

# College Spending on Attainment

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## 1 Introduction

### Trends

- It has often been postulated that increasing spending and decreasing tuition could increase college enrollment and attainment (Dynarski (2008), Deming and Dynarski (2010)).
- Bachelors degree has only grown from 27.9% in 2000 to 30.2% in 2013 (NCES 2015).
- There is evidence of longer time to degree completion (Bound et al. (2010)).

### Price

- Tuition has outgrown inflation: between 2006 and 2016, sticker-price in-state tuition and fees at public four-year institutions increased at an average rate of 3.5% per year beyond inflation (Ma et al. (2016)).
- Tuition has grown from 14,724 in 2000 to 22,424 in 2015 (in 2015 dollars).
- "In 2016, the estimated average net tuition and fee price paid by full-time in-state students at public four-year institutions is \$3,770, \$860 (in 2016 dollars) higher than the net price a decade earlier and \$1,550 higher than the 2009-10 low of \$2,220." (Ma et al. (2016))
- Lowering tuition should increase attendance Deming and Dynarski (2010) and completion Dynarski (2008).

- Deming and Walters (2017) found no impact of tuition price on enrollment or completion at public colleges.
- Possible explanation: those going to college will go to college regardless?

### Spending

- Deming and Walters (2017) found that increasing spending increased both enrollment and completion at public colleges.
- Deming (2017) proposal to increase spending.
- Increased spending in primary and secondary schools leads to completion rates. (Lafortune et al 2016, Jackson et al 2016, Card and Krueger 1992, Chetty et al 2017).
- The above results could be explained by spending increasing quality
- Cohort crowding (Bound and Turner 2007)

### Outlook of the paper

- What happens at the state level?
- Is there a transfer of students from private schools to public schools?
- Tuition and spending are affected by state appropriations (especially if a school is reliant on them - ie it is a big part of their revenue). Explain state level budget cut shocks
- Explain why good instruments

## 2 Data

Data is compiled from the Delta Cost Project (who compiled it from Integrated Postsecondary Education Data System (IPEDS)) and the Census and the American Community Survey (ACS). Total spending, tuition, and appropriations from the state were aggregated by state and divided by enrollment. In the analysis, I aggregate ACS data (Individuals currently enrolled in college, individuals with a Bachelor's degree, and controls) to the state level.

## 3 Methods

### 3.1 Institution-level

As there exists endogeneity between per-student spending and tuition price, and enrollment and degree attainment, we will use an instrumental variable approach. When the state imposes a budget cut on schools in the state, schools will respond by reducing spending and/or increasing tuition price. This budget shock variable is defined as:

$$Z_{i,t} = \frac{Approps_{i,90}}{Rev_{i,90}} \times \frac{Approps_{s,t}}{Pop_{s,t}}$$

where  $Approps_{i,90}$  is the revenue from state appropriations for institution  $i$  in 1990, and  $Rev_{i,90}$  is institution  $i$ 's total revenue in 1990. That first term in  $Z_{i,t}$  gives institution  $i$ 's reliance on state appropriations in 1990. The second term is the state appropriations per college-age student in the state where institution  $i$  resides in that year.

The state can also impose tuition caps. Tuition cap can be broken down into two variables:  $TuitCap_{i,t}$  and  $TuitMax_{i,t}$ .  $TuitCap_{i,t}$  is binary variable measuring if a state legislature has put a cap or freeze on tuition prices.  $TuitMax_{i,t}$  is the maximum percentage a college can raise their tuition in year  $t$ . If there is a freeze, then this value is equal to 0.

Now, using these three instruments, our first stage is:

$$\Delta X_{i,t} = \phi_{s(i)} + \omega_t + \Delta W'_{i,t} \lambda + \pi_1 \Delta Z_{i,t} + \pi_2 \Delta TuitCap_{i,t} + \pi_3 \Delta TuitMax_{i,t} + u_{i,t}$$

where  $X_{i,t}$  can be log spending or log tuition,  $W_{i,t}$  is a "control" matrix that contains variables like state unemployment, institutional characteristics, etc.,  $\omega_t$  is year fixed effects, and  $\phi_{s(i)}$  is state fixed effects.

In the second stage, the following model will be estimated:

$$\Delta Y_{i,t} = \Phi_{s(i)} + \Omega_t + \Delta W'_{i,t} \Lambda + \beta_1 \Delta \log \widehat{spending}_{i,t} + \beta_2 \Delta \log \widehat{tuition}_{i,t} + \varepsilon_{i,t}$$

where  $Y_{i,t}$  is log enrollment or log completion.

## 3.2 State-level

As the purpose of this paper is to evaluate the impact of spending and tuition on enrollment and completion at the state level, I will be aggregating variables to the state level. The first stage now becomes:

$$\Delta X_{s,t} = \omega_t + \Delta W'_{s,t} \lambda + \pi_1 \Delta Z_{s,t} + \pi_2 \Delta TuitCap_{s,t} + \pi_3 \Delta TuitMax_{s,t} + \epsilon_{s,t}$$

The second stage equation becomes:

$$\Delta Y_{s,t} = +\Omega_t + \Delta W'_{s,t} \Lambda + \beta_1 \Delta \log \widehat{spending}_{s,t} + \beta_2 \Delta \log \widehat{tuition}_{s,t} + \varepsilon_{s,t}$$

## 4 Results

### 4.1 Institution-Level Results

#### 4.1.1 First Stage

Table 1 shows the results from the first stage using institution-level data. As expected, budget shock has a positive effect on spending, and a negative effect on tuition. The coefficient of budget shock on spending is 0.065, implying that that \$1,000 increase in budget shock increases spending by about 6.5%. The coefficient of budget shock on tuition is -0.088, implying that that \$1,000 increase in budget shock decreases tuition by about 8.8%. We see that tuition freezes lower tuition by about 3 percent. Also, as expected, we see that an increase in max tuition leads to an increase in tuition. These results are consistent with what Deming and Walters (2017) found.

#### 4.1.2 Second Stage

Table 10 shows the effects of tuition price and spending on log enrollment. As done in Deming and Walters (2017), we have reported estimates for how tuition price and spending in year T have affected enrollment in years T (current year), T+1, T+2, and T+3. The coefficients on spending for all institutions suggest that a

Table 1: Institution-Level First Stage

	Log Spending	Log Tuition
Budget Shock	0.065*** (0.01)	-0.088*** (0.01)
Tuition Cap	0.004* (0.00)	-0.031*** (0.00)
Max Tuition	-0.076*** (0.03)	0.423*** (0.06)

10% increase in spending increases enrollment by 2.5% in year  $T$ , 2.8% in year  $T + 1$ , 7.2% in year  $T + 2$ , and 4.2% in year  $T + 3$ . Similarly, for 4-year institutions, a 10% increase in spending increases enrollment by 1.9% in year  $T + 1$ , 4.2% in year  $T + 2$ , and 3.0% in year  $T + 3$ . Lastly, for 2-year institutions, a 10% increase in spending increases enrollment by 10% in year  $T + 2$ , and 6.3% in year  $T + 3$ .

Notice that for 4-year institutions, the tuition elasticities for years  $T + 1$  and  $T + 3$  are statistically significant. As postulated by Deming and Walters (2017), this may be due to older, independent part time students who tend to be more price sensitive (Seftor and Turner, 2002).

Table 2: Institution-Level Second Stage

Log Enrollment	Current year	T+1	T+2	T+3
<b>All institutions</b>				
Log Total Spending	0.250* (0.15)	0.279* (0.16)	0.718*** (0.17)	0.424** (0.18)
Log Tuition	-0.009 (0.07)	-0.127 (0.08)	0.013 (0.08)	-0.156 (0.10)
<b>2-year institutions</b>				
Log Total Spending	0.430 (0.31)	0.459 (0.32)	1.102*** (0.37)	0.634* (0.36)
Log Tuition	-0.043 (0.13)	-0.132 (0.14)	0.080 (0.15)	-0.127 (0.16)
<b>4-year institutions</b>				
Log Total Spending	0.020 (0.08)	0.188* (0.10)	0.424*** (0.13)	0.297** (0.14)
Log Tuition	-0.034 (0.04)	-0.092* (0.05)	-0.077 (0.07)	-0.173** (0.08)

## 4.2 State-Level Results

Results for the first stage at the state-level are in table 3. Notice that budget shock still has a positive effect on spending, and a negative effect on tuition. The coefficient of budget shock on spending is now 0.172, implying that at the state level, a \$1,000 increase in budget shock increases spending by about 17.2%. The coefficient of budget shock on tuition is now -0.035, implying that at the state level, a \$1,000 increase in budget shock decreases tuition by about 3.5%.

### 4.2.1 First Stage

Table 3: State-Level First Stage

	Log Total Spending	Log Tuition
Budget Shock	0.172*** (0.05)	-0.035* (0.02)
Tuition Cap	-0.003 (0.01)	-0.017*** (0.01)
Max Tuition	-0.018 (0.07)	0.144 (0.10)

Should I also show the first stages for 2-year and 4-year institutions?

### 4.3 Second Stage

Table 4: Public State-Level Second Stage

Log Enrollment	Current year	T+1	T+2	T+3
<b>All institutions</b>				
Log Total Spending	-0.109 (0.10)	0.021 (0.05)	0.116* (0.07)	0.109 (0.07)
Log Tuition	-0.172 (0.12)	-0.094 (0.18)	-0.189 (0.14)	-0.370** (0.16)
<b>2-year institutions</b>				
Log Total Spending	-0.187 (0.27)	-0.043 (0.24)	-0.035 (0.28)	0.130 (0.34)
Log Tuition	-0.094 (0.17)	0.004 (0.44)	-0.541* (0.32)	-0.407 (0.39)
<b>4-year institutions</b>				
Log Total Spending	-0.064 (0.06)	-0.011 (0.05)	0.109 (0.07)	0.072 (0.07)
Log Tuition	-0.157** (0.07)	-0.140 (0.13)	-0.151 (0.11)	-0.432*** (0.12)

THIS IS ONLY FOR PUBLIC INSTITUTIONS! Table 8 shows the results for the second stage at the state level. Notice that the coefficients for spending on enrollment are statistically insignificant. This could be evidence although an institution's spending increases enrollment at that institution, overall, spending does not increase enrollment at the state level. (There could be a transfer of students that were likely to go to one school, but instead go to a different school).

Table 5: Public and Private State-Level Second Stage

Log Enrollment	Current year	T+1	T+2	T+3
<b>All institutions</b>				
Log Total Spending	-0.110 (0.09)	-0.008 (0.05)	0.116* (0.07)	0.134* (0.07)
Log Tuition	-0.198* (0.11)	-0.027 (0.19)	-0.069 (0.14)	-0.124 (0.16)
<b>2-year institutions</b>				
Log Total Spending	-0.211 (0.25)	-0.047 (0.23)	-0.066 (0.27)	0.092 (0.33)
Log Tuition	-0.100 (0.17)	0.005 (0.44)	-0.548* (0.32)	-0.390 (0.38)
<b>4-year institutions</b>				
Log Total Spending	-0.060 (0.06)	-0.048 (0.05)	0.114* (0.07)	0.117 (0.07)
Log Tuition	-0.183* (0.10)	-0.083 (0.12)	-0.024 (0.11)	-0.169* (0.09)

Focusing now both public and private enrollment, the second stage becomes:

Focusing now on private enrollment, the second stage becomes:

Table 6: Private State-Level Second Stage

Log Enrollment	Current year	T+1	T+2	T+3
<b>All institutions</b>				
Log Total Spending	0.010 (0.14)	-0.196 (0.17)	0.101 (0.18)	0.054 (0.17)
Log Tuition	-0.167 (0.28)	0.209 (0.27)	0.499 (0.41)	0.488 (0.41)
<b>2-year institutions</b>				
Log Total Spending	-0.717*** (0.22)	7.505 (30.76)	1.133 (2.90)	-1.261 (1.73)
Log Tuition	-0.379 (0.39)	12.107 (50.21)	1.080 (5.11)	-0.226 (2.20)
<b>4-year institutions</b>				
Log Total Spending	0.041 (0.18)	-0.230 (0.17)	0.177 (0.18)	0.105 (0.16)
Log Tuition	-0.191 (0.25)	0.058 (0.20)	0.336 (0.24)	0.270 (0.27)

Interestingly enough, there is a negative effect of spending on current year enrollment at private NFP 2-year institutions.



# References

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## 5 Appendix

Table 7: Part-time Undergraduates State-Level Second Stage

Log Enrollment	Current year	T+1	T+2	T+3
<b>All institutions</b>				
Total Spending	0.451 (0.30)	0.379 (0.34)	1.082*** (0.27)	0.294 (0.29)
Tuition	-0.099 (0.18)	-0.372* (0.21)	-0.108 (0.14)	-0.606*** (0.18)
<b>2-year institutions</b>				
Total Spending	0.855* (0.51)	0.731 (0.66)	1.821*** (0.60)	0.974* (0.56)
Tuition	-0.053 (0.20)	-0.334 (0.33)	0.033 (0.25)	-0.274 (0.25)
<b>4-year institutions</b>				
Total Spending	0.178 (0.26)	0.128 (0.29)	0.503** (0.23)	0.080 (0.28)
Tuition	-0.063 (0.22)	-0.350* (0.20)	-0.255 (0.17)	-0.725*** (0.22)

Table 8: Full-time Undergraduates State-Level Second Stage

Log Enrollment	Current year	T+1	T+2	T+3
<b>All institutions</b>				
Total Spending	0.075 (0.17)	-0.123 (0.19)	0.416** (0.17)	0.347* (0.20)
Tuition	0.045 (0.09)	-0.106 (0.10)	0.148 (0.09)	0.144 (0.11)
<b>2-year institutions</b>				
Total Spending	0.063 (0.36)	-0.277 (0.37)	0.669* (0.36)	0.479 (0.39)
Tuition	-0.005 (0.15)	-0.161 (0.16)	0.264 (0.16)	0.174 (0.18)
<b>4-year institutions</b>				
Total Spending	-0.051 (0.10)	0.065 (0.14)	0.273** (0.12)	0.171 (0.16)
Tuition	-0.036 (0.06)	-0.051 (0.09)	-0.020 (0.07)	-0.061 (0.08)

Table 9: Institution-Level Second Stage NOT using Z shock, just state appropriations

Log Enrollment	Current year	T+1	T+2	T+3
<b>All institutions</b>				
Total Spending	0.435** (0.21)	0.253 (0.18)	0.489** (0.21)	0.371* (0.19)
Tuition	0.022 (0.11)	-0.231** (0.11)	-0.131 (0.12)	-0.260** (0.12)
<b>2-year institutions</b>				
Total Spending	0.732* (0.39)	0.526 (0.33)	1.123*** (0.41)	0.882** (0.37)
Tuition	0.072 (0.16)	-0.144 (0.17)	0.114 (0.20)	-0.058 (0.20)
<b>4-year institutions</b>				
Total Spending	-0.000 (0.07)	0.186* (0.10)	0.313** (0.13)	0.219* (0.12)
Tuition	-0.050 (0.04)	-0.109** (0.05)	-0.104* (0.06)	-0.199*** (0.07)

Table 10: Institution-Level Second Stage NOT using Z shock, just state appropriations

Log Enrollment	Current year	T+1	T+2	T+3
<b>All institutions</b>				