE)	(0.050)	(0.054)	(0.067)	(0.008)	(0.018)	(0.023)
Counties/observations	20/180	20/160	20/140	20/160	20/140	20/120
(4) 5% Discontinuity sample, unconditional	0.214**	0.070**	−0.049	−0.019**	−0.036**	−0.019
(SE)	(0.078)	(0.031)	(0.057)	(0.007)	(0.017)	(0.011)
Counties/observations	20/180	20/160	20/140	20/160	20/140	20/120
(5) 2% Discontinuity sample, conditional	−0.066	−0.181**	−0.028	−0.051***	−0.043	0.038
(SE)	(0.067)	(0.068)	(0.096)	(0.012)	(0.031)	(0.029)
Counties/observations	12/108	12/96	12/84	12/96	12/84	12/72
(6) 2% Discontinuity sample, unconditional	0.272***	0.076*	−0.038	−0.013	−0.036	−0.009
(SE)	(0.073)	(0.037)	(0.065)	(0.010)	(0.022)	(0.006)
Counties/observations	12/108	12/96	12/84	12/96	12/84	12/72

Notes: OLS, Fixed Effects, and Conditional RD specifications include the following variables: poverty rate, per capita income, unemployment rate, population, population of neighboring county, population growth, percent black, percent Hispanic, percent other race/ethnicity, percent of population age 0–14, age 15–29, and age 30–49, median home price, and dummy variables for county and year (in all except specification (1)). Standard errors (in parentheses) are clustered at the county level (except specification (1)).

***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

= PASS × VALUE to reflect the discounted value of all bonds in place in each year.[30] Though still somewhat imprecise, community college enrollments do seem to respond positively to bond passage, at least in the first year. Focusing on specifications (1)–(3), the magnitude of the results suggest that for a $100 million bond, enrollment increases by between 500 and 1,050 students in the first year—suggesting some additional crowding at community colleges before bond-related infrastructure improvements and expansions are complete. The conditional 2 percent RD estimates in specification (5) reveal no significant impact of bond passage on enrollment, but the effects are large and positive in both of the unconditional RD specifications in rows 4 and 6. The differences between the conditional and unconditional estimates raise concerns that further unobservable differences in the treatment and control groups may remain, or that the limited samples are too limited to yield reliable estimates. In later years, we observe further differences in the conditional and unconditional estimates, and no consistent patterns in enrollment. In fact, there is weak evidence

[30] Specifications excluding Los Angeles county (available upon request) are a bit weaker, but qualitatively similar.

of a decline in enrollment two and three years after bond passage. A decline might be expected if, for example, construction projects limit enrollment in the medium term, a point I return to below.

While the impact of bond passage on community college enrollment is somewhat unclear, estimates of the impact on proprietary schools is much more consistent. The right-hand panel of Table 6 (columns 4–6) reveals consistently negative and significant impacts of bonds on the number of private two-year colleges in the market in the first three years after bond passage. Compared to the results in Table 5 and Figures 5B and 6, adjusting for the amount of the bond appears to make a difference in the sign of the effect in the first year. Larger bonds have a greater impact on proprietary schools, inducing a negative reaction even in the first year after passage. In the first year, the fixed effects results in specification (2) are smallest in magnitude, suggesting that just one proprietary school per county is forced out of the market with the passage of a $100 million bond measure.[31] The discontinuity results in rows 3–6 are somewhat larger, suggesting a slight downward bias in the full-sample fixed effects estimates. Unlike the results for community college enrollments, conditional and unconditional estimates are more similar. Both the conditional and unconditional 5 percent RD estimates in rows 3 and 4 suggest that roughly two schools are forced out of the market or discouraged from entering, when rounded to the nearest whole number. Despite the smaller sample sizes in the regression discontinuity approach, the results are still significant in three of the four specifications one year after bond passage. Community college funding continues to exert a negative impact on private two-year colleges in the second and third year after passage as well, showing some of the strongest effects two years later, though these are not always significant, and are likely due to the smaller sample size.[32]

VIII. Discussion

Despite the somewhat weak results for community college enrollment, the impact of bond passage on community colleges and proprietary schools revealed in Table 6 is remarkably consistent. Accounting for the fact that the average enrollment in proprietary schools is about 350 students (Cellini 2005), a net loss of two proprietary schools (resulting from the passage of a $100 million bond) would imply that roughly 700 students had shifted away from the private sector. Although measured imprecisely, it is noteworthy that the net gain in community college enrollments from a $100 million bond is also around 700 students, or between 500 and 1,000 students in the estimates reported above. These results suggest that bond passage may cause students at the intensive margin to shift from the private to the public sector. Based on rough estimates of community college and proprietary school enrollments that I report in Cellini (2005), a shift of 700 students accounts for about 2 percent of all two-year college students in the average California county.

[31] Note that the average size of a bond is actually larger, around $145 million, with a standard deviation of $109, as reported in Table 1.

[32] The results reported above are robust to dropping Los Angeles county and are only slightly weaker when focusing only on the majority of bond measures that were subject to the 55 percent vote threshold.

Despite this evidence of direct substitution between the private and public sectors in the first year after bond passage, it is not clear whether this effect persists in subsequent years. Community college enrollment effects appear to be immediately responsive to bond passage, yet short-lived. One possible explanation is imperfect information in the two-year college market. Potential two-year college students may simply be unaware of their public sector options. With limited budgets and virtually no advertising—a particular disadvantage relative to the private sector—community colleges may be overlooked by many local residents. Fewer still may know the extent of the programs and courses offered by the public sector, particularly considering that the growth in vocational fields has been relatively recent for many colleges.

In the presence of this type of market failure, bond passage may generate a temporary surge in awareness of these institutions. The positive media attention elicited after bond passage may increase demand for institutions that were previously overlooked. Consider, for example, a lengthy cover story in the *Santa Maria Sun* after a recent bond measure passed: "A Community's Trust at Work: The Face of Alan Hancock College is Beginning to Change Thanks to Measure I Funds." The article details a number of planned improvements, highlighting their potential impact on technology, nursing, and dental programs (Sarah E. Thien 2007). Such stories not only increase awareness of community colleges, but instill confidence in their programs, perhaps leading some to enroll immediately as they predict higher returns to their degree. Finally, with California's open admissions policy, enrollment in community college programs is remarkably quick. Students simply fill out a form or register online for an open spot in a course and they are automatically enrolled. Moreover, with weekend and alternatively-scheduled courses starting and ending throughout the semester, students are afforded much more flexibility in enrollment than in traditional four-year colleges, making a quick response to bond passage possible.

This initial boost in enrollment, however, may fade quickly. Positive publicity is likely to drop off sharply in the few years after bond passage, even turning negative if funds are misused or insufficient for planned improvements. Further, because new facilities and large-scale renovations take time and physical space, enrollment may actually decrease in the second or third year after bond passage. If, for example, some classrooms become inaccessible as they are upgraded, colleges may be forced to cut back their course offerings in the near term. While this drop in enrollment in the medium-run may be expected, enrollment would likely recover and grow over the longer term as large-scale facilities open, perhaps five or ten years after bond passage—a time frame far beyond the period studied here.

Unlike public sector enrollment gains, private sector crowd-out appears to persist into the second and possibly third years after bond passage. This may suggest that proprietary schools not only respond to current enrollment, but also anticipate heightened competition over the longer term as bond funding is capitalized. Further, because proprietary schools are notorious for their dependence on student tuition and financial aid, it may be that short-term enrollment shocks wreak financial havoc on these institutions, making medium-run sustainability infeasible.[33]

[33] Future research will explore this issue.

Despite data limitations, the estimates presented here support the notion that proprietary schools and community colleges compete in the same market and draw on an overlapping consumer base. More importantly, a marginal increase in public funding for sub-baccalaureate education does, indeed, appear to increase student demand for public sector education and crowd out private providers, yielding no net gain in college attendance in the short run. In the medium run, two to three years after bond passage, two-year college attendence may actually decline overall as proprietary schools continue to exit the market in the years following bond passage, with no offsetting increase in public sector enrollment. Over the long run, however, public sector enrollment is likely to increase as large-scale facilities improvements come online.

IX. Conclusion

This study assesses the impact of public subsidies on the market for two-year college education using a new dataset of California proprietary schools and a unique regression discontinuity approach. I exploit a sharp discontinuity in community college funding that occurs among the set of California counties in which local community college bond measures passed or failed by narrow margins. The results suggest that taxpayer support for local community colleges elicits an increase in community college enrollment in the short term and the exit, or lack of entry, of proprietary schools in the first few years after bond passage: a case of crowded colleges in the public sector and college crowd-out in the private.

The magnitude of the effects of the funding on community college enrollment and proprietary school entry is remarkably similar, suggesting that about 700 sub-baccalaureate students per county, or about 2 percent, are diverted from the private sector to the public sector for every $100 million increase in direct funding to community colleges. The results confirm that public and private sub-baccalaureate institutions are indeed competitors and draw from an overlapping student base. Moreover, bond passage appears to do little to increase two-year college attendence in the short term, and may even decrease human capital investment in the two to three years following bond passage, as proprietary schools exit the market and community college enrollments decline slightly. Over the longer run, large-scale facilities improvements in community colleges may serve to increase enrollment, but because we observe only three years after bond passage, these effects are as yet unstudied.

In light of these findings, policymakers should consider these two types of institutions together in designing effective policies in the two-year college market. If proprietary schools and community colleges offer education and training of equal quality, particularly in vocational fields where programs exhibit the greatest overlap, then the case could be made that public investment in sub-baccalaureate education should focus on promoting the transfer option in community colleges, while allowing the private sector to address the demand for vocational skills. Under certain conditions, such a change may enhance efficiency.

Turner (2006) contends that for-profit institutions may be particularly well-suited to provide vocational and pre-professional skills for several reasons. First, unlike liberal arts, these types of skills are relatively easy to observe and assess, for example,

with certification exams. Second, many national programs require minimal physical infrastructure, making it easy for new schools to enter the market. Further, for-profit institutions undoubtedly react more quickly than the public sector to fluctuations in student demand for education and training (James J. Heckman 2000, Turner 2005, 2006), potentially mitigating job loss and promoting retraining during economic downturns. And finally, research by Jacobson, LaLonde, and Sullivan (2005) finds that quantitative and technical courses in community colleges generate higher earnings gains than nontechnical courses such as humanities and social sciences.[34] To the extent that vocational courses are, by nature, more technical than academic courses, it is likely that private investment in vocational education will be closer to the social optimum in the absence of government intervention in the market.

But community colleges still play an essential role in the provision of two-year education. While the immediate labor market returns to lower-division academic coursework may not be apparent, sub-baccalaureate academic programs promote long-term gains by encouraging future enrollment in four-year institutions and the eventual attainment of a bachelor's degree. Indeed, many California community colleges offer students written guarantees of the transferability of their coursework to specific universities (CCCCO 2005). In contrast, the *Wall Street Journal* recently reported on the lack of transferability of credits earned in for-profit colleges (John Hechinger 2005). If students who are diverted from the private to the public sector by community college bond measures are more likely to transfer to four-year colleges, then a strong case can be made in favor of public investment in community colleges.

One additional reason to promote academic coursework in community colleges is that the per-student cost of education is lower in these institutions than in four-year colleges ($4,419 compared to $10,078 in the California State University system (CPEC 2003)), so educating students in community colleges for the first two years of a four-year college career would reduce the burden on taxpayers. On the other hand, some have argued that community college enrollment is not conducive to completing a bachelor's degree, even for students who aspire to that level of education. Interestingly, Brint and Karabel (1989) and Burton R. Clark (1960) blame this problem on the fact that community colleges offer so many vocational education and terminal degree programs. But even with these programs, Rouse (1995) shows that high school graduates starting their college careers in community colleges experience no change in the probability of attaining a bachelor's degree compared to students starting off in four-year colleges. If both sets of claims have merit, it may be possible for community colleges to increase the probability that students obtain bachelor's degrees in the future if they offer fewer vocational and more academic programs. As it stands, however, only about 4 percent of all community college students in the state, or about 42,000 students, transfer from community colleges to California's

[34] Note that in Jacobson, LaLonde, and Sullivan (2005) all courses were provided by a community college. Technical courses include vocational courses in health professions, technical trades (such as air conditioner repair), technical professional courses (such as software development), and math and science academic courses. The nontechnical group includes all other courses, including academic social sciences and humanities, courses in sales and service, physical education, English as a second language, and basic skills courses.

public four-year colleges each year (CPEC 2005), suggesting that more effort should be made to encourage students in academic fields to continue their education.

In assessing the welfare consequences of a change to a more segmented academic and vocational market, three further considerations are paramount. First, vocational students switching from the public to the private sector would likely pay a higher out-of-pocket price. While federal, state, local, and private sources of financial aid may cover much of the difference in cost between the private and public sector, it is likely that many students still pay more for a private education than for a similar program in the public sector. Second, even if sufficient financial aid is made available, in a market with imperfect information and overly complicated federal aid programs, a higher "sticker price" of private education may discourage many low-income students from pursuing a two-year college education (Christopher Avery and Kane 2004; Susan M. Dynarski and Judith E. Scott-Clayton 2006).

Finally, it is not at all clear that public and private two-year colleges offer education of comparable quality. While there is a substantial body of evidence on the returns to a community college education,[35] we know very little about school quality in the private sector. Without systematic data on graduation rates, earnings, job placement, or any other metric that might prove useful in measuring school quality in the private two-year college sector, it is impossible to assess the effectiveness of these institutions. Questions remain as to whether prospective two-year college students have full knowledge of their educational options and the relative quality of those options. With allegations of proprietary school fraud and abuse in the headlines almost daily, these questions have never been more important. Much more data, and more research, are needed to fully assess school quality, competition, and efficiency in the often overlooked market for two-year college education.

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[35] For an excellent review of this literature see Kane and Rouse (1999).

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