The Rise and Fall of College Tuition Inflation

By Brent Bundick and Emily Pollard

The cost of college tuition increased rapidly from 1980 to 2004 at a rate of about 7 percent per year. During that time, the average cost of tuition and required fees for one year of college rose from $1,289 to $7,122, significantly outpacing the inflation rate of the overall basket of goods and services purchased by households. Since 2005, however, college tuition inflation has slowed markedly and has averaged closer to 2 percent per year for the last few years.

Understanding what drives tuition inflation is important for predicting future tuition as well as personal income mobility. Higher-skill positions increasingly require a college degree, and the cost of a college education may represent a significant barrier to upward mobility. College-educated workers earn significantly more than workers with only a high-school education, and this earnings gap increased significantly from 1980 to 2005.

However, untangling the various factors that influence college tuition can be challenging. Changes in supply-side factors, such as rising wages in the education sector or declines in state appropriations for higher education, may cause colleges and universities to pass changes in their costs and revenues on to students in the form of higher tuition. Changes in demand factors, such as increased availability of student loan programs, may also raise tuition by increasing demand for higher education.

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In this article, we document changes in college tuition over time and attempt to explain the long rise and subsequent fall in college tuition inflation. Statistical evidence suggests that wages in the education sector and state appropriations to higher education both play an important role in explaining changes in college tuition inflation. Specifically, we find that higher labor costs in the education sector pass through to consumers in the form of increases in college tuition. In addition, we find that large declines in state appropriations to higher education, which typically occur during and after recessions, correlate with increases in college tuition. We find little evidence that changes in the availability of student loans or other demand-side factors have a significant effect on college tuition.

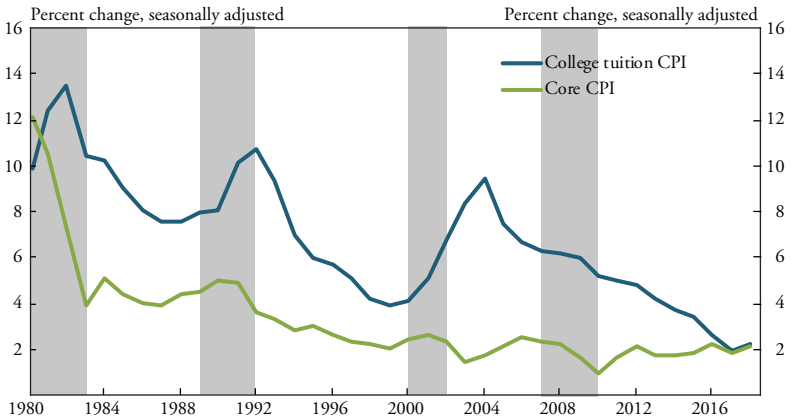
Section I documents the evolution of college tuition over time. Section II introduces some possible explanatory supply- and demand-related factors that may help explain these changes in college tuition inflation rates. Section III presents results from a statistical model and suggests that supply factors are an important driver of fluctuations in tuition inflation.

I. The Evolution of College Tuition Inflation

From 1980 to 2004, the cost of college tuition grew significantly faster than prices of other goods and services. Chart 1 shows the rate of inflation for college tuition, as measured by the Consumer Price Index (CPI) for College Tuition and Fees, and compares it with inflation in the CPI excluding food and energy components (core CPI).[1] Until about 2005, the price of college tuition increased at a rate of over 7 percent per year, while overall prices of goods and services increased by an average of about 4 percent a year.[2] In addition, cyclical fluctuations in college tuition inflation over that period differed from core CPI inflation. For example, Chart 1 shows that college tuition inflation over the 1980–2004 period tended to rise sharply during or shortly after recessions, periods when core inflation tended to decline.

However, college tuition inflation began to slow rapidly around 2005. After peaking near 10 percent in 2004, college tuition inflation has trended down over the last decade and averaged about 2 percent during 2017 and 2018. This slowdown in college tuition occurred

Chart 1
College Tuition Inflation and Core Inflation



Note: Shaded areas denote NBER-defined recessions.
Sources: BLS (Haver Analytics) and NBER (Haver Analytics).

during a period in which core CPI inflation was relatively stable at roughly 2 percent.[3]

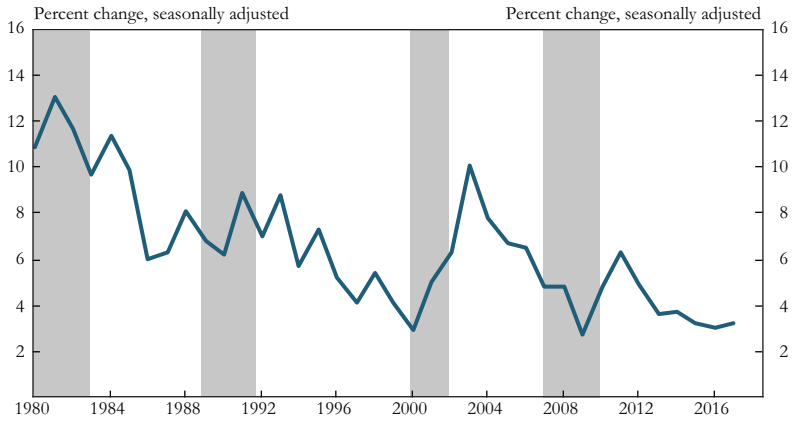
These patterns are consistent with other measures of the price of college tuition, such as survey data from the National Center for Education Statistics (NCES). The NCES data provide detailed breakdowns of college tuition by institution type (such as private versus public universities), which are unavailable in the CPI for College Tuition and Fees.[4] Panel A of Chart 2 plots the college tuition inflation rate using this alternative measure. Similar to the CPI for college tuition, the NCES measure of college tuition inflation tends to rise either during or shortly after recessions and has generally trended down since the mid-2000s.

Using NCES data also allows us to analyze how college tuition inflation rates have varied by institution type. Panel B of Chart 2 illustrates the tuition inflation rates for public versus private colleges. This decomposition suggests that public rather than private colleges have contributed importantly to both the countercyclical behavior of college tuition inflation and the decline over the past decade.[5] Tuition inflation rates at public colleges tend to rise sharply during and after recessions and have trended downward in the last few years, similar to the overall trends observed in the college tuition component of CPI.[6] After trending down

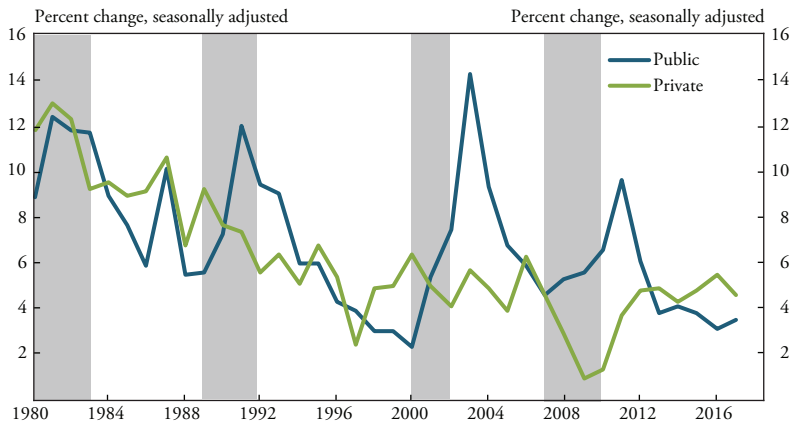
Chart 2

NCES College Tuition Inflation

Panel A: Average College Tuition Inflation across Institutions



Panel B: Public versus Private College Tuition Inflation



Note: Shaded areas denote NBER-defined recessions.
Sources: NCES and NBER (Haver Analytics).

slightly during the 1980s, tuition inflation rates for private colleges have been less volatile than public college tuition inflation rates over the past 20 years.

Taken together, the inflation rates plotted in Charts 1 and 2 suggest that college tuition inflation rates have changed significantly over time. However, these inflation rates do not seem to correlate with changes in the level of core inflation. The countercyclical patterns observed in the 1980–2004 period and the recent decline over the last decade suggest that prices in the college education sector may respond to factors that differ from underlying inflationary pressures in the economy.

II. Possible Explanatory Factors for Changes in College Tuition

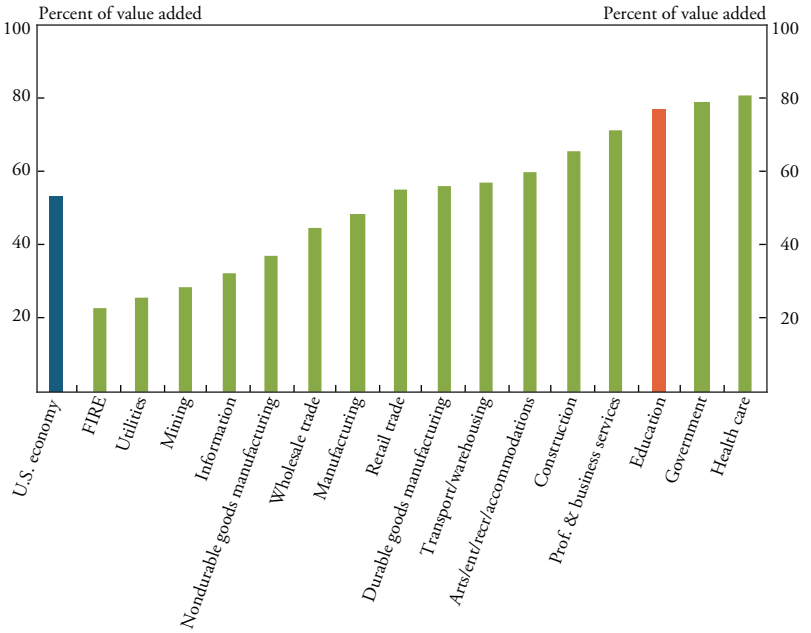
To better understand why college tuition inflation rates change over time, we examine several potential explanatory factors. We include both supply and demand factors in the higher education sector, as both could affect college tuition. For example, on the supply side, higher costs in the education sector or declines in non-tuition revenue could induce colleges to raise tuition. In addition, changes in the demand for college education—for example, due to an increased availability of student loans—could also cause universities to change their tuition over time. While the factors we describe below do not capture all possible reasons why colleges may change tuition prices, they capture a broad range of factors that previous research and anecdotal evidence suggest may be important in understanding movements in college tuition.

Supply factors

Changes in labor costs in the higher education sector may play a significant role in determining college tuition. Chart 3 illustrates the share of income paid to employees relative to total value added for several industries in the economy (Bureau of Economic Analysis [BEA]). Similar to the labor-intensive health-care and government sectors, the education sector pays out about 80 percent of the value of its total production to workers in the form of labor compensation. This high reliance on labor suggests that changes in wages may significantly affect the costs of higher education services, which may be passed on to students as changes in tuition. Panel A of Chart 4 plots the CPI for

Chart 3

Labor Share across Industries in 2017



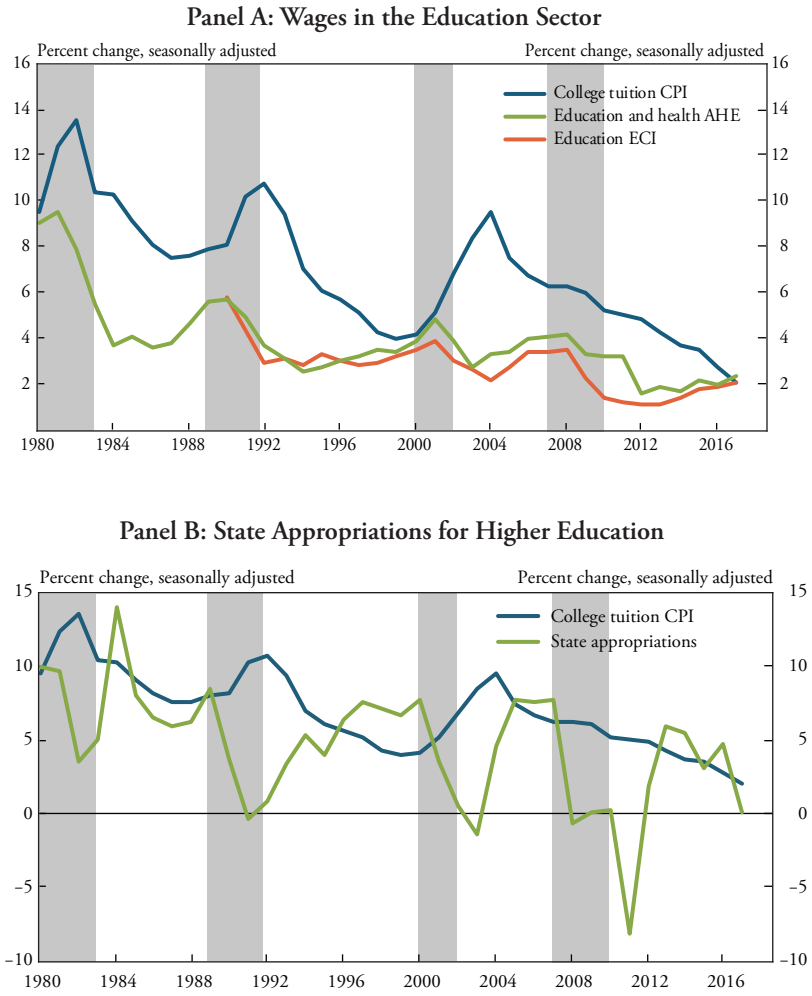
Notes: The blue bar denotes the average for the entire economy; the orange bar denotes the education sector. FIRE denotes finance, insurance, real estate, rental, and leasing.
Source: BEA (Haver Analytics).

college tuition against average hourly earnings (AHE) in the education and health sectors and the wages and salaries component of the Employment Cost Index (ECI) for the education sector from the Bureau of Labor Statistics (BLS).[7] The data illustrate that college tuition tends to decline when labor costs fall, supporting a possible link between costs and price-setting.

Changes in state and local appropriations to higher education may also help explain changes in college tuition. Government funding represents a nontrivial fraction of public colleges' operating revenue (about 40 percent in 1990, dropping to about 20 percent in 2015).[8] In addition, anecdotal evidence and interviews with college administrators suggest that declines in state and local appropriations to higher education force many institutions to raise prices in an effort to balance their budgets.[9] Panel B of Chart 4 plots the growth rate of state and local appropriations for higher education, measured in the 2017 State Higher Education Finance (SHEF) report from the State Higher Education

Chart 4

Some Supply-Side Factors in the Higher Education Sector



Note: Shaded areas denote NBER-defined recessions.
Sources: BLS (Haver Analytics), 2017 SHEF Report, and NBER (Haver Analytics).

Executive Officers, against college tuition inflation as measured by the CPI. The chart shows that government support for higher education tends to fall after recessions, which may help explain why college tuition prices rise sharply following economic downturns.[10]

Demand factors

In addition to changes in supply factors, changes in the demand for higher education may also help explain fluctuations in college tuition over time. For example, changes in the availability of student loans may have a significant effect on prices charged in the higher education sector. Over the last several decades, the federal government has periodically expanded the maximum amount students can borrow to finance their post-secondary education. A greater capacity for students to pay for college from an expanded student loan program may allow colleges to raise tuition. This possible explanation is known as the "Bennett hypothesis" after former Secretary of Education William Bennett, who attributed the rapid rise in college tuition to the expansion of federal student aid in the late 1970s.[11]

Prior research finds evidence both for and against the Bennett hypothesis. Long (2006) summarizes several related papers, stating, "of the many studies that have tried to identify whether colleges react to federal financial aid, most find little or no response." This conclusion contrasts with recent work by Gordon and Hedlund (2018), who use a structural calibrated model and find that the expansion of the student loan borrowing limits can explain the rapid rise in college tuition over the 1987–2010 period.[12] In addition, Lucca, Nadauld, and Shen (2017) find that the changes in the student loan program over the 2007–09 period led to higher tuition. They estimate that a one-dollar increase in limits to student loan borrowing leads to a 60-cent increase in tuition.

In addition to changes in the availability of student loans, other demand factors, such as changes in the college wage premium, may also explain changes in college tuition. Autor, Katz, and Kearney (2008) show that the college wage premium, defined as the average difference in wages between college-educated and non-college-educated workers, increased by roughly 50 percent over the 1980–2005 period. If a college education is increasingly required to obtain higher wage jobs, households may demand higher quantities of higher education services,

which may lead to higher prices in the higher education sector. Unfortunately, Autor, Katz, and Kearney's (2008) analysis on the college wage premium stops in 2005, so we cannot use their data to help explain more recent fluctuations in college tuition inflation.[13] Therefore, in our following statistical analysis, we proxy for changes in the college wage premium and other demand factors using changes in the percent of 18–24 year olds enrolled in college.

III. A Model of College Tuition Inflation

To investigate which of these possible explanations account for changes in college tuition inflation over time, we use the following statistical model:

$$\pi_t^c = a + b\pi_{t-1}^c + cw_t^{edu} + dS_t + fL_t + gE_t + \varepsilon_t,$$

where π_t^c denotes the yearly inflation rate for CPI college tuition prices, a is a constant, w_t^{edu} denotes the annual growth rate of the wages and salaries component of the ECI for the education sector, S_t denotes the annual percent change in state and local appropriations to higher education, L_t denotes the annual percent change in federal subsidized loan limits, E_t denotes the annual percent change in the percent of 18–24 year olds enrolled in college, and ε_t denotes other forces not accounted for by the model.[14]

We find that changes over time in labor costs help explain changes in college tuition inflation. Column 1 of Table 1 shows the coefficient estimates for our statistical model over the 1990–2016 sample period.[15] The positive coefficient on education wage inflation (0.43) suggests that a 1 percent increase in wage growth correlates with a 43 basis point increase in college tuition inflation. Column 2 of Table 1 shows that we find similar results if we instead measure wage growth using AHE for workers in the education and health sectors.[16] This alternative measure of wage growth is likely a less accurate measure of labor costs in the education sector; however, it is available prior to 1990, giving us a longer time horizon. Column 3 shows the results using this alternative measure from 1980 to 2016. We find a positive and statistically significant coefficient on wage inflation of 0.49, which is similar to our baseline coefficient estimate.

Table 1

Estimated Parameters from Baseline Higher Education Inflation Model

Variable	ECI education 1990–2016 (1)	AHE education and health 1990–2016 (2)	AHE education and health 1980–2016 (3)
Lagged higher education inflation	0.86***	0.86***	0.77***
Wage inflation	0.43**	0.45***	0.49***
State appropriations	–0.14***	–0.11*	–0.07
Subsidized loan limits	–0.02	–0.02	–0.01
Percent of 18–24 year olds enrolled	0.02	0.02	0.10
Observations	27	27	37
R^2	0.86	0.86	0.90

* Significant at the 10 percent level
** Significant at the 5 percent level
*** Significant at the 1 percent level
Sources: BLS (Haver Analytics), 2017 SHEF Report, Public Law (99-498, 102-325, 109-171), NCES, and authors' calculations.

Changes in state appropriations for higher education also play an important role in explaining college tuition inflation. The negative coefficient on state appropriations (–0.14) in column 1 of Table 1 suggests that over the 1990–2016 period, a 1 percent increase in state appropriations correlates with a 14 basis point decrease in college tuition inflation.[17] However, the coefficient in column 3 of Table 1 is smaller and much less significant over the 1980–2016 sample period, suggesting that state appropriations may be less important from 1980 to 1990.[18]

Demand factors do not appear to play a large role in explaining fluctuations in aggregate college tuition prices. The coefficients on the loan limit and the percentage of student-age population enrolled in college variables are small and insignificant.[19]

To check our results with a different inflation measure—and to see how college tuition inflation differs for public and private institutions—we next estimate the model using the NCES tuition and fees series instead of the CPI for college tuition inflation. Table 2 shows the coefficient estimates for the model estimated using this alternative measure of college tuition prices. Similar to our baseline results, column 1 of Table 2 suggests that changes in labor costs and state appropriations for higher education generally help explain movements in the higher education sector.

Table 2

Estimated Parameters from NCES Higher Education Inflation Model

Variable	All institutions 1990–2016 (1)	Public colleges 1990–2016 (2)	Private colleges 1990–2016 (3)
Lagged higher education inflation	0.57***	0.55***	0.65***
ECI education wage inflation	0.61***	0.81***	0.38*
State appropriations	–0.26***	–0.47***	–0.09
Subsidized loan limits	0.06***	0.03*	0.01
Percent of 18–24 year olds enrolled	–0.16*	0.05	–0.39***
Observations	27	27	27
R^2	0.61	0.76	0.63

* Significant at the 10 percent level
** Significant at the 5 percent level
*** Significant at the 1 percent level
Sources: BLS (Haver Analytics), 2017 SHEF Report, Public Law (99-498, 102-325, 109-171), NCES, and authors' calculations.

Public colleges appear to be more sensitive to these supply changes than private colleges. Columns 2 and 3 of Table 2 restrict our sample to only public and only private colleges, respectively. Not surprisingly, the coefficient on state appropriations is both larger and more significant for the public education sector, since private colleges receive no state funding by definition and thus should not be affected by changes in state appropriations. However, the coefficients on wage inflation suggest that tuition at public colleges is also more sensitive to changes in labor costs relative to private colleges. While these results do not explain why public colleges may be more sensitive to labor costs, private colleges may have additional sources of non-tuition revenue (such as endowments) that also rise during periods of high wage inflation. Such endowments or other sources of revenue might offset the need to pass on labor costs to students in the form of higher tuition.

Although changes in labor costs and state appropriations help explain movements in college tuition inflation on average, the coefficient estimates themselves cannot tell us which of these factors is responsible for the large increase in college tuition during the 1980–2005 period and the deceleration over the last decade. To answer this question, we calculate the marginal R^2 for each explanatory factor in our model, which measures the model's ability to fit the data as we remove each factor in isolation. To conduct this exercise, we estimate our baseline model over

various subperiods in our 1980–2016 sample using AHE in the education and health sectors as our measure of wages.

Statistical evidence suggests that changes in labor costs help explain the rapid increase in college tuition inflation during the 1980–90 period. In contrast, state appropriations appear to be more important during the 1990–2005 period. Table 3 shows how the fit of our statistical model (the explained variation) changes as we remove each factor in isolation, with larger values indicating greater explanatory power for a given factor. The first row of data in Table 3 shows that over the 1980–2005 period, wage inflation primarily explains movements in college tuition inflation. Restricting the sample to the 1990–2005 period dramatically raises the importance of state appropriations, while sharply decreasing the role of wages. Expanding the sample to include the most recent data up to 2016 slightly raises the contributions from wages and lowers the contribution from state appropriations, suggesting that labor costs may have again become a more important factor since 2005. However, the relatively small marginal R^2 values for wages and state appropriations in the bottom row suggests that our included factors may not be as successful in describing the recent decline in college tuition compared with earlier periods. Our proxy for broader demand factors, the percent of 18–24 year olds enrolled in college, seems to play a small role in explaining fluctuations in college tuition inflation rates during the 1980–2005 period. However, since this factor is statistically insignificant in Table 1, the combined evidence in Tables 1 and 3 suggests that supply factors are generally more important than demand factors in explaining fluctuations in college tuition inflation rates.

These conclusions are supported by the tuition, wage, and state appropriations data shown earlier in Chart 4. During the 1980–89 period, state appropriations actually *peaked* shortly after the 1980–81 recession. College tuition inflation rates seemed to move more closely in line with changes in wages during that time, suggesting that wages were more important from 1980 to 1989. Over the 1990–2005 period, state appropriations fell sharply during or after recessions, correlating with a rise in college tuition inflation.[20] Despite the large decline in state appropriations for higher education in 2008–10, college tuition inflation also declined over the last decade, a time when wages in the education

Table 3

Estimated Marginal R^2 Values from AHE Higher Education Inflation Model

Sample period	Wage inflation (1)	State appropriations (2)	Subsidized loan limits (3)	Percent of 18–24 year olds enrolled (4)
1980–2005	0.12	0.04	0.00	0.02
1990–2005	0.02	0.16	0.00	0.00
1990–2016	0.04	0.03	0.00	0.00

Notes: All values are marginal R^2 values. To calculate these values, we estimate the full model over the specified time period. We then re-estimate the model with the relevant variable omitted. The difference between the R^2 (explained variation) for these two models is the marginal R^2 value for the variable. The R^2 for each of the full statistical models is 0.88, 0.92, and 0.86, respectively.
Sources: BLS (Haver Analytics), 2017 SHEF Report, Public Law (99-498, 102-325, 109-171), NCES, and authors' calculations.

sector also declined. However, the magnitude of the decline in college tuition inflation appears a bit larger than the fall in wage growth over the last decade, suggesting other factors that are absent in our model may also be influencing the recent evolution of college tuition inflation. Although the individual factors explaining movements in college tuition have changed over time, these results continue to suggest that supply rather than demand factors accounted for a greater portion of changes in aggregate tuition prices.

Our statistical model contains a variety of supply and demand factors, but it may not capture more complex changes in the higher education sector that might affect college tuition. For example, our various measures of wage growth may not fully account for higher labor costs due to an increase in administrative or other non-teaching positions or other changes in the composition of labor employed by colleges. To test this idea, we augment our baseline model with the change in the employee-to-student ratio (measured using enrollment data from the NCES and employment data from either the CPS or the Quarterly Census of Employment and Wages (QCEW). The coefficient on this additional variable in either specification is negative and insignificantly different from zero, suggesting that changes in the number of employees may not be a key driver of the aggregate changes in college tuition.

Our model could also be missing other demand-side factors as well. Colleges are highly heterogenous along many dimensions and thus may have idiosyncratic factors that are important in understanding changes

in their tuition prices over time. Although our use of a simple statistical model using aggregated statistics may be informative about some of the recent aggregate trends in the higher education sector, it cannot account for all possible factors that influence an individual college's decision in setting tuition prices.

IV. Conclusion

After more than 20 years of rapid growth, college tuition inflation has slowed recently, raising questions about the forces driving it. We investigate patterns in college tuition inflation and present two key findings. First, we document that college tuition inflation rates change significantly over time. After averaging over 7 percent per year over the 1980–2004 period, college tuition inflation has fallen over the past decade and is currently running around 2 percent. Second, changes in labor costs in the higher education sector and state appropriations for higher education help explain movements in college tuition inflation. Since college-educated workers earn significantly more than workers with only a high-school education, changes in the cost of college tuition likely have important implications for current and future household incomes.

Endnotes

[1]The Bureau of Labor Statistics (BLS) calculates the prices paid by households for college tuition based on the annual consumer expenditures for undergraduate and post-graduate students at two-year colleges, four-year colleges, major universities, and professional schools such as law, dental, or medical schools. Thus, the CPI for College Tuition and Fees represents the average price paid by consumers across all of these institutions. The BLS includes adjustments for financial aid when calculating college tuition prices. See https://www.bls.gov/cpi/factsheets/college-tuition.htm for additional details and discussion. Throughout the article, we use the terms "colleges" and "universities" interchangeably to refer to institutions providing post-secondary education.

[2]Thus, in inflation-adjusted or "real" terms, college tuition became much more expensive over the 1980–2004 period. Other metrics also suggest that the price of college relative to overall prices and incomes expanded rapidly over that time. Using data from the National Center for Education Statistics (NCES) and the Current Population Survey (CPS) of households, we calculate that one year of college tuition and required fees represented about 7 percent of median household income in 1980. By 2005, a year of college tuition represented about 16 percent of median household income.

[3]Previous work such as Gordon and Hedlund (2018) also documents the rapid rise in the cost of college tuition over the 1980–2004 period. However, Gordon and Hedlund stop their analysis in 2010 and thus do not analyze the slowdown in college tuition inflation over the past several years. The key contribution of our work is examining the more recent slowdown and determining whether the factors that led to the rapid increase in college tuition prices during the 1980–2004 period also help explain the more recent slowdown.

[4]Unlike the college tuition and fees component of the CPI, the prices reported by the NCES are the "sticker prices" of college tuition, which do not control for financial aid. Thus, we prefer to use the college tuition component from the CPI as our baseline measure of college tuition. The NCES provides some data on the net price (tuition minus aid) that consumers actually pay (see https://nces.ed.gov/programs/digest/d17/tables/dt17_331.30.asp?current=yes). Unfortunately, these data are only available intermittently since 2009, which makes it difficult to conduct substantial statistical analysis. Using institution-level data, Gordon and Hedlund (2018) document that sticker prices from the NCES and their calculations of net tuition and fees have similar trends over the 1987–2010 period. For public colleges, the NCES data use only in-state tuition rates.

[5]Since the NCES data only reflect the sticker price of college, which does not control for financial aid, we interpret this institution-type decomposition with caution. Financial aid at private colleges, which may depend on endowments and

other sources of revenue, could be quite cyclical in nature. Thus, net prices paid by students may actually be more countercyclical than the reported sticker prices.

[6]Further decomposing the data, we observe a similar pattern among both two-year and four-year public colleges.

[7]ECI data for wage growth in the education sector are not available before 1989. Therefore, we also examine labor costs using average hourly earnings in the education and health sectors, which allows us to extend our analysis back to 1980.

[8]Revenue statistics are calculated from the following tables in the NCES's Digest of Education Statistics: Table 332 (1999), Table 336 (2006), Table 352 (2009), Table 366 (2011), and Table 333.10 (2017). Statistics are by academic year. The 1990 statistic is for the 1990–91 academic year. The 2015 statistic is for the 2015–16 academic year.

[9]For example, the Associated Press reported in March 2018 that the Missouri House of Representatives and the state's public colleges and universities came to an agreement to limit tuition increases in exchange for steady state funding. Mumper (2001) interviewed administrators in 11 states from 1995 to 1999 about why they thought college prices were rising. Many blamed rising prices on decreases in state appropriations.

[10]Kane, Orszag, and Gunter (2003) find that appropriations to higher education respond to changes in the unemployment rate and are, in fact, one of the most cyclical state budget categories.

[11]In a 1987 opinion piece in the *New York Times*, Bennett stated that "increases in financial aid in recent years have enabled colleges and universities blithely to raise their tuitions, confident that Federal loan subsidies would help cushion the increase."

[12]In a comment on Gordon and Hedlund, Baum (2018) illustrates the differences in tuition rates for public versus private universities (similar to Panel B of Chart 2). In addition, she also illustrates a countercyclical relationship between state appropriations and college tuition prices.

[13]Recent work by Valletta (2018) also analyzes the higher education wage premium. Valletta finds that after expanding rapidly over the 1980–2000 period, the gap grew only slightly during the 2000–10 period and has been relatively unchanged over the 2010–15 period.

[14]State appropriations data are from the 2017 State Higher Education Finance Report put out by the State Higher Education Executive Officers. Specifically, we use the Educational Appropriations series. Note that these data are by fiscal year. We match the data with the year in which the relevant fiscal year started. We create a federal subsidized loan limit series by reading over the Higher Education Act of 1965 and its amendments. We use the implementation dates of changes rather than the dates the laws were passed. When calculating the limits, we use the sum of each year's loan limits rather than the aggregate loan limits. In other words, we add together the freshman yearly limit, the sophomore limit,

the junior limit, and the senior limit. This number is generally lower than the aggregate limit.

[15]We estimate our baseline model using ordinary least squares (OLS) regression at an annual frequency since colleges generally only make tuition changes once a year. One possible concern with our specification is the use of nominal, rather than real, variables. If common trends are present on both the left- and right-hand sides of our model, then our specification could lead to spurious results. However, we find similar results if we estimate our model in real terms by subtracting off aggregate core CPI inflation from all of the variables except enrollment or if we include core CPI as an additional explanatory right-hand-side variable. Another possible concern with our specification is the possible endogeneity of wages as an explanatory variable. To address this concern, we estimate a version of our baseline model using instrumental variables in which we instrument contemporaneous wages using various lags of wages. If we instrument using only one lag of wages, the Wu-Hausman test suggests that wages are endogenous. However, this test is somewhat sensitive to the exact instrument set. If we increase the number of lags used as instruments, we fail to reject the null hypothesis that wages are exogenous. However, estimating our baseline model using instrumental variables and only one lag of wages as an instrument produces very similar results to our findings using OLS with a positive and statistically significant coefficient on wages and a negative and statistically significant coefficient on state appropriations. Since our statistical conclusions are unchanged using this alternative approach, these findings suggest that wage endogeneity does not drive our main conclusions.

[16]We also find similar results using a wage growth measure from the Quarterly Census of Employment and Wages (QCEW) from the BLS. We construct a wage measure for higher education by weighting the average weekly wage values for the North American Industry Classification System categories "611210 Junior Colleges" and "611310 Colleges, Universities, and Professional Schools" by their quarterly employment. This measure allows us to isolate wages for college employees; our ECI baseline series measures wages for the entire education sector. Since the QCEW data are not available until 1990, our sample period for this robustness check is 1991 to 2016.

[17]We find that the constant is not statistically different from zero in our baseline model and thus do not report it in our regression results. In all but one of the specifications in Tables 1 and 2, tests for autocorrelated residuals (Durbin-Watson statistics) fail to reject the null hypothesis of no serial correlation in the regression residuals. The exception is our baseline specification, for which the Durbin-Watson test is inconclusive (the test statistic falls between the lower and upper bound of the critical values). However, adding an additional lag to our baseline regression produces similar coefficient estimates on the other non-lag variables, suggesting serial correlation in our residuals is not driving our findings.

[18]We also run two sets of regressions over the 1980–2016 and 1990–2016 sample periods replacing average hourly earnings with other measures of the cost of running a college. We replace wages with the State Higher Education Executive Officers' Higher Education Cost Adjustment (HECA) and then the Commonfund Institute's Higher Education Price Index (HEPI). HECA and HEPI attempt to incorporate multiple costs colleges face to create an overall college cost index. These indexes closely track our wage measures, which is not surprising given that labor costs account for much of the cost of college education. The HECA and HEPI models offer similar results to both the ECI and average hourly earnings models, suggesting we are not leaving out important college cost variables. The regression results also show the coefficients on state appropriations to be smaller over the longer time period, once more suggesting that state appropriations were less important to college tuition inflation during the 1980–90 period.

[19]Our finding that changes in student loan borrowing limits do not help explain movements in overall college tuition inflation differs from the conclusions of Gordon and Hedland (2018) as well as Lucca, Nadauld, and Shen (2017). However, two important considerations may help reconcile our differing conclusions. First, Gordon and Hedlund reach their conclusions using a calibrated structural model in which they assume a representative nonprofit institution. They acknowledge that their representative college assumption may be too simplistic and state that their finding "likely exaggerates the impact of the Bennett hypothesis." Second, Lucca, Nadauld, and Shen exploit the cross-sectional variation of college tuition rates using student-level data that provide them much more variation to identify the effects of changes in student loan borrowing limits. At the aggregate level, which is the focus of this article, we have only limited variation in student loan limits, which may make it difficult to determine their statistical effects. One combined interpretation of our findings and the work of Lucca, Nadauld, and Shen suggests that changes in loan programs may be quite important for borrowers near their borrowing limit but might not have large aggregate implications.

[20]These conclusions are broadly consistent with a 2001 commissioned study by the NCES, which finds that changes in state appropriations are the most important factor associated with changes in college tuition prices during the 1988–98 period.

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