Decomposing the Dispersion of Higher Education Endowments

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Abstract

This paper documents the increasing variance in the distribution of college and university endowments and decomposes the increase into components coming from variations in investment returns, endowment spending rates, and annual giving to build the endowment. By simulating counterfactual endowment distributions from 1992 through 2010 without variation in each element we examine the contribution of each component to the total. We find that in addition to the original 1992 variation in endowment levels which is responsible for the largest portion (61%) of the variation in 2010 endowment sizes, variation across institutions in annual giving to the endowment and rates of return are important sources of the increase corresponding to 27% and 38% of the 2010 variance in endowment levels respectively. In contrast, variations in the endowment spending rate across institutions is a far smaller contributor, making up only 7% of the variance.

1 Introduction

The total size of endowments held by colleges and universities in the United States increased from $108 billion in 1992 to a peak of $419 billion in 2009.[1] However their overall size belies their distribution – most of this growth has gone to the very largest of these endowments. While 1780 college and university endowments contribute to this total, over half of this sum, $225 billion, was held by the 25 largest endowments; the top 100 endowments held 78% of all endowment assets. Figure I plots the value of these endowments over time. This inequality impacts the administration of institutions of higher education. For those schools fortunate enough to have large endowments, endowments are a significant source of revenue. Schools with larger than a $100 million endowment have potential endowment revenue equal to 10% of their expenses on average. However, even among these schools there is inequality: schools with the top 100 endowments per student have potential endowment revenue equal to 21% of their expenses on average.[2]

Colleges and universities with large endowments gain flexibility in how they raise and use other revenues. The major sources of funds to support undergraduate education at private academic institutions are annual giving from alumni and others, undergraduate tuition, and spending from the endowment. Ehrenberg and Smith (2001) shows that among the eight Ivy League universities, all of which have large endowments, by far the largest portion of the difference in their spending power comes from differences in endowment revenues. A large endowment allows a university to rely less on revenue from student tuition. The institution can charge a lower sticker price, or give larger discounts off its posted tuition to students with need. Winston (1999) shows that the distribution across universities of the size of discounts given to students is also highly unequal. In fact, the tuition discount for need based grant aid is highly correlated with the school's endowment size. Table I shows the cost of attendance net of financial aid in 2010-2011 for the top 100 schools ranked by their endowment per student. For families between 48 and 74 thousand dollars in income, the cost of attending a school with a top ten ranked endowment is approximately half that of attending a school with a 65th ranked

[1] Author's calculations from NCES IPEDS data. Figures in 2010 dollars

[2] Author's calculation from NCES IPEDS data. Potential endowment revenue is 5% of value of endowment in 2010, which is the average rate of endowment spending across schools.

endowment.[3] While this relationship is not necessarily causal, universities with large endowments tend to have advantages in other revenue sources too; it suggests that the distribution of endowment funds across schools may have important implications.

In this paper we document that the inequality in endowments as a source of revenue for colleges and universities increased between 1992 and 2010. While more institutions report endowments in 2010 than in 1992, those present in both years with large endowments in 1992 saw much larger increases than those with smaller endowments in 1992. As a result, even among a balanced panel of institutions the variance of endowment sizes increased dramatically. This increase in variance for our sample schools (described below) is shown in Figure II. Changes in the distribution of endowments come from a few distinct sources. To understand what types of policies and circumstances might impact this distribution we analyze the sources of this dispersion.

Each year, schools vary in (1) their starting endowment level, (2) the level of gifts they receive (and the portion of these that they apply to building their endowment), (3) the share of their endowment that they spend, and (4) the rate of return their endowment earns. Together these four components determine their endowment entering the next year. The distributions of and correlations between these components will determine the overall distribution of endowments for the following year. We decompose the variance of 2010 endowments into portions that come from the three components that vary each year and a portion coming from the original variation in endowments at the beginning of our sample period.

The *level* of a university's endowment may mask the spending power an endowment provides as schools also vary in enrollment. For instance, while the University of Texas system has an endowment that rivals the largest endowments in the country it has far more students than other institutions with endowments of its size. On a per student basis, its endowment provides far less revenue. In general schools with large endowments have not increased their enrollments faster than those with smaller endowments so the distribution of endowment funds per student has increased in dispersion similar to the overall endowment level. Figure III plots the changes in variance of endowment per student. So, in addition to the decomposition

[3]This inverse relationship holds on balance for all family income levels.

of endowment levels, we decompose the variance of endowments per student into its constituent components in this paper.

In our analysis of endowment levels, we find that variations in the initial endowment levels, in gifts devoted to building the endowment, and in rates of return all contribute to the increase in dispersion of endowments. Because the decomposition is non-linear, the contribution of each component depends upon the components remaining. However by simulating distributions with variation only in a subset of the components we can assign a portion to each component. Initial endowments have the largest impact on the 2010 endowment dispersion (61%), followed by gifts to the endowment (27%), and rate of return (38%), while the spending rates contribute far less to the increased dispersion (7%). Our decomposition of the variance in endowments per student shows similar results. Again the original 1992 variation is the most important component accounting for 60% of the 2010 endowment variance. The rate of return explains 36% of the variance while gifts per student explain 18.3%. Variation in the spending rate and changes in enrollment explain only 12% and 3% respectively.

By quantifying the contribution to endowment inequality of each of these components this paper seeks to provide guidance on their relative importance to the existing large literature that examines specific components in isolation. The prior literature focuses on what characteristics of schools and students are correlated with high performance in one of the components of endowments. These studies either use individual student level data from one school or cross-sectional and panel data from many schools.

The causes and correlates of alumni giving to universities have received the most attention. For example, using data on alumni giving from single institutions, researchers find that alumni giving is increasing in the athletic performance of the university (Holmes, 2009; Meer and Rosen, 2009b) and increasing in characteristics of the student's experience that might suggest a positive experience while in school (Clotfelter, 2001; Holmes, 2009). Meer and Rosen (2009a) found evidence supporting a non-altruistic motivation for alumni giving; life cycle patterns of donations at one institution suggest that families make donations to schools in the hopes of increasing the chances their child will be admitted.

Other papers have used cross-sectional or panel data to examine the characteristics of schools that have

high levels of giving to build the endowment or high rates of return. Using a panel of schools, Ehrenberg and Smith (2003) finds that schools with larger endowments apply a larger share of the gifts they receive towards their endowment. Cunningham and Cochi-Ficano (2002) affirm findings above that show that athletic performance is a predictor of later alumni giving as well as incoming student achievement. Lerner, Schoar, and Wang (2008) study school characteristics that are related to high rates of return on the endowment and find that schools with larger endowments and more selective admissions saw higher market returns on their endowment.

Our study is the first systematic breakdown of the current distribution in higher education endowments. We show that while differences in endowment levels almost two decades earlier are persistent, differences in giving to build the endowment and the rates of return experienced by the endowments add to changes in the overall dispersion of endowment sizes.

2 Decomposition

Four components determine the size of the endowment in a given year: (1) The prior year's endowment size, (2) the rate of return, (3) the rate of spending from the endowment, (4) and the amount of new gifts applied to the endowment. These are related by the accounting identity:

$$w_{i,t+1} = w_{it} r_{it} (1 - s_{it}) + g_{it} \tag{1}$$

where w_{it} is the size of institution i's endowment in period t, r_{it} is their rate of return, s_{it} is its endowment spending rate, and g_{it} is the amount of gifts applied to building its endowment.[4] We want to decompose the increase in variance of endowments over a given time period into the portion that comes from each of these factors. Repeated substitution yields:

[4] Assuming that institutions could earn return on gifts the year that they received them would give the alternative equation $w_{i,t+1} = w_{it}(1 + \frac{g_{it}}{w_{it}})(1 + r_{it})(1 - s_{it})$ which would yield a functional form linear in logs. However, schools with smaller endowments tend to get more gifts as a fraction of endowment size and so this term acts to decrease variance. This interpretation while justifiable, makes it difficult to draw conclusions.

$$w_{i,t} = w_{i0} \prod_{\tau=0}^{t} r_{i\tau}(1 - s_{i\tau}) + \sum_{\tau=0}^{t} g_{i\tau} \prod_{k=\tau}^{t} r_{ik}(1 - s_{ik}) \tag{2}$$

which gives the level of endowment in a future period in terms of the history of gifts devoted to building the endowment, spending rates, and rates of return as well as the school's initial endowment level.

Similarly, the evolution of endowment levels per student can be broken into five components: (1) the prior year endowment per student, (2) the spending rate, (3) the rate of return, (4) gifts per student added to the endowment, and (5) growth in enrollment. This relationship is described by:

$$\frac{w_{i,t+1}}{E_{i,t+1}} = \frac{E_{i,t}}{E_{i,t+1}}[\frac{w_{it}}{E_{it}} r_{it}(1 - s_{i,t}) + \frac{g_{it}}{E_{it}}] \tag{3}$$

where $E_{i,t}$ is the enrollment of institution i in year t, so $\frac{w_{it}}{E_{it}}$ is the size of the endowment per student, and $\frac{E_{i,t}}{E_{i,t+1}}$ is the inverse growth rate in enrollment.

We use these equations to decompose the variance of endowment levels and endowment per student. However, because both formulas are non-linear and the variables involved are not independent we cannot use a simple variance decomposition. Instead we use these identities to simulate what the distribution of endowments would have looked like without variation in each of these variables. For example, to simulate the distribution of endowments if there were no dispersion in rates of return we set $r_{it} = \bar{r}_t$ for all universities, i, where $\bar{r}_t$ is the average across all universities in year t in the rate of return to endowment assets. Using Equation 2 with these standardized rates of return gives us the value for each endowment in each year as if they had all experienced equal rates of returns in each year. Simply taking the variance of these endowments yields a counterfactual variance without the impact of variation in rates of return.

3 Data

To perform this analysis, we require annual data for a set of institutions on their spending rates from endowment funds, their endowment rates of return, their endowment sizes, their annual giving used to build their endowments, and their enrollment levels. While data on these components have been available for some

time, coverage for many institutions is not available every year and some data are not reliable. We assemble a panel of 78 schools for the period 1992 through 2010 that contains data for each variable for each year.

Endowment spending rate and return rate data come from the National Association of College University Business Officers (NACUBO) and the Commonfund Institute. This information comes from an annual survey of colleges and universities. Surveys on endowment returns began in 1980, while spending rate surveys began in 1992 and are available through 2010. However many institutions did not consistently respond to the NACUBO surveys in early years.

Endowment size data come from The National Center for Education Statistics' Integrated Postsecondary Education Data System which surveys higher education institutions annually. The finance survey contains the yearly beginning and ending market values of the institution's endowment. This information is available starting in 1986. However from 1997-2002 endowment values were asked only of public institutions. In 2003 the question was optional for private institutions and it was fully reinstated as a mandatory question beginning in 2004. During the years 1997-2003 when IPEDS endowment data are incomplete we use data from NACUBO to supplement it. Years in which they overlap allow us to check for consistency between the two data sources.

Data on annual giving come from the Council for Aid to Education (CAE). The CAE provided us with annual information on the sources and uses of annual giving from 2,299 institutions. This allows us to identify the quantity of gifts an institution applied towards building its endowment in each year.

We require a balanced panel of institutions across the largest possible span of time that includes all the required variables. Due to data constraints this results in a panel of 78 schools from 1992 through 2010. While there are many more than 78 institutions of higher education in the United States, most do not generate a significant amount of revenue from their endowments. In 2010, there were 225 schools with more than $50,000 in endowment per full time equivalent student. At the average spending rate of 5% this results in $2,500 in endowment spending per student. Our sample includes 51 of these schools. So, while our sample excludes most schools, it does include a large share of those for whom endowment earnings are an important source of revenue. Additionally, the distribution of the endowments in our sample follows a

similar pattern as the distribution of endowments among all schools. Figure IV plots both variances over time but on separate scales. Since the latter is far larger the variance is much larger, but the pattern of changes is similar.

A comparison of summary statistics for our sample and the available universe of institutions in 1992 and 2010 are given in Table II. On average, our sample has larger endowments, receives more gifts, has more extreme rates of return, spends a slightly larger fraction of their endowments, and has more students than those institutions not in our sample. Within our sample much variation remains. The 78 schools come from 28 states. Three are large public university systems, three are individual public universities, and the remaining 72 are private colleges and universities.[5] The 2010 endowments of institutions in our sample range from approximately $30 million to over $5 billion.

4 Results

In this section we decompose the variation of two separate measures of endowment size into their respective components according to equations 1 and 3.

4.1 Endowment Levels

As described above, we turn to a simulation method to quantify the effect of each component on the variance of endowments. However since the relationship between endowments and these components is nonlinear the effect of removing a component is not independent of the remaining components. In other words, the order in which the components are removed matters.

We simulate 1993 through 2010 endowments with each of the 14 possible combinations of components and present the resulting 2010 simulated endowments in Table III. Each line refers to a separate simulation. Panel 1 of table III shows simulated variances with variation in only one component, while panels 2 and 3

[5]Since many systems of public institutions have a system wide endowment we treat a system as a single institution. We do this using IPEDS system identifiers and combine any two schools into a system if they are listed as being in the same system in any year.

have two and three components varying respectively. For example, the first line comes from a simulation in which the rate of return, spending rate, and gifts for each school are set to the yearly average and each school's resulting endowment is simulated for each year. In 2010, this simulation results in a variance of endowments that is 35.4% of the actual total 2010 variance.

These results show that spending rates do not have a large effect on the variance of endowments. Row three of Panel 1 shows that spending rate variation alone can reproduce only 4.7% of the 2010 variance in endowments. Likewise, row two of panel 3 shows that removing only spending removes only 7.1% of the 2010 variance.

In contrast, variation in initial endowments, gifts, and the rate of return all have important roles in explaining the variance in endowments. Given that the variance in endowments was already large in 1992, initial endowments necessarily have a large impact on 2010 endowments. Alone, variation in initial endowment generates 35.4% of 2010 variation in endowments. Removing only variation in initial endowments also removes 61.1% of the variance. Giving alone can explain 26.0% of the variance and removing only variation in giving removes 26.8% of the variance.

Rate of return has an important amplifying effect on the variation in giving and initial endowments. Variation in the rate of return itself is not adequate to generate a large amount of variation in endowments over the simulation period. Including only its variation produces only 8.9% of the variance. However removing it while variation in the other components remains removes 47.8% of the variance. This suggests that while there is not a huge variation in rates of return it is correlated with endowment levels and giving in an important way.

Figure V plots the simulations given in Panel 1 of table III over all years of the sample period. Variances are given as a fraction of the variance of endowments in 1992. Those simulations that do not include the initial endowment begin in 1993 with zero variances and increase over time. Here again, the rate of spending and the rate of return acting alone are not important contributors to the variance. Variation in gifts results in a steadily increasing variance. Variation only in initial endowment does not produce a horizontal line because fluctuations over time (but made constant between schools) in the other components change the

distribution.

Figure VI similarly shows the simulations given in panel 3 of table III where variation in only one component has been removed. The qualitative results described above hold true here as well.

Table IV shows a less detailed version of the analysis. Here we give the correlation coefficient between school averages of each component. These results follow in line with those presented already. The spending rate is less correlated with the other components and the initial endowment levels which results in its relative unimportance in the simulations. In contrast giving levels and the rate of return are correlated with each other and with the original endowment level.

4.2 Endowment Per Student

Using the same process but based on Equation 3 we present the 2010 variance in endowment per student broken into variation in five components: 1992 endowment per student, spending rate, rate of return, gifts to the endowment per student, and enrollment growth. Table V shows the results of this decomposition for simulations including only variation in the given components.

Panel 1 of Table V shows simulated variances using variation only in one component. Each row corresponds to a separate simulation and reports the simulated variance as a fraction of the total 2010 variance. Alone, the spending rate and enrollment growth each contribute less than 10% of the total 2010 variance. Panel 3 shows similar simulations where each simulation includes variation in four of the five components. Removing variation in enrollment growth removes only 3.1% of the 2010 variation. Initial 1992 variation accounts for a similar portion of the total variance as in the endowment levels analysis above, while the spending rate accounts for a larger portion in the endowment per student analysis. This suggests that while the variation in spending rate was not large, it is more correlated with the endowment per student than it is endowment levels.

Figures VII and VIII plot these simulated variances as a portion of the total 1992 variance over time. These make clear that the analysis in 2010 made the otherwise strong effect of the variation in rate of return appear smaller. Figure VIII shows that removing variation in the rate of return accounts for the largest

portion of the variance in endowment per student but that this decreases following the decline in endowment values in 2010.

Table VI shows correlations similar to those in IV but for the endowment per student analysis. Enrollment growth has very small correlation coefficients with the other components of endowment per student. However in general schools with larger endowments and more giving increased their enrollment less over the period. As a result, enrollment growth contributes to the widening distribution of endowments per student.

5 Conclusion

University endowments constitute a significant source of revenue for some schools, and there is significant inequality in endowment levels among schools. While previous studies have looked at individual components that makeup endowments in isolation we provide the first systematic breakdown of the distribution of endowments into their major components and study their changing dispersion over time. We show that the distribution of endowment sizes increased in dispersion between 1992 and 2010. Over this time period both the value of endowments held by universities and the variance of their distribution tripled. We then decompose this variance into its constituent components, the initial 1992 endowments, rates of return, spending rates, and gifts.

Our analysis covers a small sample of the higher education institutions in the United States and hence, our results may not hold for a more complete sample. However, for the vast majority of institutions, endowments do not provide a large source of revenue so it is less important for them to be in our analysis. Of those that are able to spend at least $2,500 per student annually from their endowment our sample includes 23%.

The impressive size and growth of university endowments has garnered attention from legislators and the popular press. Some have suggested that wealthy universities are not spending a sufficiently high percentage of their endowments each year and that, akin to regulations under which private foundations operate, the universities should be required to spend a specified minimum percentage of their endowment values each year, in the hope that this would lead the institutions to moderate their rates of tuition increases or increase their

need-based grant aid to undergraduate students. Such a policy change would not have a large impact on the distribution of endowment assets because our research shows that the variation in endowment spending rates across institutions contributes far less to the growing inequality of endowment levels than do variations across institutions in annual contributions devoted to building the endowments and rates of return on endowment assets.

The size and growth of university endowments, coupled with the size of federal deficits has also periodically led to suggestions that the federal government might tax the earnings of endowments or limit tax deductions for contributions to endowments that exceed a certain level (either absolutely or on a per student basis). Such policies would have a larger impact on the widening distribution of endowment wealth. However, in addition to making the distribution of endowment wealth more equitable, these policies would likely decrease the total size of endowments. Before seriously contemplating such policies, one might hope that proponents would provide a clearer explanation of the social costs of large endowments because, as we showed in table 1, the net prices (after need-based financial aid) paid by students at private colleges and universities tend to be lower at the institutions with the largest endowments per student.

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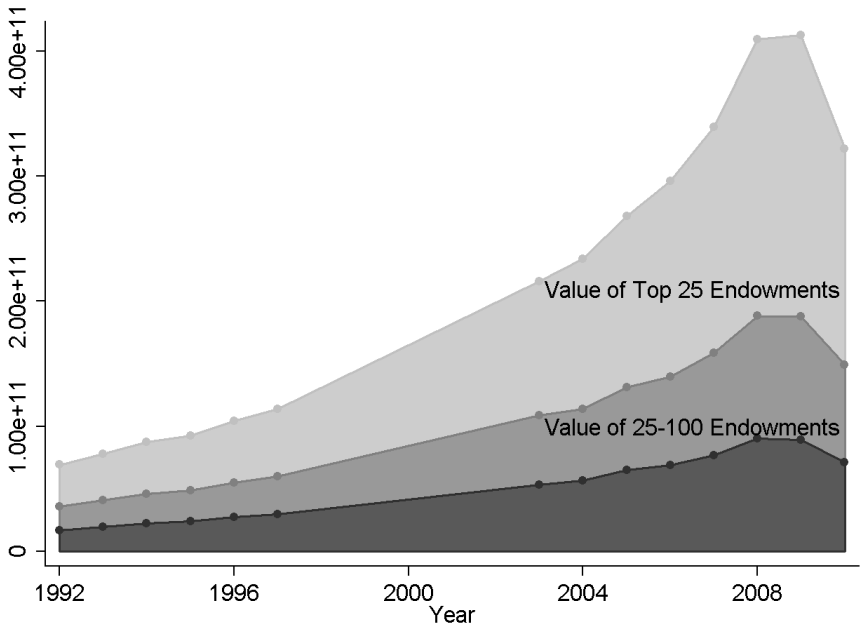
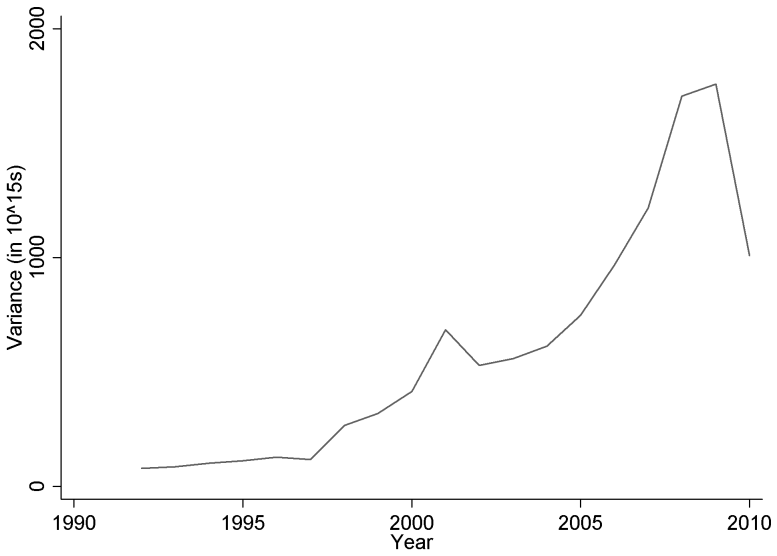
Figure I: Total value of higher education endowments



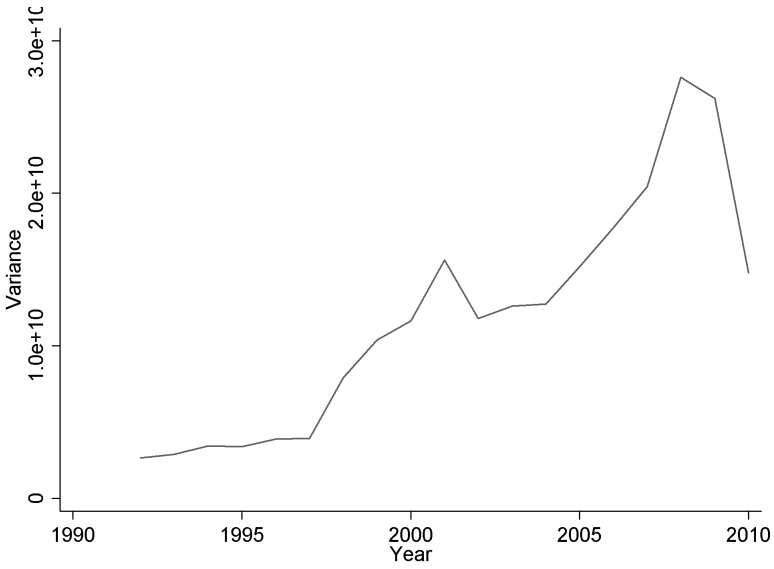
Note: Author's calculations from NCES IPEDS finance surveys.

Figure II: Variance of endowment size over time



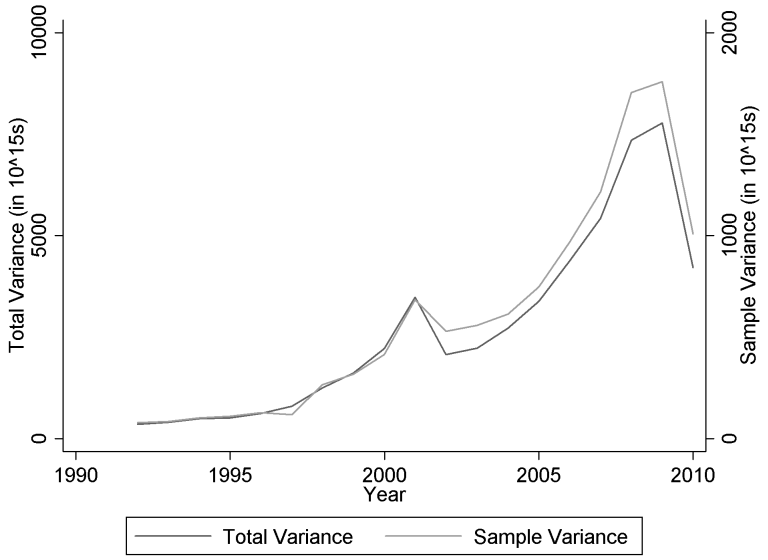
Note: In 2010 dollars from sample of 78 institutions described in text.

Figure III: Variance of endowment per student over time



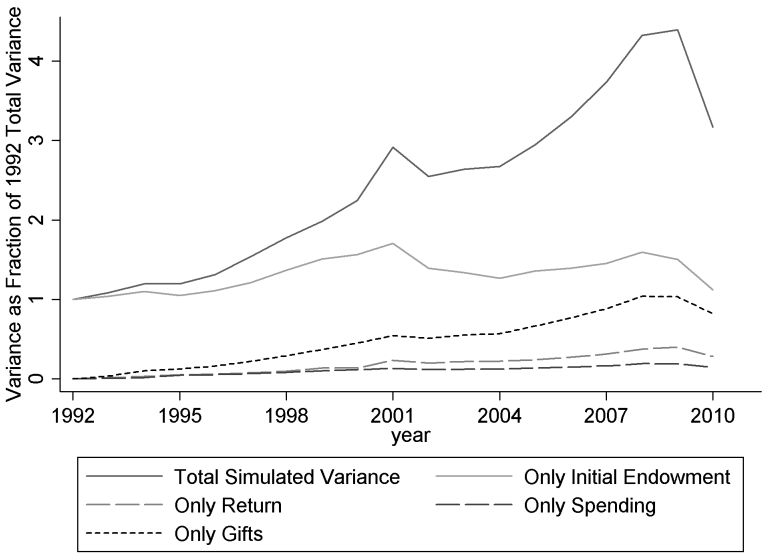
Note: Endowment per full time equivalent student in 2010 dollars from sample of 78 institutions described in text.

Figure IV: Variance of sample endowments versus all endowments



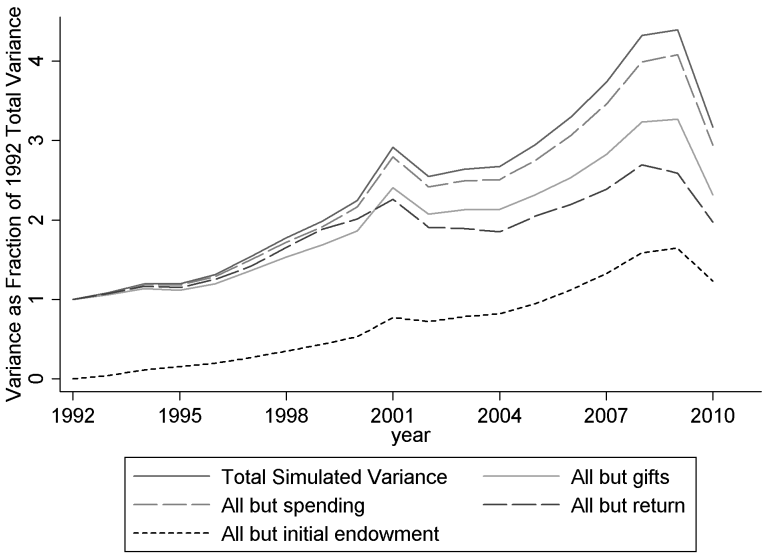
Note: In 2010 dollars from sample of 78 institutions described in text.

Figure V: Contribution of single components to variance of endowments



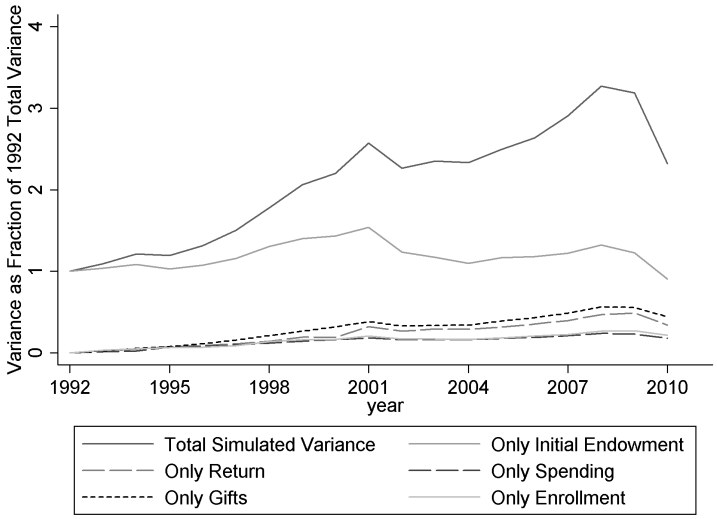
Note: Variances simulated according to Equation 1 where all but the stated component have been replaced with the average across all schools for each year. Variances are reported as a fraction of the 1992 total variance of endowments.

Figure VI: Removing single components from variance of endowments



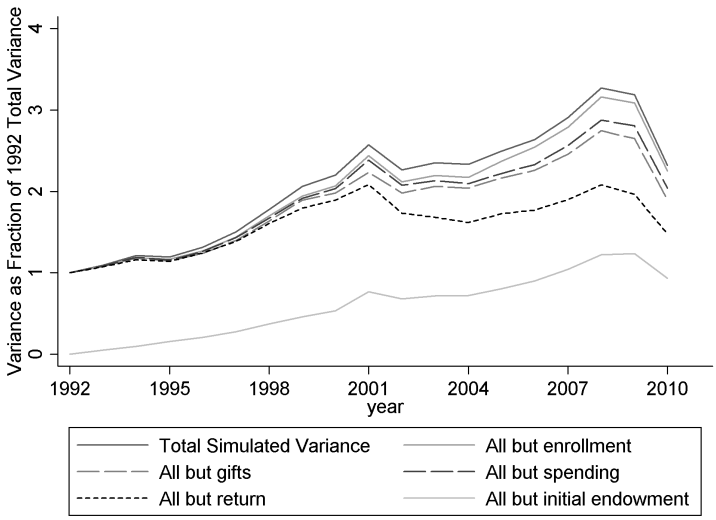
Note: Variances simulated according to Equation 1 where only the stated component have been replaced with the average across all schools for each year. Variances are reported as a fraction of the 1992 total variance of endowments.

Figure VII: Contribution of single components to variance of endowment per student



Note: Variances simulated according to Equation 3 where all but the stated component have been replaced with the average across all schools for each year. Variances are reported as a fraction of the 1992 total variance of endowments.

Figure VIII: Removing single components from variance of endowment per student



Note: Variances simulated according to Equation 3 where only the stated component have been replaced with the average across all schools for each year. Variances are reported as a fraction of the 1992 total variance of endowments.

Table I: Net Price by Family Income and University Endowment Size

	Family Income			
Endowment Ranking	0-29k	30-47k	48-74k	75-109k
1-10	5918	6836	9269	15554
11-20	5423	7671	10921	16888
21-30	10025	11301	17433	23858
31-40	8108	10020	15440	21385
41-50	12311	14287	17258	23319
51-60	11237	12026	15982	21312
61-70	13430	14558	18085	22092
71-80	16964	16696	22007	26441
81-90	14582	16925	19470	24547
91-100	18908	19892	23995	28989
100+	16883	17842	20413	22936

Note: Data from NCES IPEDS Net cost of attendance for students receiving Title IV financial aid. Ranking is of private colleges and universities in endowment per fte student.

Table II: Summary statistics of sample institutions

	1992		2010	
	Out of Sample	In sample	Out of Sample	In Sample
Endowment	6.14×10^7	3.54×10^8	1.44×10^8	1.06×10^9
	(3.31×10^8)	(5.95×10^8)	(9.79×10^8)	(2.22×10^9)
Gifts	3.23×10^6	1.25×10^7	5.60×10^6	1.82×10^7
	(1.00×10^7)	(1.90×10^7)	(1.74×10^7)	(3.18×10^7)
Return Rate	.133	.135	.119	.124
	(.031)	(.027)	(.035)	(.024)
Spending Rate	.052	.055	.046	.057
	(.015)	(.014)	(.019)	(.011)
FTE Students	2290	8898	3320	12019
	(13173)	(22910)	(18329)	(32044)
N		78		78

Note: Standard deviations given in parenthesis. Dollar figures given in 2010 dollars. Full time equivalent (FTE) students includes undergraduate, graduate, and professional students. All schools statistics include all available observations for that variable (ranges 287-6249).

Table III: Contribution of gifts, spending, rate of return, and initial endowment to variance of 2010 endowments

	Components Included	Fraction of Total Variance Remaining
(1)	Only Initial Endowments	.354
	Only Rate of Return	.089
	Only Spending Rate	.047
	Only Gifts	.260
(2)	Initial Endowment and Return	.661
	Initial Endowment and Spending	.390
	Initial Endowment and Gifts	.587
	Return and Spending	.118
	Return and Gifts	.365
	Spending and Gifts	.276
(3)	All but Gifts	.732
	All but Spending	.929
	All but Return	.623
	All but Initial Endowment	.389

Note: Each cell gives the simulated variance of 2010 endowments with variation only in the given components as a fraction of the total variance of 2010 endowments. Components whose variation has been removed are set to the average for that time period for all schools.

Table IV: Correlation Among Components of Endowments

	1992 Endowment	Spending Rate	Return Rate	Gifts
1992 Endowment				
Spending Rate	0.158			
Return Rate	0.572	0.394		
Gifts	0.834	0.163	0.497	

Note: Table states correlation among school averages from 1992-2010 of each component.

Table V: Decomposition of 2010 Endowment Per Student

	Components Included	Fraction of Total Variance Remaining
(1)	Only 1992 Variation	.390
	Only Rate of Return	.148
	Only Spending Rate	.078
	Only Gifts Per Student	.192
	Only Enrollment Growth	.093
(2)	All but 1992 Variation	.402
	All but Return	.636
	All but Spending	.879
	All but Gifts Per Student	.817
	All but Enrollment Growth	.969

Note: Each cell gives the simulated variance of 2010 endowments with variation only in the given components as a fraction of the variance of 2010 endowments including all components. Components whose variation has been removed are set to the average for that time period for all schools.

Table VI: Correlation Among Components of Endowment Per Student

	1992 End. per Stu.	Spending Rate	Return Rate	Gifts per Stu.
1992 End. per Stu.				
Spending Rate	0.174			
Return Rate	0.538	0.394		
Gifts per Stu.	0.733	0.218	0.570	
Enrollment Growth	-0.080	-0.107	0.013	-0.134

Note: Table states correlation among school averages from 1992 through 2010 of each component. Per student figures are calculated per full time equivalent student including both undergraduate and graduate enrollment.