Does the Number of College Applications Affect U.S Tuition?

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1 Economic Problem and Purpose Statement

Today in the United States, higher education is one of the largest investments for an average household; perhaps second only to real estate property. It is also increasing at an alarming rate of roughly 4-8% per year while its competitive value in the job market becomes more and more questionable as the average tuition inflation well exceeds average wage growth. The nominal dollar value of consumer goods has increased by roughly 47% since the year 2000, the average cost of attending a 4-year institution has more than doubled. According to online statistics, the cost of higher education has surged more than 538% since 1985. Furthermore, the inflation of tuition dwarfs that of other necessities such as food, shelter, energy, medical care and so on. What are the driving forces behind such disparities? How cost effective is this asset we call diploma in comparison to its alternatives? How can "consumers" of education select the most cost-effective program? What are the possible remedies for the education system that the government and the public can explore so that student debt would not negatively impact

our financial future? I want to answer all of these questions by conducting a series of tuition cost structural analyses in order to identify all such non-education-related factors that drive tuition inflation. In this analysis, however, I will focus on one factor only, that is the number of applications received.

For a college degree to be price-efficient, tuition must reflect the quality of education to a reasonable degree. Some scholars agree that the quality of education being offered today is 2.5 times more superior in comparison to the education offered 20 years ago, or that its 2.5 times more valuable. The abundance of cost-less education provided through the Internet should have alleviated a significant amount of efforts, and thus costs for schools to provide the same quality education. Yet, they still cannot evade the issue of soaring tuition costs. What justifies the inflation then? By identifying and quantifying an underlying factor that drives the inflation of our second largest investment, we aim to increase information symmetry in the educations market and to assist consumers of education on making more price-efficient school selections. Furthermore, potential employers may benefit from this type of study as they will become savvier in estimating a potential candidates competency through his or her choice of institution. Preferably without government intervention, we will then rely on the educations markets transparency, rationality and efficiency to adjust the price on its own to a level that is both justifiable and sustainable.

2 Literature Review

In an article published by the Scholarship System as well as many others alike, a relationship between the availability of financial aids and high tag price for tuition was concluded (System (2019)). With the acknowledgment of students' financial aid eligibility and willingness to pay, universities seem to know financial aids can cover the difference. In a book bluntly titled Why Does College Cost So Much? written by Professor David Feldman (Archibald R. (2016)), an economics professor at The College of William and Mary, he suggested that colleges sticker price is set by their wealthiest students ability to pay. Lastly, in an article published by New York Times Magazine (Davidson (2019)), the writer suggested that colleges have high incentives to control their demographics; raising the sticker price allows them to tailor scholarships in order to shape the ideal student body. Another article from Best Value Schools(Schools (2018)) directly pointed out that, rising education cost is a simple matter of supply and artificially inflated demand. Higher demand, as well as increasing talented applicants, provides colleges with the confidence of raising tuition fees. Moreover, government programs weren't prepared for the rise in education costs, and with less subsidization from government sources, colleges turned elsewhere to pay for education: tuition and fees owed by families. With rising financial burdens on tuition and student loans, education is perceived as a more and more expensive commodity. In this analysis, we will consider a much broader assumption that is consistent with all of the above suggestions: quantity of applicants, wealthy or underprivileged, directly affects tuition. As a college applicant pool increases, the amount of financial aid eligible students as well as wealthy students both increases as well. Conveniently, a larger applicant pool provides schools with a larger space of adjustment to shape their ideal student body using a higher

sticker price. In other words, if our hypothesis regarding the effect of application number has on the tuition is true, all previously mentioned conclusions will be validated.

3 Methodology

3.1 Hypotheses

This analysis will rely on the following key assumptions. First, the market treats education as a commodity, tuition as the price of the commodity, and the number of applicants as a key implication of demand for such a commodity. Second, consumers of education are drawn by a colleges popularity, which is not a perfect indicator of the colleges education quality. The number of applications received has a positive effect on tuition just as high demand increases the price of commodities. Third, universities, like profit-seeking enterprises will seize the opportunity and increase tuition through methods that do not contribute directly to education quality. Formally, if we apply the simultaneous equation model (SEM) that is the 2-stage least squares (2SLS) to estimate the effect of application numbers have on tuition, given that we choose the appropriate unbiased, exogenous, independent variables as well as reliable instrumental variables, the parameter will be quite large and the results will be significant.

3.2 Model and Data Description

I gathered data on 750 4-year colleges/universities across the United States in 2013. Continuous data include each colleges out-of-state nominal tuition before financial aid ($Tuition3$), the number of applications received ($Applcn$), student-to-faculty ratio ($Stufacr$), the average

expected total income upon graduation (k_mean). As for discrete data, the ownership status, public or private ($Public$), is included as a dummy variable, 1 for public status, 0 otherwise; a score ranging from 1-9 indicates the degree of urbanization of campus location ($Locale$), with 1 being the most urbanized, 9 being the least; a score ranging from 1-7 indicates the level of reputation ($tier$), with 1 being the highest ranked, 7 being the least.

Considering endogenous problem and simultaneous effect the application numbers might have on variables such as tuition, we will choose the simultaneous equation model 2SLS instead of OLS. Below shows equation 1 and equation 2 in SEM model.

$$Eq(1) : \log(Tuition3) = \beta_0 + \beta_1 \log(\widehat{Applcn}) + \beta_2 \log(Stufacr) + \beta_3 Locale + \beta_4 tier + \beta_5 public + \epsilon$$

$$Eq(2) : \log(Applcn) = \gamma_0 + \gamma_1 \log(Tuition) + \gamma_2 \log(Stufacr) + \gamma_3 Locale + \gamma_4 tier + \gamma_5 k\_mean + \mu$$

All continuous data are transformed into the form of logged value. All discrete data are presented as it is. Average income after graduation (k_mean) is served as an instrumental variable for the reason that expected income should only positively affect tuition through application number. Based on our hypothesis, the parameter of $Applcn$ should have a positive sign when condering its effect on tuition. Holding all else constant, $Tuition3$ should negatively impact $Applcn$ according to the law of demand. $Stufacr$ should negatively influence tuition as a high student-to-faculty ratio always suggests low faculty salary per student. Public universities should charge lower average tuition in comparison of that for private schools. We expect the parameter of $Locale$ to have a negative sign for both equation (1) and (2) as less urbanized areas (high Locale score) should generally cost less to maintain and are less popular in concern

of location. We expect the parameter of $tier$ (smaller value indicating higher ranking) to also have negative signs on both equations as high tier score indicates low prestigiousness. Moreover, $public$ from equation (1) is excluded from equation (2), while k_mean from equation (2) is excluded from equation (1). This can make both equations identifiable.

3.3 Data Source

Apart from $tier$,$Locale$ and k_income, all of other variables are extracted from The Integrated Post-secondary Education Data System (IPEDS). IPEDS is a pretty large dataset which involves more than hundreds of statistical variables covering more than 4000 universities and colleges from 1987 to 2017. We collected the our key variables which are application number ($Applcn$) and tuition fee ($Tuition3$). Also, we chose student-to-faculty ratio ($Stufacr$) as the control variable. Our important instrumental variables are collected from "Mobility Report Cards: The Role of Colleges in Inter-generational Mobility". We collected average income of graduates (k_mean) and public dummy variable from this report as well.

As there are only 758 colleges reported in the second report, in order to include instrumental variables k_mean and $public$, we shrink the sample size as a sacrifice. Also, this Mobility Report only lasted for one year. As a result, we ran a cross-sectional SEM in 2013 data.

4 Results

Table 1 shows results of SEM equation 1 and SEM equation 2.According to the equation 1 results, the number of applications does positively impact tuition cost. The parameter is 0.28, suggesting a 1% increase in application number will, on average, result in a 0.28% increase in tuition, or a 3.57% increase in application number will increase tuition by 1%. According to t-test result, the probability of failing to reject the null hypothesis is extremely negligible; thus, the result is significant. This was consistent with our main hypothesis. High student-to-faculty ratio suggests lower faculty salary per student; a 1% increase in student-to-faculty ratio decreases tuition by 0.46%. This result is intuitive and significant. Public institutions are known to be less expensive. The result of our dummy variable suggests a 67% decrease in tuition if the institution is public rather than private. The discrete variable locale, that indicates the campus environments urbanization yielded a negligible and insignificant result. College ranking and prestigiousness do not directly affect the sticker price of tuition according to this model.

From SEM equation 2, tuition has a negative impact on the number of applications received. The coefficient of -0.796 indicates that a 1% increase in tuition will, on average, result in a 0.796% decrease in application numbers. This corresponds to the law of demand. The average expected income after graduation (k mean) positively affects application numbers, with a coefficient of 2.04. That is, a 1% increase in expected income will increase demand by 2.04%. High expected income indicates that the school offers quality education, or has excellent career service. The coefficient of Locale is -0.018, showing that a less urbanized college decreases the number of applications received. What needs to be stressed is that, both tier and locale are insignificant in equation 1, but significant in equation 2. Tier has a coefficient of -0.22, suggesting

a 22% decrease in application numbers if the institution is less prestigious. This corresponds to our hypothesis that college rankings only affect tuition costs positively through the demand channel, rather than the supply side. T-test shows that all these results are significant, in equation 2.

Table 1: SEM Regression

	Equation 1	Equation 2
$log(Tuition3)$		-6.932***
		(0.00021)
$log(Applcn)$	0.281***	
	($2.22e^{-16}$)	
$log(Stufacr)$	-0.4769***	1.00***
	($2.22e^{-16}$)	($3.748e^{-09}$)
$public$	-0.678***	
	($2.22e^{-16}$)	
k_mean		2.040***
		($2.22e^{-16}$)
$Locale$	0.00248	-0.0179***
	(0.06100)	($1.0876e^{-07}$)
$tier$	-0.011	-0.222***
	(0.44091)	($2.6645e^{-15}$)
N	750	750
R-Squared	0.545	0.367

p-values in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

5 Conclusion

According to the SEM results, the number of applications received, a factor that does not contribute directly to education quality, does positively impact tuition cost. With the parameter of 0.28, roughly a 3.5% increase in application numbers will result in a 1% increase in tuition on average. Another notable finding is that prestigiousness (ranking), graduates future income, and location only affect tuition costs positively through the application quantity channel, in an indirect way. In other words, schools may not set tuition fees based on these factors, yet applicants really take them into consideration.

For the consumers of education, the purpose of this analysis is not to explicitly discourage students from applying to popular universities, rather, it is to place a price on the popularity of universities. Information symmetry regarding the cost and the price of education may render less affluent consumers of education, who find the price of popularity to be excessive, make wiser decisions on where to apply for college. In other words, applicants should be aware of tuition inflation, knowing that high tuition fees does not necessarily indicate better education. Instead, applicant should choose a college that is suitable for him or her.

For the suppliers of education, this finding suggests that non-education related costs exist. To increase transparency and minimize unintended deception in the education market, universities should disclose more detailed cost structures to potential clients. Besides, it might be helpful for schools to predict overall expenses on a four-year basis to applicants. This would help them gain a better idea of future costs during their entire education duration. Universities that receive federal funding and are considered nonprofit should be more accountable as they enjoy the benefits of such status.

As for the regulator of the education market, it may be in the public's interest that institutions with a smaller gap (tuition minus cost per student) receive more funding than institutions with larger gap given that costs between the two are equally efficient as smaller gap indicates a more accurate reflection of tuition on education quality.

This analysis can be extended and improved in various ways. As mentioned previously, the quantity of application alone can not fully explain the disparity between tuition inflation and CPI inflation. Many other non-quality related factors of tuition, such as non-academic 8 faculty-to-student ratio, the number of majors offered, advertisement costs (for-profit universities), etc. requires a similar examination. The aggregate effect of all such variables combined will be much more convincing than the application number alone. On the other hand, many other factors could also influence demand of a college, including application fee, personal preferences, macroeconomic situations,etc. To increase precision, panel data or time series model can be incorporated to examine the relationship between the tuition increase (Δx) and the change in independent variables such as application quantity or other possible variables mentioned (Δx).

6 References

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