



Pennies on the Dollar

THE SURPRISINGLY WEAK RELATIONSHIP
BETWEEN STATE SUBSIDIES AND
COLLEGE TUITION

PRESTON COOPER

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A M E R I C A N E N T E R P R I S E I N S T I T U T E

Executive Summary

College tuition is one of the fastest-climbing prices in the modern economy. One proposed culprit for rising tuition at public colleges and universities is the “state disinvestment hypothesis”—the idea that tuition has risen because states have cut back on the direct subsidies they provide to public colleges. Since 2004, per-student direct subsidies to four-year public colleges have fallen by 15 percent, while net tuition rose by 56 percent over the same period. It is tempting to infer a link between the two.

However, the state disinvestment hypothesis falls apart upon closer scrutiny of the data. This report uses a fixed-effects regression method, which isolates underlying tuition trends from fluctuations plausibly caused by state disinvestment. At four-year public colleges between 2004 and 2015, every dollar of per-student subsidy cuts was associated with a tuition hike of less than five cents. State subsidies appear to have little, if any, effect on tuition levels at public colleges.

Rather than increasing tuition, public colleges respond to subsidy cuts by reducing spending, specifically

spending in areas not related to instruction such as research and administration. For every three to five dollars in subsidy cuts, spending on instruction goes down by one. Perhaps intuitively, expenditures tangential to the central educational mission of universities are the first to go when subsidies fall.

These findings have multiple implications. First, colleges appear to maximize tuition revenue at all times, and other revenue streams such as state subsidies are mostly independent from trends in tuition. Therefore, even if states had kept higher education subsidies at pre-recession levels, the upward trend in tuition would be little changed.

Second, were state governments to restore higher education subsidies lost during the Great Recession, universities would largely not use those funds to defray tuition for students or increase spending on instruction. It would take a \$20 or more increase in per-student direct subsidies to achieve just a one-dollar reduction in tuition. State policymakers aiming to reduce tuition burdens should look to policy tools besides direct subsidies.

Pennies on the Dollar

THE SURPRISINGLY WEAK RELATIONSHIP BETWEEN STATE SUBSIDIES AND COLLEGE TUITION

Preston Cooper

Why has college tuition risen faster than the overall rate of inflation over the past half-century? Scholars have offered various theories, including slow productivity growth and the wide availability of government subsidies. For public colleges, one possible explanation is the “state disinvestment hypothesis.” In recent years, state and local governments have reduced, on a per-student basis, the direct subsidies they provide to public colleges and universities in their jurisdictions. The state disinvestment hypothesis holds that to compensate for the lost subsidy revenue, colleges have increased tuition.

During the 2016 presidential election, Democratic nominee Hillary Clinton cited the state disinvestment hypothesis as a justification for her higher education policy proposals. “The barriers to obtaining a degree are becoming increasingly steep,” Clinton’s platform read. “The recession accelerated the trend of state disinvestment in higher education. . . . Colleges have responded not by tightening belts but by raising tuition, passing the costs on to students and families.” Clinton went on to propose a large federal investment in state public higher education systems with the aim of lowering or eliminating tuition.¹

Proponents of the state disinvestment hypothesis are correct that reductions in direct subsidies to public colleges have coincided with increases in tuition. In 2004, public four-year colleges received \$8,856 in direct subsidies from state and local governments for every full-time equivalent (FTE) student they enrolled.² However, that figure fell to \$7,537 by 2015—a reduction of \$1,319 or 15 percent. Meanwhile, tuition revenue per FTE student at these schools rose from \$6,223 to \$9,711 over the same time period—an increase of \$3,488 or 56 percent.³ (All figures are adjusted for inflation.)

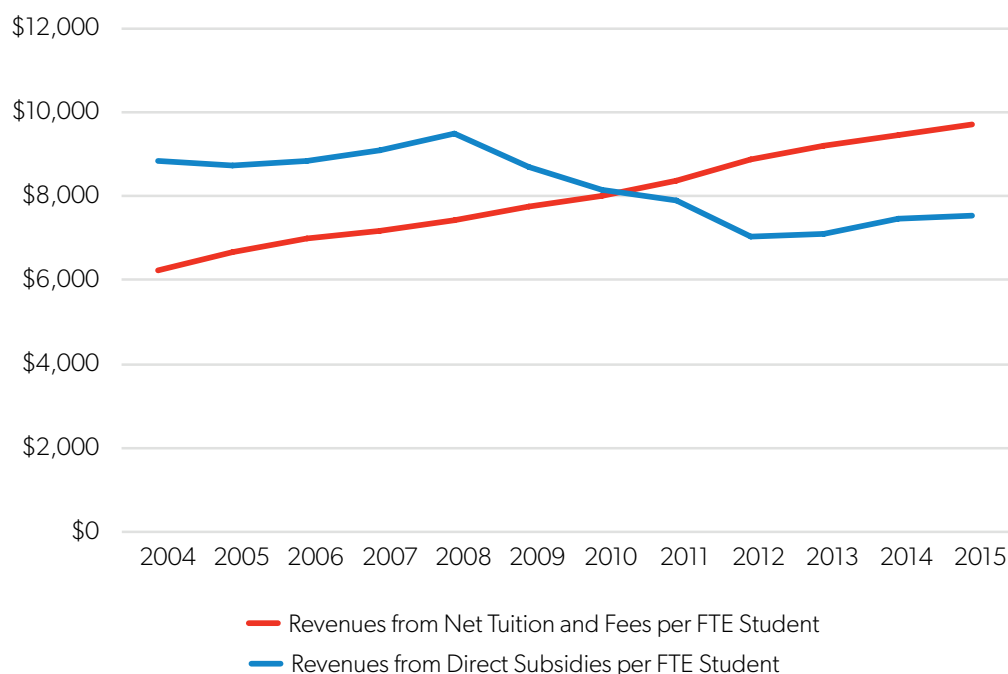
Figure 1 illustrates these trends. From 2004 to 2008, tuition and direct subsidies both rose at a steady rate. During and immediately after the Great Recession, tuition continued to rise. However, many states simultaneously made cuts to the portion of their budgets allocated to higher education to deal with falling tax revenue. Combined with a large increase in student enrollment, these cuts caused direct subsidies per student to fall substantially. The decline continued until 2012, when rising aggregate subsidies and flat enrollment caused direct subsidies per student to level off.

Proponents of the state disinvestment hypothesis often present the twin trends of rising tuition and falling subsidies as evidence of a causal link between the two.⁴ But this argument has two shortcomings. First, it fails to explain why tuition rises even during periods of increasing direct subsidies, such as 2004 to 2008 and 2012 to 2015. This phenomenon points to an underlying trend in tuition revenues that is independent of changes in direct subsidies.

Second, the divergent trends in tuition and direct subsidies are presented only at the *aggregate* level. Factors other than subsidies might have driven the rise in tuition during the recession, but we would never know it just by looking at the overall trends. Examining whether trends in tuition and subsidies line up at the *institution* level is necessary to identify the strength of the relationship between the two.

This report provides institution-level evidence on the relationship between tuition revenues and direct subsidies at public institutions. Specifically, it seeks to identify what share of reductions in direct subsidies are “passed through” to higher tuition revenues and vice versa. For instance, if a \$100 reduction in direct subsidies per student causes a \$50 increase in tuition, the

Figure 1. Tuition vs. Direct Subsidy Revenues per FTE Student, Public Four-Year Colleges and Universities, 2004–15



Notes: Tuition revenues are calculated as the sum of net tuition revenues per FTE student. Net tuition revenues include all tuition paid by students regardless of whether they are state residents, nonresidents, undergraduates, or graduates. Subsidies are calculated as the sum of appropriations from state governments, appropriations from local governments, and revenues from state and local grants and contracts per FTE student, exclusive of student grants. All figures are in 2016 dollars.

Source: Author's calculations based on Integrated Postsecondary Education Data System (IPEDS) data.

pass-through rate of subsidies to tuition is 50 percent. If such a reduction causes a \$100 increase in tuition, then the pass-through rate is 100 percent. If changes in direct subsidies cause no changes in tuition whatsoever, then the pass-through rate is 0 percent.

The state disinvestment hypothesis has justified numerous proposed and enacted public policies on the state and federal levels. Proponents argue that reversing Great Recession-era “disinvestment” in public higher education will lower tuition or at least slow the rate of increase.⁵

Implicit in this argument is the assumption that the pass-through rate of subsidies to tuition is high. But this assumption is inappropriate without verification. If the true rate of pass-through is low, then even large increases in direct subsidies will have little effect on tuition. Large taxpayer investments in higher education

with the aim of lowering prices for students could thus waste billions of dollars.

Policymakers need reliable estimates of pass-through before increasing direct subsidies for public colleges with the aim of lowering tuition. This report will review the existing evidence on the relationship between direct subsidies and tuition and provide new estimates of the pass-through rate.

Why Is (or Isn't) There a Relationship Between Direct Subsidies and Tuition?

Competing economic theories predict different rates of pass-through, and there is no scholarly consensus on any one explanation. When public institutions face a cut in direct subsidies, they have three options: raise

tuition, raise revenue from other sources (such as private philanthropy), or reduce expenditures. As public institutions are not-for-profit, they cannot reduce profits to absorb the subsidy reduction in the way a traditional business might.

A high rate of pass-through means institutions depend heavily on tuition increases when subsidies fall and keep spending and other sources of revenue relatively constant. A low rate of pass-through means institutions do not adjust tuition much in response to direct subsidy cuts and instead cut spending or raise revenue elsewhere. Therefore, rates of pass-through depend on not only an institution's propensity to raise tuition but also its willingness and ability to pursue these two alternative options.

Full Pass-Through. The extreme scenario in which every dollar of cuts to direct subsidies is fully compensated for by rising tuition represents 100 percent pass-through. Under this scenario, institutions are either unwilling or unable to cut expenditures in response to subsidy reductions, signaling that there are few superfluous costs in public higher education. This is unlikely given that public institutions allocate, typically, less than half of their core expenditures to instructional costs.⁶ More plausibly, full pass-through also suggests that institutions have little to no ability to raise revenue from alternative sources.

Proponents of the full pass-through theory include Robert Hiltonsmith of Demos, who compares the fall in subsidies to the rise in tuition at public universities between 2001 and 2011. Relying on a full pass-through assumption, Hiltonsmith concludes that four-fifths of the rise in tuition is attributable to subsidy cuts.⁷ In a separate analysis, Temple University economist Douglas Webber relied on the same assumption to argue that such cuts explain three-fourths of the tuition increase from 2001 to 2014.⁸ The Hillary Clinton campaign also asserted full pass-through in its higher education platform.⁹

Partial Pass-Through. Under partial pass-through, tuition rises substantially in response to reductions in state subsidies, but the relationship is not one-to-one. For example, if tuition rises 60 cents for every dollar of subsidy cuts per student, then the pass-through rate

is 60 percent. The institution finds 40 cents' worth of expenditure cuts or alternative revenue increases to make up for the rest of the subsidy cut.

This scenario is consistent with a traditional competitive-market understanding of higher education. Reductions in state support cause tuition increases, but expenditure cuts also absorb some of the blow. If an institution raises tuition too much, students will flock to its competitors. Institutions must therefore find some spending cuts (or alternative revenue sources) to avoid losing students to competitors who negotiated the tuition-expenditures trade-off more judiciously.

Michael Mitchell and Michael Leachman of the Center on Budget and Policy Priorities figure, using state-level data from 2008 to 2014, that pass-through of subsidy cuts to tuition increases is roughly 85 percent, with the other 15 percent of cuts reflected in lower spending. "Because most public schools do not have significant endowments or other sources of funding," Mitchell and Leachman write, "public colleges and universities have simultaneously cut spending to make up for declining state funding."¹⁰

Little to No Pass-Through. A traditional "Econ 101" theory predicts that the incidence of a subsidy cut falls partly on the producer (the college) and partly on the consumer (the student). This understanding predicts partial pass-through. But theories that hold that higher education fundamentally functions differently than other sectors of the economy may predict little to no pass-through—for example, a scenario in which tuition increases in response to subsidy cuts are negligible.

The most prominent such theory is the revenue theory of costs, which economist Howard Bowen proposed. According to Bowen, colleges do not seek to minimize costs like other firms do. There are several reasons for this: Most colleges (and all public ones) do not have profits to maximize in the traditional sense, so they cannot increase profits by reducing costs. Public universities are also insulated from competition by state boundaries, so they face little competitive pressure to cut costs.

Most importantly, it is difficult for colleges to measure "unit costs" the way other industries can measure, for example, the cost of producing a ton of steel or a barrel of oil. What is a "unit" of education? A wide

swath of expenses can potentially be classified as “educational” expenses that contribute to the value of a college degree. For instance, institutions may view hiring faculty purely for research as increasing the prestige of the university and thus the prospects of alumni, even if it does not affect the quality of students’ education directly. As Bowen writes, “it is easy [for institutions] to drift into the comfortable belief that increased expenditures will automatically produce commensurately greater outcomes.”¹¹

How do institutions determine spending when they face so little pressure to control it? According to Bowen, institutions seek to maximize all available revenue streams and then benchmark their costs to the revenue they are able to raise. An institution finds a way to use each dollar it accesses. Bowen explains this phenomenon as follows:

Within wide limits, institutions can adjust to whatever amount of money they are able to raise. When resources are increased, they find uses for the new funds, and unit costs go up. When resources are decreased, they express keen regret and they protest, but in the end they accept the inevitable, and unit costs go down.¹²

If colleges do indeed operate according to Bowen’s theory, pass-through rates should be quite low. Tuition is a source of revenue for institutions, so they always maximize tuition revenue regardless of the levels of direct subsidies they receive. If direct subsidies go up, institutions will apply all those dollars toward higher spending and none toward lower tuition. If direct subsidies go down, institutions have no ability to raise tuition, since they have already squeezed every dollar out of that revenue stream. Institutions therefore have no choice but to finance the subsidy cut by lowering expenditures.

This corollary of the revenue theory of costs is summarized thus: Institutions charge all the tuition they can all the time. Whether direct subsidies go up or down is irrelevant. Subsidies and tuition are independent of one another; the pass-through rate is zero.

All this depicts the extreme scenario in which the revenue theory of costs explains all revenue dynamics in higher education. In reality, it could explain some but

not all. For instance, if revenue falls too far, an institution might run out of superfluous expenditures to cut and have no choice but to raise tuition. The theory breaks down in such a situation, since it predicts that tuition levels are independent of other revenue streams.

Empirical evidence on the revenue theory of costs is limited, but one study by Robert Martin and Carter Hill concludes that cost trends attributable to the theory explain 55 percent of the increase in expenditures at public research universities from 1987 to 2008.¹³ The authors caution that they likely have not controlled for all cost trends potentially attributable to Bowen’s theory, so their results may underestimate its importance.¹⁴

To conclude, understanding institutions of higher education using traditional economic principles predicts partial pass-through of direct subsidies to tuition. But an alternative understanding, the revenue theory of costs, predicts a low or zero rate of pass-through. The estimates of pass-through in this report will therefore provide indirect evidence on the revenue theory of costs.

Attempts to Measure Pass-Through Empirically

While rigorous economic studies on the state disinvestment hypothesis are few, existing evidence is consistent with a low rate of pass-through. Analyses using state-level data find a moderate to nonexistent relationship between subsidies and tuition, while analyses using institution-level data estimate a pass-through rate of subsidy cuts to in-state tuition rises of 10 percent or less.

State-level analyses are most common. For instance, researchers at the New York Federal Reserve compare states that experienced large reductions in direct subsidies since 2000 to states that experienced small reductions or increases. They find that before 2007, changes in direct subsidies are not associated with changes in tuition, but between 2007 and 2011 a moderate relationship emerges.¹⁵ The authors do not claim this is a causal relationship.

Another state-level analysis by Marvin Titus, Sean Simone, and Anubha Gupta examined direct appropriations and tuition in all 50 states from 1982 to 2006.

Table 1. Aggregate Revenue for Public Four-Year Colleges and Universities, 2004–15

	Revenues from Net Tuition and Fees	Revenues from Student Grants	Revenues from Direct Subsidies	Number of FTE Students
2004	\$33,908,374,313	\$8,415,720,004	\$48,259,053,125	5,449,145
2005	\$36,805,369,754	\$8,917,745,356	\$48,299,501,861	5,520,940
2006	\$38,856,189,454	\$8,964,155,084	\$49,313,139,104	5,567,160
2007	\$40,793,327,261	\$9,234,890,615	\$51,691,693,872	5,677,452
2008	\$42,641,556,744	\$9,717,591,209	\$54,403,152,597	5,739,572
2009	\$45,477,680,502	\$10,635,944,226	\$51,015,136,725	5,874,728
2010	\$48,477,227,485	\$14,345,848,088	\$49,371,853,930	6,051,965
2011	\$51,747,364,128	\$15,952,649,542	\$48,855,838,803	6,185,693
2012	\$55,425,998,712	\$15,115,451,933	\$44,013,850,936	6,252,748
2013	\$57,286,697,519	\$14,463,732,096	\$44,083,661,125	6,215,952
2014	\$58,907,789,555	\$14,533,031,399	\$46,632,905,648	6,239,158
2015	\$61,041,405,837	\$14,808,117,954	\$47,379,563,157	6,285,984
Percentage Change	80.0%	76.0%	–1.8%	15.4%
Absolute Change	\$27,133,031,524	\$6,392,397,950	–\$879,489,968	836,839

Notes: All figures are in 2016 dollars. Direct subsidies exclude local operating grants and contracts for Governmental Accounting Standards Board schools.

Source: Author's calculations based on IPEDS data.

They find that in the short term, there is a small negative effect of state appropriations on tuition, but there is no evidence of an effect in the long term.¹⁶

Studies using institution-level data are less common. Michael Rizzo and Ronald Ehrenberg examine 91 public flagship and other public research universities from 1979 to 1998. They find only a weak relationship between subsidies and tuition. They estimate that “an increase of \$1,000 in state appropriations per student generate[s] an in-state tuition reduction of only \$60” and an out-of-state tuition reduction of \$222.¹⁷ Rizzo and Ehrenberg therefore estimate pass-through rates of 6 percent for in-state tuition and 22.2 percent for out-of-state tuition—low rates consistent with the revenue theory of costs.

Mikyong Minsun Kim and Jangwan Ko compared the change in each of 540 public colleges' in-state tuition levels from 1998 to 2007 to changes in the share of revenue each derived from direct state appropriations. They find that when the share of institutional revenue from state sources rises by 1 percentage point, published tuition falls by \$19.71.¹⁸

This does not directly equate to a pass-through rate, because different institutions have different levels of revenue. But for most institutions, it implies very low rates of pass-through. The median public institution had total core revenues of \$19,053 per student in 2015, meaning a 1 percentage point increase in the share of revenues from state appropriations implies a \$191 increase in state subsidies per student.¹⁹ This equates to a pass-through rate of just 10.3 percent.

Tuition and Subsidies at Four-Year Public Universities, 2004–15

The past decade has witnessed large changes in both tuition and subsidy levels at public universities, meaning recent experience offers an excellent opportunity to estimate pass-through empirically. Following are key descriptive statistics on tuition and subsidy trends at the aggregate, state, and institution level.

Table 1 displays aggregate statistics on the four-year public higher education sector. From 2004 to 2015, the

Table 2. Per-Student Revenue for Public Four-Year Colleges and Universities, 2004–15

	Revenues from Net Tuition and Fees per FTE Student	Revenues from Student Grants per FTE Student	Revenues from Direct Subsidies per FTE Student
2004	\$6,223	\$1,544	\$8,856
2005	\$6,667	\$1,615	\$8,748
2006	\$6,980	\$1,610	\$8,858
2007	\$7,185	\$1,627	\$9,105
2008	\$7,429	\$1,693	\$9,479
2009	\$7,741	\$1,810	\$8,684
2010	\$8,010	\$2,370	\$8,158
2011	\$8,366	\$2,579	\$7,898
2012	\$8,864	\$2,417	\$7,039
2013	\$9,216	\$2,327	\$7,092
2014	\$9,442	\$2,329	\$7,474
2015	\$9,711	\$2,356	\$7,537
Percentage Change	56.1%	52.5%	–14.9%
Absolute Change	\$3,488	\$811	–\$1,319

Notes: All figures are in 2016 dollars.

Source: Author's calculations based on IPEDS data.

study period considered in this report, aggregate revenues from net tuition and fees rose 80 percent in real terms, or roughly \$27 billion. Revenue from external student grants such as Pell Grants rose at a similar rate: 76 percent, which equates to a rise of \$6 billion.

In aggregate terms, direct subsidies fell less than 2 percent from 2004 to 2015. However, these subsidies were spread over more students: Enrollment rose 15 percent during the study period. American four-year public universities had 840,000 more FTE students in 2015 than in 2004.²⁰

This enrollment rise was the primary reason that direct subsidies per FTE student fell over the study period. These fell 15 percent, or \$1,319, from 2004 to 2015 (see Table 2). Measured from their peak in 2008, subsidies fell by nearly \$2,000. Meanwhile, revenues from total net tuition per student rose 56 percent, or \$3,488, from 2004 to 2015. Again, external student grants saw a similar relative increase: 53 percent.

Different periods of time saw different overall trends in per-student subsidies. From 2004 to 2008, subsidies climbed but then fell substantially with the Great

Recession. Subsidies bottomed out in 2012 and have since been rising again, albeit at a slow rate. By contrast, net tuition revenue per student rose every year between 2004 and 2015, with little variation in the rate of increase.

Changes in per-student tuition revenue and direct subsidies varied markedly across states (Table 3). While all states saw a real increase in tuition over the study period, these varied from a \$297 increase (Maryland) to an \$8,709 increase (Arizona). Direct subsidies rose in some states and fell in others. Changes in direct subsidies per student ranged from a decrease of \$4,688 (Illinois) to an increase of \$8,778 (Wyoming).²¹

In 2015, Vermont had the highest tuition revenue per student, inclusive of external grants, at \$20,850. Wyoming was at the opposite end of the spectrum at \$4,871. Wyoming also had the highest level of direct subsidies per student at \$23,784, while Colorado had the lowest at \$2,310.²²

Variation in the trends of net tuition revenue and direct subsidies becomes even clearer at the institution level. Figure 2 shows the distribution of individual institutions' changes in direct subsidies by year.

Table 3. Per-Student Revenue for Public-Four-Year Colleges and Universities, by State, 2004 and 2015

State	Net Tuition			Direct Subsidies		
	2004	2015	Change	2004	2015	Change
Alabama	\$5,774	\$10,873	\$5,099	\$8,850	\$8,002	-\$848
Alaska	\$4,178	\$6,422	\$2,244	\$14,322	\$19,257	\$4,935
Arizona	\$6,083	\$14,792	\$8,709	\$9,735	\$6,688	-\$3,047
Arkansas	\$3,869	\$5,477	\$1,608	\$9,207	\$7,603	-\$1,604
California	\$5,241	\$9,372	\$4,131	\$11,378	\$9,499	-\$1,879
Colorado	\$6,549	\$12,553	\$6,004	\$3,758	\$2,310	-\$1,448
Connecticut	\$6,970	\$9,711	\$2,741	\$11,732	\$16,909	\$5,178
Delaware	\$11,613	\$16,056	\$4,442	\$7,970	\$6,499	-\$1,471
District of Columbia	\$5,371	\$8,014	\$2,644	\$23,937	\$18,940	-\$4,997
Florida	\$4,026	\$6,355	\$2,329	\$10,389	\$8,843	-\$1,545
Georgia	\$4,586	\$8,432	\$3,846	\$10,539	\$7,176	-\$3,363
Hawaii	\$4,936	\$9,948	\$5,012	\$18,485	\$19,257	\$772
Idaho	\$4,512	\$7,863	\$3,352	\$11,141	\$8,600	-\$2,540
Illinois	\$6,423	\$10,650	\$4,228	\$9,628	\$4,941	-\$4,688
Indiana	\$7,943	\$11,602	\$3,659	\$8,686	\$6,616	-\$2,070
Iowa	\$7,406	\$10,925	\$3,519	\$12,248	\$8,979	-\$3,269
Kansas	\$5,205	\$9,049	\$3,844	\$8,482	\$8,111	-\$371
Kentucky	\$4,983	\$9,204	\$4,221	\$11,241	\$8,612	-\$2,629
Louisiana	\$4,061	\$7,420	\$3,360	\$7,245	\$5,141	-\$2,104
Maine	\$6,233	\$8,955	\$2,722	\$10,328	\$8,966	-\$1,362
Maryland	\$8,750	\$9,047	\$297	\$9,119	\$9,095	-\$24
Massachusetts	\$7,633	\$10,097	\$2,464	\$8,571	\$8,503	-\$68
Michigan	\$9,162	\$13,753	\$4,591	\$7,694	\$5,297	-\$2,397
Minnesota	\$6,952	\$8,477	\$1,525	\$9,569	\$8,587	-\$982
Mississippi	\$5,290	\$7,368	\$2,078	\$9,348	\$9,848	\$500
Missouri	\$6,457	\$8,623	\$2,166	\$8,371	\$6,512	-\$1,859
Montana	\$6,374	\$8,328	\$1,954	\$5,875	\$6,387	\$512
Nebraska	\$4,703	\$7,227	\$2,524	\$9,392	\$9,395	\$3
Nevada	\$4,290	\$6,669	\$2,379	\$11,211	\$7,171	-\$4,040
New Hampshire	\$8,846	\$11,854	\$3,008	\$4,874	\$3,547	-\$1,327
New Jersey	\$4,472	\$11,648	\$7,176	\$5,221	\$10,090	\$4,869
New Mexico	\$3,305	\$4,987	\$1,682	\$13,686	\$12,636	-\$1,050
New York	\$4,963	\$6,187	\$1,224	\$9,197	\$10,453	\$1,256
North Carolina	\$5,220	\$7,807	\$2,588	\$12,325	\$11,646	-\$678
North Dakota	\$5,638	\$8,510	\$2,872	\$6,611	\$9,601	\$2,990
Ohio	\$8,612	\$11,799	\$3,186	\$7,488	\$5,950	-\$1,538
Oklahoma	\$4,045	\$8,291	\$4,246	\$7,620	\$7,415	-\$205
Oregon	\$7,731	\$11,148	\$3,417	\$5,873	\$4,763	-\$1,110
Pennsylvania	\$10,125	\$14,897	\$4,772	\$6,297	\$4,698	-\$1,599
Rhode Island	\$7,742	\$10,947	\$3,205	\$7,625	\$5,027	-\$2,597

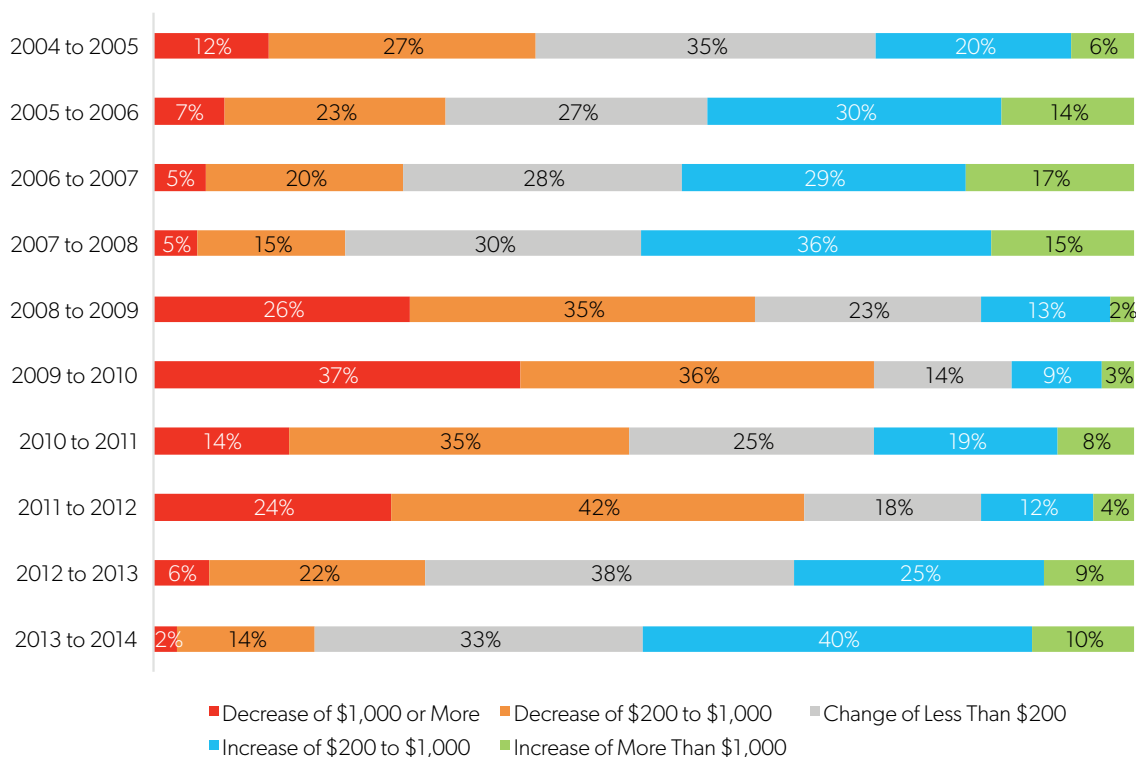
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Table 3. Per-Student Revenue for Public-Four-Year Colleges and Universities (continued)

State	Net Tuition			Direct Subsidies		
	2004	2015	Change	2004	2015	Change
South Carolina	\$7,590	\$11,578	\$3,988	\$6,694	\$3,484	-\$3,210
South Dakota	\$4,827	\$7,390	\$2,563	\$7,028	\$6,349	-\$679
Tennessee	\$5,720	\$7,587	\$1,867	\$10,050	\$6,658	-\$3,392
Texas	\$5,237	\$8,124	\$2,888	\$7,388	\$6,086	-\$1,302
Utah	\$4,615	\$7,734	\$3,119	\$9,214	\$8,432	-\$783
Vermont	\$15,487	\$20,580	\$5,092	\$5,351	\$3,552	-\$1,799
Virginia	\$7,258	\$11,515	\$4,257	\$6,964	\$5,860	-\$1,104
Washington	\$7,223	\$12,353	\$5,129	\$9,057	\$5,396	-\$3,662
West Virginia	\$5,369	\$9,013	\$3,644	\$7,923	\$6,590	-\$1,333
Wisconsin	\$5,969	\$7,889	\$1,920	\$7,890	\$5,971	-\$1,919
Wyoming	\$3,315	\$4,871	\$1,557	\$15,006	\$23,784	\$8,778
All States	\$6,223	\$9,711	\$3,488	\$8,856	\$7,537	-\$1,319

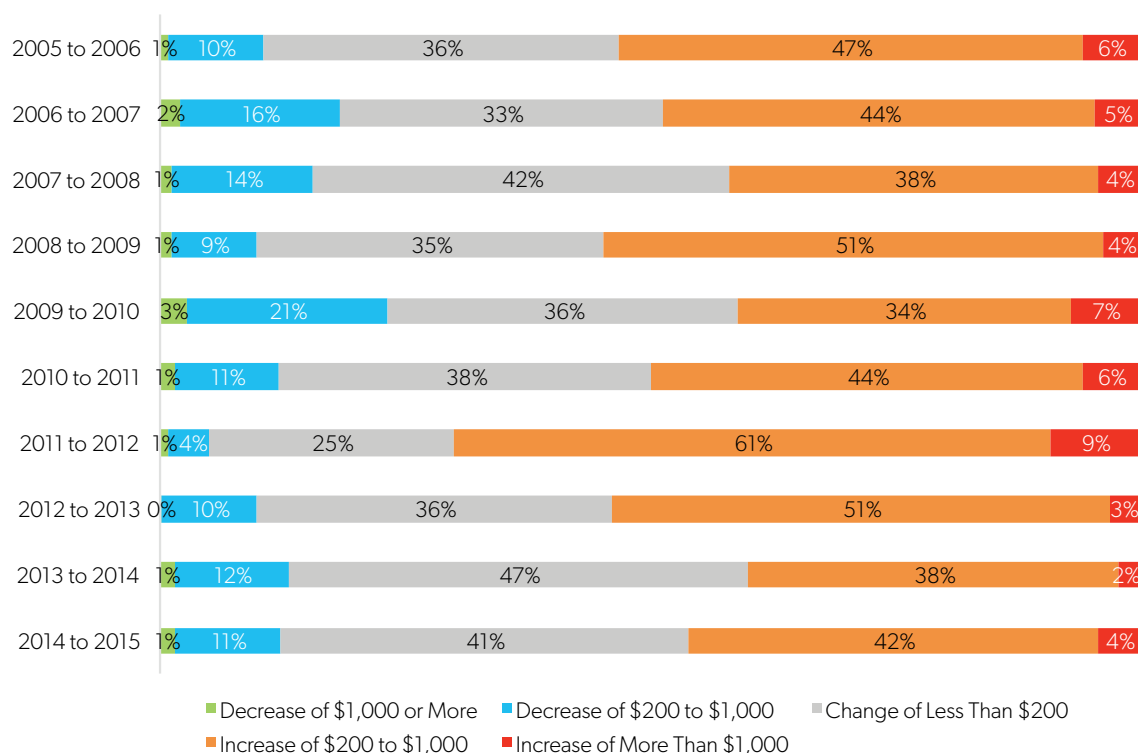
Notes: All figures are in 2016 dollars.

Source: Author's calculations based on IPEDS data.

Figure 2. Distribution of Changes in Direct Subsidy Revenue per FTE Student, by Year

Notes: All figures are in 2016 dollars.

Source: Author's calculations based on IPEDS data.

Figure 3. Distribution of Changes in Net Tuition Revenue per FTE Student, by Year

Notes: All figures in 2016 dollars.

Source: Author's calculations based on IPEDS data.

Changes in subsidies are highly cyclical. As aggregate statistics predict, most institutions experienced substantial (more than \$200 per FTE student) reductions in direct subsidies during and immediately after the Great Recession. Funding has since rebounded some, with half of institutions receiving substantial increases in direct subsidies in 2014.

Changes in tuition revenue are less cyclical than changes in direct subsidies (Figure 3). While up to 70 percent of institutions experienced substantial increases in tuition during and immediately after the Great Recession, substantial tuition increases have never affected less than 40 percent of institutions in any single year. By contrast, substantial reductions in direct subsidies have in some years affected as few as 16 percent of institutions.

While aggregate trends show subsidies falling and tuition rising over the study period, individual institutions

frequently deviate from the overall trend. We can exploit those deviations to isolate the true relationship between subsidies and tuition, according to the methods described in the following section.

Methods for Measuring Pass-Through

This report estimates the rate of pass-through of direct subsidy changes to tuition changes using a fixed-effects, ordinary least-squares panel regression. This method is more rigorous than a normal bivariate regression and controls for all factors unique to each institution that do not change over time, as well as factors that vary over time but affect all institutions equally. The fixed-effects regression therefore “nets out” any underlying trend in tuition for each institution. We can compare the way tuition deviates from this trend to changes in state

subsidies, isolating the relationship between the two from other factors that influence tuition.

The following section will overview the fixed-effects method used in this report. More details on the methodology, such as variable definitions and data limitations, are available in Appendix A.

The regression in this report uses one-year changes in net tuition revenue per student, excluding financial aid grants, as the dependent variable. One-year changes in direct subsidies per student, lagged by one year, are the independent variable. Detailed definitions of these variables are available in Appendix A. The coefficient on the independent variable (changes in direct subsidies) is the pass-through rate: It represents the change in net tuition when direct subsidies rise by one dollar.²³

Including *only* subsidies and tuition in the regression, though, does not provide a complete picture. This simple method does not account for institutional characteristics that may affect both subsidies and tuition trends. For instance, more prestigious public universities may be able to command both higher appropriations from their state legislature *and* higher tuition from their students. If this is the case, failing to control for prestige would produce a positive relationship between subsidies and tuition—making the rate of pass-through appear smaller than it really is.

Consider the following hypothetical example. Students are willing to pay high prices to attend a state flagship school, University A, and the school's reputation also gives it clout with the state government during budget season. By contrast, University B, a low-selectivity school with a poor reputation, may not be able to increase tuition by much lest it lose applicants. It may also lack the clout to compete for scarce public dollars allocated by the state legislature.

Figure 4 depicts this example graphically. Each point on the chart represents the changes in subsidies and tuition for a particular institution in a particular year. Blue points represent year observations for University A, while orange points represent University B. Putting both University A and University B into the same regression (the black regression line) yields a *positive* relationship between tuition and subsidies, the opposite of what theory predicts. However, the relationships between tuition and subsidies for *each school*

What Is a Regression?

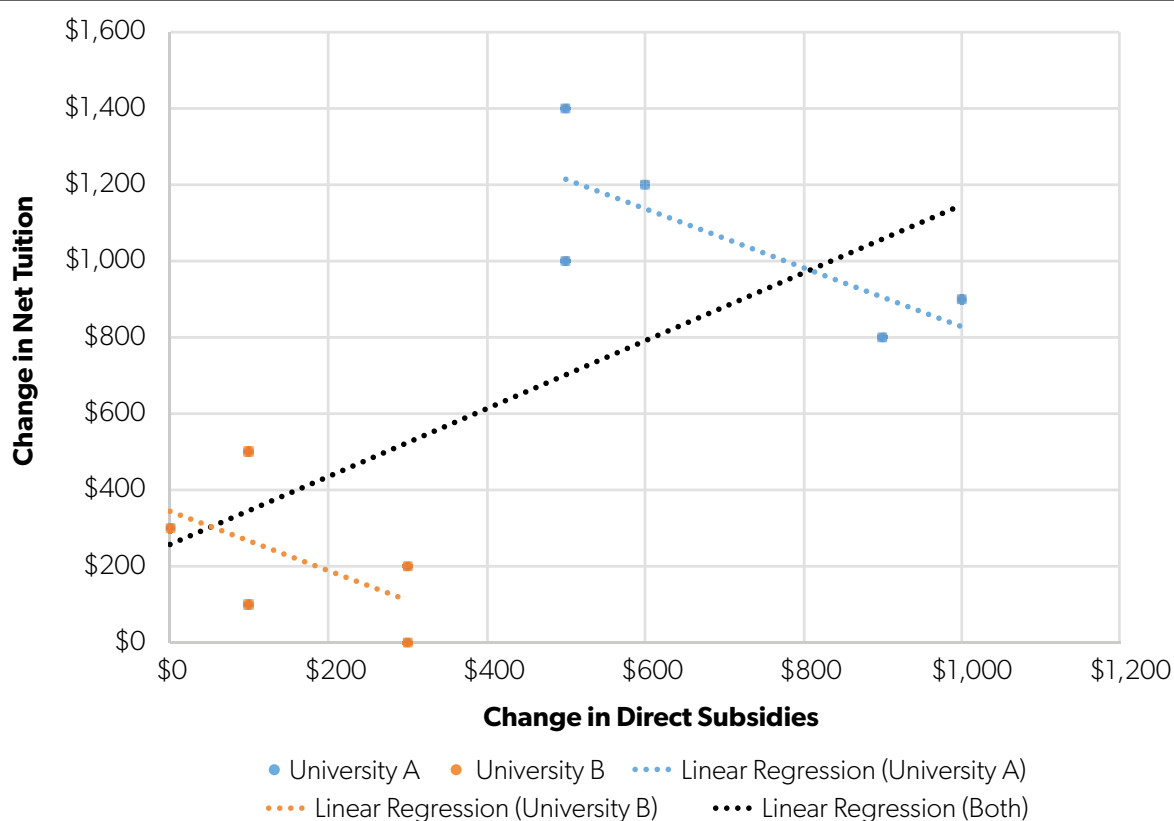
A regression is a way of quantifying the relationship between one or more independent variables and a dependent variable. Regressions are the standard tool economists use to analyze large quantities of data. The analysis in this report covers nearly 500 institutions with more than a decade's worth of data each, so a regression is the appropriate way to approach the research question.

In this case, we want to quantify the relationship between changes in direct subsidies per student (the independent variable X) and changes in tuition (the dependent variable Y). A regression model observes changes in subsidies and tuition for a large number of observations then calculates an equation of the form $Y = a + bX$ that best fits the data. The " b " in this equation is the *coefficient* on X , which tells us how much Y increases for every one-unit change in X . If b equals -0.5 , for example, then tuition falls by 50 cents for every one-dollar increase in subsidies and vice versa.

One can add additional independent variables to the regression to "control" for the factors they represent. In cases in which two independent variables may be correlated, adding both to the regression as controls allows us to identify the association of the dependent variable with *each independent variable individually*. One of the control variables in this report's regression is economic conditions, which are associated with changes in direct subsidies. If changes in tuition that appear to be driven by subsidies are actually driven by economic conditions, adding economic conditions as a control will reveal that.

individually (the blue and orange regression lines) are negative.

This is where the fixed-effects method comes in. Fixed effects includes control variables for "fixed" institutional characteristics and "fixed" year characteristics.²⁴ In other words, it accounts for factors unique to each institution that do not change over time and for

Figure 4. Hypothetical Example of Relationship Between Direct Subsidies and Tuition

Source: Author.

factors unique to each year that affect all institutions similarly. Collecting several years' worth of data on multiple institutions makes this possible.

My controls for fixed institution characteristics account for the typical annual increase in tuition *at each institution individually*. These net out underlying tuition trends unrelated to subsidies: Specifically, they account for the effects on tuition of institution-specific factors that are constant (or roughly constant) across all years. For instance, if institutions in certain states have a higher propensity to raise tuition, the institution fixed effects control for this—because each institution stays in the same state throughout the entire study period. Importantly, the method also controls for unquantifiable factors such as an institution's prestige. As long as "prestige" remains roughly constant over the study period, the effects of prestige on tuition will not bias the estimates of pass-through.²⁵

Fixed *year* characteristics account for factors that change over time but affect all institutions equally or roughly equally. For instance, Congress increased the maximum Pell Grant in 2007. The year fixed effects control for the average effect, if any, this move had on tuition increases.

The institution fixed effects net out each institution's underlying trend in tuition, while the year fixed effects net out the temporal trend in tuition that is common to all institutions. This allows us to isolate how tuition increases at each institution *deviate* from their underlying trends in a way that is *not explained* by cyclical fluctuations in the public higher education sector as a whole. One can then compare these "deviations" to changes in direct subsidies, the major factor that varies across both institutions and years.

Using fixed effects for this report's analysis involves collecting data on 487 public institutions across 12

years (2004–15 inclusive). I calculate the year-over-year changes for both subsidies and tuition, which yields 11 years’ worth of changes. I also lag changes in subsidies by one year, which reduces the number of year-over-year changes in my study frame to 10. Therefore, my dataset has 4,870 “institution-year” observations: 10 years of data on each of 487 institutions, or data on 487 institutions for each of 10 years. More detailed descriptions of the data and the universe of institutions in this analysis are available in Appendix A.

I include a one-year lag in the model because it is often difficult for universities to adjust tuition quickly in response to subsidy changes. Most institutions agree on tuition charges with their students in the academic year before enrollment; tuition revenue for the 2015–16 academic year is generally determined during the 2014–15 academic year. An institution that receives a subsidy cut for the year 2015–16 usually has tuition levels for that year already locked in. Therefore, it may have to wait until the 2016–17 academic year if it wants to increase tuition. For this reason, it is appropriate to compare subsidy changes from 2014–15 to 2015–16 with tuition changes from 2015–16 to 2016–17.

The last step is to control for factors that fixed effects alone cannot isolate. These factors do not affect all institutions equally and must change over time. These include local economic conditions, which I control for in all versions of the model. As discussed earlier, I also divide subsidy and tuition levels by student enrollment. However, I include a secondary control for enrollment in most specifications: the absolute change in the size of the student body, lagged by one year. This controls for potential demand effects—for example, if enrollment falls, institutions may lower tuition to attract more students.

I also control for changes in other sources of core revenue, such as investment and donations. Finally, I control for changes in external student grants, such as Pell Grants and state and local student grants. These are defined as aid money, which, rather than being appropriated to an institution directly, follows a particular student to his or her college of choice to offset his or her tuition. Note that such grants are *not* included in my definition of net tuition: I only include tuition paid by the student.

These controls, combined with institution and year fixed effects, likely account for most but not all potential confounding factors. However, any remaining uncontrolled factors should not be substantial enough to mask the effect of direct state subsidies on tuition.

Subsidy Cuts Have Almost Zero Effect on Rising Tuition

This section reports the results of the fixed-effects model, both overall and for certain subgroups of institutions. I report results as rates of pass-through: A rate of 48 percent means 48 percent of subsidy cuts are passed on to tuition increases. Negative pass-through percentages represent scenarios in which lower subsidies are associated with lower tuition and vice versa.

A note on terminology in this section and the discussion to follow: I use “increase” and “decrease” to describe movement in tuition *relative to the underlying trend in tuition levels*. The fixed-effects method nets out this underlying trend, so the statistics reported in this section refer to whatever tuition changes are *not* explained by the trend. For example, if an institution typically increases tuition by \$300 every year but a change in subsidies one year leads it to raise tuition by only \$200, I describe that as a tuition *decrease* because it is a decrease relative to the trend.

For expediency, I describe pass-through, in this section, as the relationship between decreases in subsidies and increases in tuition. However, pass-through also refers to the relationship between increases in subsidies and decreases in tuition. A pass-through rate of 20 percent means that a one-dollar *decrease* in per-student subsidies is associated with a 20-cent *increase* in tuition, but it also means that a one-dollar *increase* in per-student subsidies is associated with a 20-cent *decrease* in tuition.

Finally, I do not report statistical significance in the results. This report does not use a sample but rather looks at the entire universe of eligible four-year public institutions in the analysis. Therefore, statistical noise due to sampling error is a nonissue, and the concept of statistical significance is irrelevant.

Topline Result and Results by Time Period.

Results are available in Table 4. I estimate a pass-through rate of 4.6 percent, meaning that for every dollar of subsidy cuts per student, tuition rises by less than five cents. This finding holds across many different ways of defining the model (see Appendix B). The relationship between subsidies and tuition is almost always quite weak.

The rate of pass-through varies somewhat over time. During the late 2000s, around 5 percent of changes in subsidies were passed through to tuition. However, this fell to 2 percent and lower during the Great Recession, with the early 2010s experiencing a pass-through rate that was negative but not substantially different from zero.²⁶

By Institution Type. How does pass-through vary across different types of colleges?

The 2010 Carnegie Classification of Institutions of Higher Education provides a useful and objective division of public four-year universities according to their research output and mix of degrees awarded.²⁷ Pass-through rates by Carnegie type are recorded in Table 5.

Master's colleges experience positive but small rates of pass-through, while for research universities, pass-through hovers around zero. Baccalaureate colleges actually experience negative pass-through, meaning tuition *falls* ever so slightly when subsidies go down.

By Selectivity. An alternative classification of institutions is produced by Barron's, which assigns each institution a ranking based on its acceptance rate, typical

Table 4. Topline Result and Results by Time Period

First Year	Last Year	Number of Observations	Share of Subsidy Cuts Passed Through to Tuition
2005 to 2006	2014 to 2015	4,859	4.6%
2005 to 2006	2008 to 2009	1,940	5.5%
2007 to 2008	2010 to 2011	1,940	1.8%
2009 to 2010	2012 to 2013	1,945	-0.8%
2011 to 2012	2014 to 2015	1,948	1.8%

Source: Author's calculations based on IPEDS data.

Table 5. Results by Carnegie Classification

Carnegie Classification	Number of Observations	Share of Subsidy Cuts Passed Through to Tuition
Research University (Very High Research Activity)	719	-0.5%
Research University (High Research Activity)	720	1.8%
Doctoral/Research Universities	280	0.6%
Master's Colleges and Universities (Large)	1,600	4.7%
Master's Colleges and Universities (Medium)	537	9.0%
Master's Colleges and Universities (Small)	340	3.6%
Baccalaureate Colleges (Arts & Sciences)	223	-1.3%
Baccalaureate Colleges (Diverse Fields)	410	-2.3%
Research, All	1,719	0.3%
Master's, All	2,477	6.8%
Baccalaureate, All	633	-1.5%

Source: Author's calculations based on IPEDS data.

undergraduate SAT score, and other factors related to selectivity. I run the regression for institutions in each of several selectivity "tiers" assigned by the Barron's ranking in 2008 (Table 6). For most institutions, the pass-through rate hovers within a few percentage points of zero. The exceptions are the highest-ranked institutions, which have a 7 percent pass-through rate, and mid-tier (competitive) institutions, which have a 6 percent pass-through rate.

By State. Among states, estimated rates of pass-through vary substantially (Table 7). Among states with more than 100 observations (equating to more than 10 public institutions), Michigan experiences the highest rate

of pass-through, at 43 percent. Indiana has the lowest rate of pass-through, at negative 11 percent. Rates of pass-through do not appear to be related to state size or geographic region.

Given the small subgroup sizes in most states, these results could be driven by the idiosyncrasies of particular institutions rather than systematic trends in the state. For this reason, I do not report results for states with fewer than 100 observations.

Some states enact policies to limit tuition increases at their public universities, a potential reason for variation in rates of pass-through. While institutions have ways around statutory limits—for instance, by increasing mandatory fees, reducing institutional financial aid, or enrolling more nonresident students—it is worth examining the potential impact of these policies on pass-through.

The State Higher Education Executive Officers Association (SHEEO) conducts periodic surveys of state fiscal officers, which ask whether each officer's state had experienced a “curb, cap, or freeze” on tuition in the preceding years.²⁸ I used data from SHEEO surveys in 2006 and 2011 to test whether such “tuition control” policies affected pass-through. States with such policies

Table 6. Results by Barron's 2008 Ranking

Barron's Classification	Number of Observations	Share of Subsidy Cuts Passed Through to Tuition
Highly Competitive or Better	339	6.7%
Very Competitive	840	1.6%
Competitive	2,398	6.1%
Less Competitive	730	-0.5%
Noncompetitive	370	2.5%
Unranked or Other	182	5.1%

Notes: “Highly Competitive or Better” includes the Barron's “Most Competitive” and “Highly Competitive” categories; observation numbers were too small to report these two categories separately.

Source: Author's calculations based on IPEDS data.

Table 7. Results by State

State	Number of Observations	Share of Subsidy Cuts Passed Through to Tuition
Alabama	130	-8.7%
California	310	4.5%
Colorado	118	0.7%
Florida	110	3.2%
Georgia	130	2.6%
Illinois	110	0.2%
Indiana	130	-10.7%
Louisiana	120	15.3%
Maryland	110	13.1%
Massachusetts	130	-2.5%
Michigan	150	42.7%
Minnesota	110	5.1%
Missouri	130	17.4%
New Jersey	99	4.9%
New York	290	0.0%
North Carolina	160	3.4%
Ohio	130	11.0%
Oklahoma	120	-9.5%
Pennsylvania	180	-10.4%
South Carolina	110	13.7%
Texas	297	-10.3%
Virginia	150	-6.1%
Wisconsin	130	3.5%

Notes: State-level estimates do not include controls for economic conditions. This would be impossible because economic data are reported at the state level and would not vary across institutions in state-specific regressions. All variation in state economic conditions happens across years in this regression, and systematic variation across years is already captured in the year fixed effects.

Source: Author's calculations based on IPEDS data.

experienced slightly negative pass-through when the policies were in effect, while states without tuition control policies had a pass-through rate of 5 percent (Table 8). While tuition control policies appear to reduce the rate of pass-through, pass-through is still in single digits in states where such policies are absent. Therefore, it does not appear that tuition control policies are responsible for the low rates of pass-through estimated in this report.

By Distribution of Revenues and Expenditures.

Pass-through may vary depending on what sources of revenue institutions rely on. For instance, institutions more reliant on subsidies may be more sensitive to subsidy cuts. I calculate each institution's per-student level of revenue from tuition and subsidies (separately) in the first year of the study period. I then divide institutions into groups based on whether they had high (above median) or low (below median) levels of subsidy and tuition revenue.

Table 9 displays regression results for each group. Institutions with both low tuition revenue and low subsidy revenue experienced very low rates of pass-through, while high subsidy institutions experienced slightly higher rates. The highest rate of pass-through belonged to the group of institutions most dependent on subsidies: those with high subsidy revenue and low tuition revenue. For the exact opposite group, institutions with high tuition revenue but low subsidy revenue, pass-through was negative.

Institutions' spending priorities may also affect how they respond to subsidy cuts. I divide institutions into

Table 8. Results by Tuition Control Policies

State Had Curb, Cap, or Freeze on Tuition from 2006 to 2011	Number of States	Number of Observations	Share of Subsidy Cuts Passed Through to Tuition
Yes	11	712	-2.3%
No	22	1,123	5.0%
Inconsistent Policy or Unclear	18	1,076	4.1%
All States, 2006–11	51	2,911	4.1%

Notes: Results in this table only cover institution-year observations before 2011. The "Yes" and "No" categories include states that reported data on the presence or absence of tuition curbs, caps, or freezes in both 2006 and 2011. The "Inconsistent Policy or Unclear" category includes states that gave different responses to the curbs, caps, or freezes question or did not respond in one or both years.

Source: Author's calculations based on IPEDS data.

Table 9. Results by Revenue Streams

Revenue Streams in 2004 (Tuition Includes Grants)	Number of Observations	Share of Subsidy Cuts Passed Through to Tuition
Low Tuition and Subsidy Revenue	1,207	4.9%
Low Tuition Revenue but High Subsidy Revenue	1,210	6.4%
High Tuition Revenue but Low Subsidy Revenue	1,214	-2.8%
High Tuition and Subsidy Revenue	1,229	4.1%

Notes: "Low" and "High" refer to below median and above median, respectively. Median tuition revenue per student in 2004 was \$6,788, while median subsidy revenue per student was \$7,324. I include external student grants in my definition of tuition here because the point of this exercise is to compare how pass-through varies across institutions reliant on different sources of funds.

Source: Author's calculations based on IPEDS data.

groups based on their levels of instructional and non-instructional spending per student in 2004 (Table 10). Pass-through is low and positive for all categories of institutions here, with little variation.

By Number of Students. Student body size is also associated with rates of pass-through. Table 11 displays pass-through rates by each institution's size (as measured by the number of FTE students) in 2004. Smaller institutions (those with less than roughly 7,800 students) experienced higher rates of pass-through. For larger institutions, pass-through was essentially zero.

More detailed results for different revenue and expenditure categories are available in Appendix B. In addition, the appendix includes several checks to ensure that the results hold up across different versions of the model. For instance, I run the regression using alternative ways of defining tuition and subsidies. I also run the regression with two-, three-, and five-year changes in tuition and subsidies, rather than just one-year changes. For the most part, these alternative versions do not substantially alter the results.

Relationship of Subsidies and Expenditures.

Except for a few individual states, subsidy cuts pass through to tuition increases at very low rates. One explanation is that institutions finance

subsidy cuts out of spending reductions rather than tuition increases. To test this, I examine the relationship of per-student changes in subsidies to per-student changes in instructional and noninstructional expenditures. I use the same fixed-effects method as in the previous regressions, only in this case I use changes in expenditures, rather than tuition, as the dependent variable.

Institutions generally have little latitude to adjust tuition midyear in response to subsidy reductions, but expenditures could be a different story. Therefore, I test the relationship between subsidies and expenditures both for subsidy changes in the current year and in the prior year. I also test the relationship between the one-year change in expenditures and the change in subsidies across the current and prior years combined.

The results are detailed in Table 12. On a per-student basis, instructional expenditures fall by roughly 32 cents for every dollar in subsidy cuts in the same year. In the

Table 10. Results by Spending Categories

Allocation of Spending in 2004	Number of Observations	Share of Subsidy Cuts Passed Through to Tuition
Low Instructional and Noninstructional Spending	1,810	5.2%
Low Instructional Spending but High Noninstructional Spending	610	3.2%
High Instructional Spending but Low Noninstructional Spending	610	4.5%
High Instructional and Noninstructional Spending	1,829	5.2%

Notes: “Low” and “High” refer to below median and above median, respectively. Median instructional expenditures per student in 2004 were \$6,538, while median noninstructional expenditures were \$7,661.

Source: Author’s calculations based on IPEDS data.

Table 11. Results by Student Body Size

Number of FTE Students in 2004	Number of Observations	Share of Subsidy Cuts Passed Through to Tuition
0 to 4,185	1,214	5.9%
4,185 to 7,779	1,220	6.7%
7,779 to 14,901	1,217	0.3%
14,901 and Above	1,209	0.9%

Source: Author’s calculations based on IPEDS data.

following year, instructional expenditures rise by seven cents for every dollar in cuts. Noninstructional expenditures, which include research and administrative costs (among other things), bear a far greater share of the burden. These expenditures fall by \$1.40 for every dollar in subsidy cuts in the same year but then rise by 47 cents in the following year.

The lagged estimates in this specification could be affected by subsidy changes in the current year. Therefore, I also estimate a model in which the dependent variable is the one-year change in expenditures, but the independent variable is the *two-year* change in subsidies (e.g., the change in expenditures from 2008 to 2009 and the change in subsidies from 2007 to 2009).²⁹ Under this specification, about 23 percent of subsidy cuts over two years are passed through to instructional expenditures, and about 87 percent are passed through to noninstructional expenditures.

Table 12. Relationship of Direct Subsidies to Expenditures

Dependent Variable	Number of Observations	Share of Subsidy Cuts In Current Year Passed Through to Expenditure Cuts	Share of Subsidy Cuts In Prior Year Passed Through to Expenditure Cuts	Share of Subsidy Cuts in Prior and Current Years Combined Passed Through to Expenditure Cuts
Instructional Expenditures	4,858	32.1%	-7.1%	22.6%
Noninstructional Expenditures	4,858	140.4%	-47.2%	87.0%

Source: Author's calculations based on IPEDS data.

These results are consistent with institutions “over-correcting” in response to subsidy cuts, by reducing spending more than is necessary to bring their budgets into balance. Institutions also appear to partially reverse this overcorrection in the following year. When all is said and done, though, expenditures bear almost the full brunt of cuts in state subsidies.

Why Is Pass-Through So Low?

The primary finding from this report is that public institutions do not, by and large, compensate for reductions in direct subsidies by increasing tuition. I estimate that for every dollar of subsidy cuts on a per-student basis, institutions increase tuition revenue by five cents. This finding does not substantially change if I define the model in different ways. This is consistent with past economic evidence that also finds a low rate of pass-through, often in the single digits.

Public institutions also do not appear to compensate for reductions in direct subsidies by enrolling more non-resident or foreign students. While it is impossible to test this question directly with this report's methodology, an increase in nonresident enrollment would trigger an increase in per-student tuition revenue, since nonresident students pay more in tuition but still only count as one student each. Institutions largely do not turn to charging more to *any* type of student—resident or non-resident, undergraduate or graduate—to compensate for subsidy cuts.

Moreover, the slight relationship between subsidies and tuition appears to have grown weaker over time. In the late 2000s, pass-through was around 5 percent. However, by the early 2010s, pass-through had fallen below zero. It could be that institutions became more efficient at finding alternative ways of absorbing subsidy cuts (such as expenditure reductions) as time went on and subsidy cuts became more commonplace.

Negative Pass-Through. Negative pass-through itself is an interesting and counterintuitive finding. Negative pass-through does not mean that institutions respond to subsidy cuts by reducing tuition outright but that institutions reduce tuition *relative to its underlying trend* when subsidies fall. While negative pass-through is not the norm, certain subgroups of institutions experience it—notably, those in states that maintained tuition control policies between 2006 and 2011. Most of the time, negative pass-through is not substantially different from zero.

The exceptions are Alabama, Indiana, Oklahoma, Pennsylvania, and Texas, which experienced negative pass-through rates of roughly 10 percent. Some of these states had tuition control policies, which partially explains negative pass-through. However, this is not the case for all states in this category.

Observation numbers are small enough here to make it plausible that negative pass-through could be driven by the unique circumstances of individual institutions. For instance, an institution facing a subsidy cut might lower tuition to attract more students, expand enrollment and aggregate revenue, and exploit economies of scale with

a larger student body. (Whether such a scheme would work is another matter entirely.)

Even in these states, it is crucial to remember that the magnitude of negative pass-through is quite small. Although some institutions may reduce tuition in response to subsidy cuts, this effect is at best a minor factor in tuition trends.

High Pass-Through. Except for a handful of states, no subgroup had a pass-through rate higher than 10 percent. Not only was pass-through low across all major subgroups, it was consistently so. There is no obvious set of institutions to which the central finding of this report does not apply.

Institutions with high subsidy revenue and low tuition revenue had slightly higher pass-through than their counterparts in other subcategories. These institutions, being the most dependent on subsidies, are naturally more sensitive to subsidy cuts. But even at these schools, the pass-through rate is still only 6 percent. Small institutions (those with less than 7,800 students in 2004) had higher rates of pass-through as well, possibly because they are less willing or able to exploit economies of scale with lower expenditures per student.

Several states also experience abnormally high rates of pass-through. These include Michigan (43 percent), Missouri (18 percent), Louisiana (15 percent), South Carolina (14 percent), and Maryland (13 percent). No large state had a pass-through rate above 50 percent.

A lack of state-imposed curbs, caps, or freezes on tuition does not appear to be the culprit here, as some states (Louisiana and Missouri) with high pass-through applied such policies during all years for which data was available, while others (Maryland, Michigan, and South Carolina) applied such policies during at least part of the study period. Moreover, my regressions showed that states with no tuition control policies still experienced a rate of pass-through in the single digits.

The idiosyncrasies of particular institutions may drive pass-through differences across states. This possibility is quite likely for states with fewer observations (and thus a small number of institutions). Michigan is one of the larger states, but it still has only 150 observations, or 15 institutions. Certain institutions may, for their own reasons, have a higher or lower propensity to raise

tuition in response to subsidy cuts than others. Unfortunately, the fixed-effects method makes it impossible to test pass-through rates for individual institutions.

Expenditures. In the year subsidy cuts take effect, institutions appear to overcompensate by cutting expenditures (relative to their underlying trend) by more than is necessary to keep their budgets in balance. In the year following subsidy cuts, institutions restore some of the reduced spending.

This is consistent with institutions facing uncertainty regarding how, precisely, subsidy cuts will affect them. Immediately, they may cut more spending than is necessary to avoid the risk of further spending cuts down the road, then restore some of that spending in the following year, once their financial situations become clearer. Institutions do not restore all the reduced spending, however, possibly because of continued uncertainty or anticipation of future subsidy cuts.

Finally, institutions appear to finance subsidy cuts mostly out of noninstructional spending. Instructional expenditures bear 19 percent of spending reductions in response to same-year subsidy cuts and 21 percent of spending reductions in response to combined same- and prior-year subsidy cuts. Since the median institution devotes roughly 46 percent of its core spending to instruction, instruction bears a disproportionately small share of the burden of reduced subsidies. The primary casualty of subsidy cuts is noninstructional spending.

Application to Revenue Theory of Costs. This report provides indirect evidence in support of Bowen's revenue theory of costs. To recap, the revenue theory holds that institutions of higher education maximize all available revenue streams and then benchmark their expenditures to the amount of funds they can raise. Therefore, when revenue goes down, institutions are far more likely to finance the revenue loss through spending cuts rather than revenue increases in other areas.

This report has shown that institutions usually do not finance direct subsidy cuts by hiking tuition. This is consistent with Bowen: If institutions have already squeezed all the money they can out of tuition as a revenue stream, then they will have no ability to increase tuition in response to subsidy cuts. Tuition and subsidies

should thus be independent of one another. This analysis finds that, for the most part, they are.

Bowen also predicts that institutions will raise more revenue than they need to provide education and then channel the excess funds into superfluous expenditures that may be tangential to the core educational mission. When revenue streams contract, this low-value spending will be the first to go. This is consistent with my finding that institutions finance subsidy cuts primarily by reducing noninstructional expenditures.

In sum, public institutions charge whatever tuition they can regardless of what happens to subsidies. Consistent with Bowen, this report suggests that had states not cut direct subsidies to higher education during the Great Recession, tuition would nonetheless be similar to its present level. Raising or lowering direct subsidies cannot change the adamant upward trend of tuition.

Conclusion

The state disinvestment hypothesis has little support in the data, which is consistent with prior research on the subject. Not only were reductions in direct state subsidies not responsible for tuition increases during the Great Recession, but there is also no evidence that restoring lost state support to higher education would have a substantial effect on tuition.

If state legislators' goal is to reduce tuition, increasing direct subsidies is a highly inefficient way to do so. Using the results from my regressions, I estimate that it would take a \$22 increase in per-student direct subsidies

to achieve just a one-dollar reduction in tuition. Holding current levels of enrollment constant, returning tuition to 2004 levels would require \$473 billion in additional direct subsidies—10 times the total amount of direct subsidies allocated to four-year public colleges in 2015.

If legislators' goal is to increase spending on instruction, increasing direct subsidies will also fail to do the trick: It would take a three- to five-dollar increase in per-student subsidies to achieve a one-dollar increase in instructional spending. Universities will apply the vast majority of additional subsidies not to tuition reductions or education spending but to noninstructional spending.

These findings suggest that a more efficient policy to lower tuition is to abolish direct subsidies to public institutions and use some or all of the money to fund grant aid for students. While grant aid may have an inflationary effect on tuition,³⁰ such a policy would still lower net tuition paid by students relative to the status quo. Grant aid in lieu of direct subsidies would also improve higher education by forcing public institutions to compete for students to attract taxpayer dollars.

While this report has provided evidence against the state disinvestment hypothesis, some questions remain unanswered. Avenues for future research include how subsidy cuts affect tuition paid by different types of students (residents vs. nonresidents, etc.) and whether the low estimated rate of pass-through holds for two-year public colleges. Finally, more research should also explore financial dynamics at institutions of higher education to further test Bowen's revenue theory of costs, as this report has found considerable evidence consistent with the theory.

Appendix A. Detailed Methodology

This appendix contains more details on the methodology of this report, including the regression equation, data descriptions, and universe and variable definitions.

Regression Equation

In equation form, the primary regression in this report is:

$$\begin{aligned} (\Delta TUIT)_{i,t} = & \beta_0 + \beta_1(\Delta SUBS)_{i,t-1} + \beta_2(\Delta GDP)_{s,t} + \\ & \beta_3(\Delta URATE)_{s,t} + \beta_4(\Delta FTE)_{i,t-1} + \beta_5(\Delta OTHERREV)_{i,t-1} \\ & + \beta_6(\Delta STUGRANTS)_{i,t} + \beta_7(\Delta STUGRANTS)_{i,t-1} \\ & + \beta_8(\Delta INV GIFTS)_{i,t-1} + \beta_{107}(YEAR07) + \dots + \\ & + \beta_{115}(YEAR15) + \beta_{12}(INST2) + \dots + \beta_{487}(INST487) + u_{it} \end{aligned}$$

Where:

- “ $(\Delta TUIT)_{i,t}$ ” represents the real change in net tuition revenue per FTE student at institution i in year t .
- “ β_0 ” represents the constant term.
- “ β_1 ” represents the coefficient of interest: our estimated rate of pass-through. A more negative coefficient represents a higher rate of pass-through, with a coefficient of -1 representing full pass-through.
- “ $(\Delta SUBS)_{i,t-1}$ ” represents the real change in direct subsidies per FTE student at institution i in the year before year t .
- “ β_n ” represent coefficients on other variables.
- “ $(\Delta GDP)_{s,t}$ ” represents the real change in gross domestic product in state s and year t .

- “ $(\Delta URATE)_{s,t}$ ” represents the change in the unemployment rate in state s and year t .
- “ $(\Delta FTE)_{i,t-1}$ ” represents the change in the number of FTE students at institution i in the year before year t .
- “ $(\Delta OTHERREV)_{i,t-1}$ ” represents the real change in revenue from investment and donations per FTE student at institution i in the year before year t .
- “ $(\Delta STUGRANTS)_{i,t}$ ” represents the real change in revenue from student grants per FTE student at institution i in year t .
- “ $(\Delta STUGRANTS)_{i,t-1}$ ” represents the real change in revenue from student grants per FTE student at institution i in the year before year t .
- “ $(\Delta INV GIFTS)_{i,t-1}$ ” represents the real change in revenue from investment and gifts per FTE student at institution i in the year before year t .
- “ $(YEAR07)$ ” through “ $(YEAR15)$ ” represent binary variables for years 2007 through 2015. Years 2004 and 2005 are lost to the differencing and the lag in this model, while year 2006 is captured in the constant term β_0 .
- “ $(INST2)$ ” through “ $(INST487)$ ” represent binary variables for institutions 2 through 487. Institution 1 is captured in the constant term β_0 .
- “ u_{it} ” represents the error term.

Data

The source for most of the data in this report is IPEDS, which is an aggregation of data on federal-student-aid-participating colleges that the US Department of Education releases.³¹ IPEDS surveys institutions on their finances, including the revenue they derive from various sources such as tuition, external student grants, and direct state subsidies. The IPEDS finance survey also includes data on institutional expenditures, broken down by category. Finally, IPEDS reports the number of FTE students at each institution.

Institutions may report financial data to IPEDS under one of two accounting systems: Governmental Accounting Standards Board (GASB) standards or Financial Accounting Standards Board (FASB) standards.³² Generally, public institutions use GASB standards while private institutions use FASB standards, but a handful of public institutions employ FASB standards. FASB institutions account for just five out of the 487 public institutions in my universe, so minor inconsistencies between the two accounting systems are not a major concern.³³ However, a few important differences are noted in the variable definitions section below.

The IPEDS data used in this paper span from the 2003–04 academic year (hereafter 2004) to the 2014–15 academic year (2015). While most variables in IPEDS go back further than 2004, a limiting factor is FTE enrollment, which has a consistent variable definition going back only to 2004. Meanwhile, 2015 was, at the time of writing, the most recent year for which all variables used in this report were available.

Universe of Institutions

The IPEDS universe includes 716 public four-year institutions. I take this set as my starting point. I exclude institutions for which at least one of the following conditions does *not* apply during one or more years in the study period:

- The institution existed in the contiguous United States, Alaska, or Hawaii.

- The institution granted undergraduate degrees.
- The highest degree offered by the institution was a bachelor’s degree or higher.
- The institution enrolled full-time, first-time degree-seeking undergraduate students.

After applying these exclusions, 543 institutions remain in the universe, including child campuses of parent universities that satisfy these conditions.³⁴

One problem is that some university systems do not have a consistent method of reporting data. For instance, several systems report financial data for the entire university system with the parent campus but report enrollment data separately for the parent campus and each child campus. Since the method used in this report requires dividing revenue figures by enrollment figures, it is necessary to collapse these various campuses into one observation for each system.³⁵

Thirteen university systems report data inconsistently and must be collapsed into one observation each. These are listed in Table A1. To collapse the observations, I take the sum of all revenue and enrollment figures for each campus and report these as one observation per system. After the collapse, 487 observations remain for each year. Throughout this report, the term “institutions” refers to both individual institutions and collapsed single observations representing university systems.

In total, this produces 4,870 institution-year observations. However, 11 institution-years data are missing, reducing the number of observations to 4,859. This is not a major concern because 99.8 percent of potential institution-year observations in the universe still have data.

Variable Definitions

This subsection defines the variables used in this report.

Tuition. The inflation-adjusted change in net tuition per FTE student is the dependent variable in this regression. Net tuition is defined as net tuition and fees paid by students—in other words, tuition and fees paid after

Table A1. University Systems Analyzed as One Observation in This Report

University System Name	State
Arizona State University	Arizona
Miami University	Ohio
Oregon State University	Oregon
Pennsylvania State University	Pennsylvania
Rutgers University	New Jersey
Southern University	Louisiana
University of Arizona	Arizona
University of Connecticut	Connecticut
University of Minnesota	Minnesota
University of Pittsburgh	Pennsylvania
University of the District of Columbia	District of Columbia
University of Washington	Washington
West Virginia University	West Virginia

Source: IPEDS.

applying financial aid. It includes any tuition financed by federal student loans. However, it does *not* include amounts paid by students for room and board. This definition of tuition also does not include student grants such as Pell Grants or grants funded by internal institutional sources (tuition discounts).

One limitation of the tuition variable, as defined in this report, is that it does not distinguish among different types of students. The tuition variable simply reports the aggregate amount of tuition revenue derived from students, regardless of whether the students are undergraduates or graduates and whether they pay resident or nonresident tuition rates. As such, this method is not able to identify how each different category of students bears the burden of tuition increases in response to direct subsidy cuts.

Direct Subsidies. The primary independent variable in this regression is the inflation-adjusted change in direct subsidies per FTE student. For both GASB and FASB institutions, direct subsidies are defined as the sum of state appropriations, local appropriations, state grants and contracts, and local grants and contracts. The two accounting systems define these categories in slightly different ways.³⁶ This definition excludes appropriations for capital

assets, such as buildings, as these revenues can be highly variable from year to year.

The distinction between these subsidy categories is that appropriations are authorized directly by a state or local legislative body, while grants and contracts are authorized indirectly. The legislature appropriates money to state government agencies, which then disburse the funds to institutions.³⁷ While appropriations account for the vast majority of direct subsidies, a handful of institutions (such as the University of Colorado system) get the bulk of their direct public funding through grants and contracts.

State and local grants provided directly to students to offset tuition (“student grants”) are *not* included as subsidies; rather, these are included as a control.

This is because the research question asks

how changes in *direct subsidies* affect the way in which institutions exploit tuition revenue, and student grants are provided to students to help them pay tuition. However, I also estimate a model in which state and local student grants are included in my definition of subsidies; this does not substantially affect the results.

FTE Students. “Per-student” figures in this report refer to figures per FTE student. An FTE student is defined by IPEDS as an undergraduate student who takes 30 credit hours of courses in a year, or a graduate student who takes 24 credit hours in a year. Therefore, two undergraduates who take 15 credit hours each are defined as one FTE student.³⁸

Student Grants. I control for the real change in revenue derived from external student grants per FTE student. These grants include Pell Grants, other federal grants, state grants, and local grants. However, I do not include tuition discounts, since these are moneys that the institution is essentially paying to itself, and the purpose of this study is to discern how institutions exploit *external* revenue streams.

In Appendix B, I run a version of the model in which student grants are included in my definition of tuition,

and another in which the state and local component of student grants is counted as subsidies. Neither of these alternate specifications substantially affect the results.

Expenditures. This report also examines the relationship between real changes in direct subsidies and real changes in institutional expenditures. There are two expenditure variables of interest: instructional expenditures and core noninstructional expenditures. Instructional expenditures are defined by IPEDS and include costs directly associated with teaching students and administrative expenses directly related to academics. Core noninstructional expenditures are the sum of spending on research, public service, academic support, student service, institutional support, and other core expenditures. (IPEDS defines all the categories.) Core noninstructional expenditures exclude spending on auxiliary enterprises such as dormitories, dining halls, and hospitals.

Other Revenues. I control for the real, per-student change in revenues from investment and donations. According to IPEDS definitions, investment income “may take the form of interest income, dividend income, rental income or royalty income and includes both realized and unrealized gains and losses.” Donations represent voluntary gifts from individuals or private organizations but exclude additions to permanent endowments and donations for capital projects.³⁹

Economic Controls and Inflation Adjustment.

I control for annual changes in state economic conditions with two variables: the real change in a state’s gross domestic product (GDP) and the change in its unemployment rate. GDP data are drawn from the Bureau of Economic Analysis,⁴⁰ while unemployment rate data are drawn from the Bureau of Labor Statistics.⁴¹ Unless otherwise specified, all dollar figures and changes are reported in 2016 dollars, adjusted for inflation using the Personal Consumption Expenditures price index.⁴²

Appendix B. Additional Results

Detailed Initial Results

The main text only reports the regression results with all controls; however, it is worthwhile to run the model with some controls excluded (see Table B1). To start, I run a simple regression of changes in tuition on changes in subsidies, with no fixed effects or controls. This yields a pass-through rate of 5.7 percent. In other words, a one-dollar decrease in per-student subsidies is associated with a 5.7-cent increase in tuition.

The estimates do not differ much once we add in fixed effects. A fixed-effects regression with no controls yields a pass-through rate of 5.3 percent, which does not change after adding in controls for economic conditions. Adding a control for the change in the size of the student body, lagged one year, reduces the estimated rate of pass-through to 4.5 percent.⁴³

Adding the change in revenue from investment and donations does not substantially change the estimated pass-through rate.⁴⁴ Finally, adding the change

in student grants as a control increases pass-through by a hair, to 4.6 percent. This is the version of the model reported in the main text. All in all, the various specifications of the model all result in estimated pass-through rates within 1 percentage point of each other.

Full regression results for my preferred version of the model, which includes fixed effects and all controls, are reported in Table B2. Year is strongly associated with tuition increases, demonstrating the cyclical nature of tuition dynamics. Changes in revenue from investment and gifts have only a minor association with tuition, consistent with the revenue theory of costs. State economic conditions also have a weak association with tuition levels. Changes in the student body size are also weakly predictive: A 1,000-student increase in the student body predicts a tuition increase the following year of just \$40.

One factor that does have predictive power is student grants. A one-dollar increase in grants revenue per student predicts that nongrant tuition revenue per

Table B1. Initial Results, Alternate Specifications

Model Specification	Number of Observations	Share of Subsidy Cuts Passed Through to Tuition
Simple Bivariate Regression (No Fixed Effects)	4,864	5.7%
Fixed Effects Regression, No Controls	4,864	5.3%
Fixed Effects Regression, Controls for Economic Conditions	4,864	5.3%
Fixed Effects Regression, Controls for Economic Conditions and Change in FTE Students	4,864	4.5%
Fixed Effects Regression, Controls for Economic Conditions, Change in FTE Students, and Change in Investment/Donations Revenue	4,864	4.5%
Fixed Effects Regression, Controls for Economic Conditions, Change in FTE Students, Change in Investment/Donations Revenue, and Change in Student Grants in Current and Previous Years	4,859	4.6%

Source: Author's calculations based on IPEDS data.

student will be *higher* by 36 cents. One explanation is that rising tuition causes students to claim more external grant money than they did previously. Another possible explanation is the “Bennett hypothesis”: Institutions may increase published tuition to capture additional grant aid.⁴⁵ This tuition increase will affect all students, including those who do not receive grants, meaning nongrant tuition revenue per student goes up. Reality is likely a mix of these two explanations, and determining which is more important is beyond the scope of this report.

By Distribution of Revenue.

Table B3 displays pass-through rates by quartiles of tuition revenue per student in 2004. Institutions with very low or very high initial revenue from tuition see higher rates of pass-through; in the middle of the distribution, pass-through rates are closer to zero.

Table B4 displays pass-through rates by quartiles of subsidy revenue per student in 2004. Institutions with above-median initial subsidies experience higher rates of pass-through, while institutions with below-median initial subsidies experience zero pass-through. The finding here is intuitive: Institutions that are less reliant on subsidies face little pressure to raise tuition when those subsidies fall.

By Expenditures. Table B5 displays pass-through rates by each institution’s level of per-student spending on instruction in 2004. Pass-through tends to rise as institutions spend more on instruction. By contrast, the relationship between levels

Table B2. Full Regression Output

Variable	Coefficient
Change in Direct Subsidies Per Student, Lagged One Year	–0.046405
2007 Binary Variable	–102.2723
2008 Binary Variable	–151.2114
2009 Binary Variable	–63.31791
2010 Binary Variable	–390.7976
2011 Binary Variable	–177.8397
2012 Binary Variable	175.0955
2013 Binary Variable	–21.66226
2014 Binary Variable	–136.4428
2015 Binary Variable	–88.70549
Change in Investment and Gifts Revenue, Lagged One Year	0.0077065
Change in Student Grants Revenue	0.3638841
Change in Student Grants Revenue, Lagged One Year	–0.0040762
Change in GDP	–286.9406
Change in Unemployment Rate	–2.862893
Change in FTE Students	0.0405744
Constant	276.6849
Number of Observations	4,859
R-Squared (Within)	0.1102
R-Squared (Between)	0.0557
R-Squared (Overall)	0.1026

Source: Author’s calculations based on IPEDS data.

Table B3. Results by Initial Tuition Level

Tuition and Grants Revenue Per Student in 2004	Number of Observations	Share of Subsidy Cuts Passed Through to Tuition
\$0 to \$5,647	1,207	6.5%
\$5,647 to \$6,788	1,210	4.0%
\$6,788 to \$8,247	1,218	0.5%
\$8,247 and Above	1,210	6.1%

Notes: Tuition levels include student grants.

Source: Author’s calculations based on IPEDS data.

of noninstructional spending and rates of pass-through is less clear (Table B6).

What about instructional spending as a *share* of total core spending? As Table B7 shows, pass-through rises

slowly but steadily as institutions devote a larger and larger share of their core expenditures to instruction. This makes sense as institutions more devoted to instruction may find fewer superfluous expenditures to cut.

Robustness Checks. I conduct several alternative regressions to ensure that the central finding in this paper—a low rate of pass-through—does not change when I define variables in different ways or exclude certain observations. Table B8 lists the results of these robustness checks.

Exclusions. To start, I run a regression excluding outliers, defined as institution-year observations in the top or bottom 5 percent of changes in per-student tuition or changes in per-student subsidies. This reduces the rate of pass-through from 4.6 percent to 2.7 percent.

I then exclude university systems that did not report data consistently across parent and child campuses and thus necessitated the “collapse” of several campuses into one observation (13 institutions out of 487). This has little effect on the estimated rate of pass-through. Excluding institutions using the FASB accounting standards (5 out of 487) also has little effect.

Alternative Variable Definitions. Next, I move into alternative ways of defining key variables. To start, I include external student grants in my definition of tuition and exclude them as controls. This lowers the estimated rate of pass-through slightly, from 4.6 percent to 4.1 percent.

Table B4. Results by Initial Subsidy Level

Direct Subsidies per Student in 2004	Number of Observations	Share of Subsidy Cuts Passed Through to Tuition
\$0 to \$5,806	1,200	−0.1%
\$5,806 to \$7,324	1,220	−0.1%
\$7,324 to \$9,790	1,220	7.0%
\$9,790 and Above	1,210	4.9%

Source: Author’s calculations based on IPEDS data.

Table B5. Results by Initial Level of Instructional Spending

Instructional Expenditures per Student in 2004	Number of Observations	Share of Subsidy Cuts Passed Through to Tuition
\$0 to \$5,615	1,211	−0.9%
\$5,615 to \$6,538	1,210	6.6%
\$6,538 to \$8,217	1,210	3.6%
\$8,217 and Above	1,220	5.5%

Source: Author’s calculations based on IPEDS data.

Table B6. Results by Initial Level of Core Noninstructional Spending

Noninstructional Core Expenditures per Student in 2004	Number of Observations	Share of Subsidy Cuts Passed Through to Tuition
\$0 to \$5,744	1,216	5.1%
\$5,744 to \$7,661	1,205	4.3%
\$7,661 to \$12,086	1,210	4.0%
\$12,086 and Above	1,220	5.1%

Source: Author’s calculations based on IPEDS data.

Table B7. Results by Share of Spending Devoted to Instruction

Instructional Expenditures as Share of Total in 2004	Number of Observations	Share of Subsidy Cuts Passed Through to Tuition
0% to 39%	1,207	4.3%
39% to 46%	1,218	4.9%
46% to 51%	1,205	6.6%
51% and Above	1,220	6.7%

Source: Author’s calculations based on IPEDS data.

Table B8. Robustness Checks

Robustness Check	Number of Observations	Share of Subsidy Cuts Passed Through to Tuition
Original Model	4,859	4.6%
Exclusions		
Excluding Outliers	3,981	2.7%
Excluding “Collapsed” University Systems	4,730	4.7%
Excluding Institutions Using FASB Standards	4,809	4.6%
Alternative Variable Definitions		
Including Student Grants with Tuition*	4,860	4.1%
Subsidies: Appropriations Only	4,867	4.4%
Including Student Grants with Tuition and Subsidies: Appropriations Only*	4,867	4.2%
Including Student Grants with Subsidies*	4,861	4.7%
Change in Published Resident Tuition as Dependent Variable	4,863	0.9%
Change in Published Nonresident Tuition as Dependent Variable	4,863	3.4%
Adjustments to Lag		
No Lag	4,862	-7.7%
Two-Year Lag	4,373	-0.7%
Longer-Term Changes		
Two-Year Change	2,435	2.4%
Three-Year Change	1,461	0.9%
Five-Year Change	974	2.3%

Notes: Specifications with asterisks (*) do not include changes in student grants as control variables.

Source: Author’s calculations based on IPEDS data.

I also explore alternative definitions of subsidies. First, I exclude operating grants and contracts from my definition of subsidies and include just appropriations—in other words, funds given to an institution directly by an act of a state or local legislative body. (Grants and contracts are given indirectly, through the budgets of state government agencies.) This narrow definition produces a 4.4 percent rate of pass-through.

If I combine both of these adjustments (using changes in appropriations only as the independent variable and including both net tuition and student grants in the dependent variable), estimated pass-through is 4.2 percent. Finally, I include state and local student grants in my definition of subsidy instead of as a control; pass-through under this specification is 4.7 percent.

Next, I use the change in *published* tuition rather than the change in net tuition as the dependent variable.⁴⁶ I

find that subsidies have essentially zero relationship to published tuition for residents of the state or locality. For nonresident published tuition, the rate of pass-through is 3.4 percent. This suggests that when institutions pass subsidy cuts on to resident students, they do so by cutting back on institutional financial aid rather than by raising published prices and holding aid constant.

Adjustments to Lag. The preferred specification of this model lags the change in subsidies by one year relative to the change in tuition. Since institutions are unlikely to be able to adjust tuition revenue midyear, the lag is necessary to identify the true relationship between subsidies and tuition. However, I test alternatives to the one-year lag. With no lag, the rate of pass-through is -7.7 percent. With a two-year lag rather than a one-year lag, the rate of pass-through is essentially zero.

Longer-Term Changes. What about the relationship of subsidies and tuition over a longer time period? To explore this, I regress the two-year change in tuition levels on the two-year change in per-student subsidies, lagged by one year. (Essentially, this means comparing the 2005 to 2007 change in subsidies with the 2006 to 2008 change in tuition, and so on.) The rate of pass-through is 2.4 percent. I also test three-year changes; the rate of pass-through falls to 0.9 percent. For the five-year change, the longest term testable using the fixed-effects method, pass-through

risks to 2.3 percent. The central finding of this report—a very low rate of pass-through—appears to hold in the long term and the short term.

About the Author

Preston Cooper is a research analyst with the Center on Higher Education Reform at the American Enterprise Institute.

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Notes

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2. “2004” refers to the 2003–04 academic year. Hereafter, “2005” refers to the 2004–05 academic year, and so on.
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13. The authors attribute another 16 percent of the increase to the “Baumol effect”—the idea that higher education suffers from low labor productivity. As wages rise, institutions cannot economize on labor, so costs rise faster in higher education than they do in other sectors of the economy. The remaining 29 percent of the increase is left unexplained but is potentially attributable to Baumol or Bowen effects.
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19. Author’s calculations based on IPEDS data.

20. The statistics presented in this section include 487 public four-year colleges and universities, which are the universe for the empirical analysis in this report. See Appendix A for a detailed description of how I define the study universe.

21. The District of Columbia also had a per-student subsidy reduction of \$4,997.

22. One reason for Colorado's low level of direct subsidies per student is its unique funding model for higher education, which allocates an atypically high share of state support in the form of student grants rather than direct subsidies. For more information, see National Conference of State Legislatures, "Higher Education Appropriations," September 8, 2015, <http://www.ncsl.org/research/education/higher-education-appropriations.aspx>.

23. For instance, if the coefficient is -0.72 , then net tuition falls by 72 cents when direct subsidies rise by one dollar. The pass-through rate is 72 percent.

24. In technical terms, the regression includes a *binary variable* for each institution and each year. A binary variable is a variable that can be equal only to zero or one. For example, the binary variable for 2008 is always equal to zero, except for the 487 institution-year observations in the year 2008, which are equal to one. The binary variable for the University of California, Berkeley, is always equal to zero, except for the 10 institution-year observations representing Berkeley, which are equal to one. Each institution binary variable accounts for the typical annual increase in tuition (relative to a baseline) for that institution. The year binary variables represent how the typical institution's tuition increase deviates from the trend in that year.

25. This is a reasonable assumption, given that the study period lasts only 12 years.

26. Are these differences due to asymmetries in the way institutions respond to rising or falling state subsidies? That does not appear to be the case. If I run the regression including only observations in which state subsidies per student rose more than \$200, pass-through is 5.4 percent. Including only observations in which state subsidies per student fell more than \$200 yields a pass-through rate of 4.2 percent. This difference is not substantial enough to make asymmetric responses to rising or falling subsidies a plausible theory.

27. Carnegie Classifications are from IPEDS.

28. I used 2006 and 2011 survey data only. While SHEEO conducted a survey in 2013, the nonresponse rate was very high. Another survey will be published this year. See State Higher Education Executive Officers Association, "State Tuition, Fees and Financial Assistance Policies: 2005-06 Final Report" and "State Tuition Fees and Financial Assistance Policies, 2010-11 Final Report," September 16, 2013, <http://www.sheeo.org/resources/publications/state-tuition-fees-and-financial-assistance-policies>.

29. This controls for the change in expenditures in the prior year.

30. David Lucca, Taylor Nadauld, and Karen Shen, "Credit Supply and the Rise in College Tuition: Evidence from the Expansion in Federal Student Aid Programs," Federal Reserve Bank of New York, February 2017, https://www.newyorkfed.org/research/staff_reports/sr733.html.

31. National Center for Education Statistics, "Integrated Postsecondary Education Data System (IPEDS)."

32. Larry Goldstein and Sue Menditto, "GASB and FASB," National Association of College and University Business Officers, January 2005, http://www.nacubo.org/Business_Officer_Magazine/Magazine_Archives/January_2005/GASB_and_FASB.html.

33. The five FASB institutions are the University of Delaware, Lincoln University (PA), the Pennsylvania State University system, the University of Pittsburgh system, and Temple University.

34. This covers 84 percent of four-year public institutions that had records in IPEDS in 2004 and 76 percent of those in 2015.

35. Some of these university systems change from inconsistent reporting to consistent reporting within the study period. For instance, the Rutgers University system reported revenue data for the whole system at the parent campus through 2014 then switched to reporting revenue data separately for each campus in 2015. Because the fixed effects method requires a consistent panel of universities throughout the study period, I collapse Rutgers and the other inconsistently reported university systems for every year in the sample, even those in which the data is reported separately for each child campus. I still include child campuses in the collapse even if they do not meet the three conditions discussed above.

36. Before 2010, local operating grants and contracts are not reported as a separate category for GASB institutions. Rather, they come lumped together with grants and contracts from private sources. Therefore, they are excluded from the definition of direct subsidies before 2010. An adjustment is made in the 2009–10 period for consistency. FASB accounting standards do not distinguish

between operating and nonoperating grants and contracts, resulting in a slight inconsistency between the definitions of direct subsidies for GASB and FASB institutions before 2010. This, however, is not a major concern, as local operating grants and contracts account for less than 5 percent of revenues from direct subsidies, and FASB institutions represent just 5 out of 487 institutions in the universe. The exclusion of local operating grants and contracts from all years in the study period, rather than just those before 2010, does not substantially affect the results. In addition, limiting the definition of direct subsidies to appropriations only or even excluding FASB institutions from the regression entirely does not substantially affect the results.

37. National Center for Education Statistics, “IPEDS Data Collection System: 2016-17 Survey Materials: Glossary,” August 24, 2016, <https://surveys.nces.ed.gov/ipeds/Downloads/Forms/IPEDSGlossary.pdf>.

38. These figures are for institutions on a trimester or semester system. For institutions on a quarterly system, undergraduates must take 45 credit hours and graduates 36 credit hours to be considered full time.

39. National Center for Education Statistics, “IPEDS Data Collection System.”

40. Bureau of Economic Analysis, “Regional Economic Accounts,” accessed May 19, 2017, <https://www.bea.gov/regional/>.

41. Bureau of Labor Statistics, “Local Area Unemployment Statistics,” accessed May 19, 2017, <https://www.bls.gov/lau/>.

42. Federal Reserve Bank of St. Louis, “FRED Economic Data: Personal Consumption Expenditures Chain-Type Price Index,” accessed May 19, 2017, <https://fred.stlouisfed.org/series/PCEPI>.

43. In all specifications, tuition and subsidies themselves are considered on a per-student basis. The control for student body size means adding in a variable that measures the absolute change in the number of FTE students.

44. One concern is that changes in tuition and prior-year changes in subsidies may be serially correlated. Serial correlation means that the errors in subsequent time periods are correlated with one another. While this theoretically has no effect on the estimated *rates* of pass-through, it could affect the R-squared values reported in Table B2. I run a Wooldridge test for serial correlation and find no evidence of it in the model.

45. The federal government and state governments have several aid programs, including grants and subsidized loans, to help students pay for college. The revenue theory of costs predicts that institutions maximize all sources of revenue, including federal student aid programs. If a college raises tuition, it can capture more federal aid dollars. Therefore, a corollary of the revenue theory of costs is the “Bennett hypothesis”—the idea that tuition rises because of the wide availability of federal aid. The Bennett hypothesis is one of the most-studied issues in higher education. While many economic studies have found evidence for it, the estimated effect is usually smaller for public institutions, which are the focus of this report. However, it is still important to consider as an alternative to the state disinvestment hypothesis as an explanation for rising tuition. For more information, see William J. Bennett, “Our Greedy Colleges,” *New York Times*, February 18, 1987, <http://www.nytimes.com/1987/02/18/opinion/our-greedy-colleges.html>; Lesley J. Turner, “The Economic Incidence of Federal Student Grant Aid,” *Review of Economics and Statistics*, January 2017, http://econweb.umd.edu/~turner/Turner_FedAidIncidence_Jan2017.pdf; and David Lucca, Taylor Nadauld, and Karen Shen, “Credit Supply and the Rise in College Tuition: Evidence from the Expansion in Federal Student Aid Programs,” Federal Reserve Bank of New York, February 2017, https://www.newyorkfed.org/research/staff_reports/sr733.html.

46. For collapsed university systems, I use the parent campus’ published tuition figures.