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 ination 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 ination of tuition dwarfs that of other necessities such as food, shelter, energy and medical care. What are the driving forces behind such disparities? How cost eective is this asset we call diploma in comparison to its alternatives? How can consumers of the education select the most cost-eective program? What are some possible remedies the education system, the government and the public can explore so that student debt does not consume our nancial future? We may answer all these questions by conducting a series of tuition cost structure analysis to identify all such non-education related factors that drive tuition ination. In this analysis, however, we will focus on one factor only, that is the number of applications received.

For a college degree to be price-ecient, tuition must reect the quality of education to a reasonable degree. Very few would agree that the quality of education being oered today is 2.5 times more superior in comparison to the education oered 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 signicant amount of eort, and thus costs for schools to provide the same quality education. Yet, they still cannot evade the issue of soaring tuition costs. What justies the ination then? By identifying and quantifying an underlying factor that drives the ination 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-ecient school selections. Furthermore, potential employers may benet 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 eciency to adjust the price on its own to a level that is both justiable and sustainable.

2 Literature Review

In an article published by The Scholarship System as well as many others alike, a rela tionship between the availability of nancial aid and high tag price for tuition was con cluded(System (2019)). With the acknowledgment of students nancial aid eligibility and willingness to pay, universities seem to know nancial aid can cover the dierence. In a book bluntly titled Why Does College Cost So Much? written by Professor David Feld man(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 the New York Times Magazine(Davidson (2019)), the writer suggested 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 points out that, rising education cost is a simple matter of supply and articially inated demand. Higher demand, as well as increasing talented applicants, provides colleges with the condence of raising tuition fees. Moreover, government programs werent 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 nancial 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 aects tuition. As a college applicant pool increases, the amount of nancial 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 eect 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 eect on tuition just as high demand increases the price of commodities. Third, universities, like prot-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 eect 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 signicant.

3.2 Model and Data Description

We have gathered the 2013 data on 750 4-year colleges/universities across the United States. Continuous data includes each colleges out-of-state nominal tuition before nan cial aid ($Tuition3$), the number of applications received ($Applcn$), student-to-faculty ratio ($Stufacr$), the average expected total income upon graduation (k_mean). Discrete data includes public or private status ($Public$) as a dummy variable, 1 for public status, 0 other wise. A score ranges from 1-9 that indicates the degree of urbanization of campus location ($Locale$), with 1 being the most urbanized, 9 being the least. A score ranges from 1-7 that indicates the level of prestigiousness ($tier$), with 1 being the highest ranked, 7 being the least.

Due to endogeneity concern and the simultaneous impact of the application numbers has on tuition and vice versa, we will choose the simultaneous equation model 2SLS over OLS. Below shows euqation 1 and equation 2 in SEM model.

$$log(Tuition3) = \alpha_0 + \alpha_1 log(Applcn) + \alpha_2 log(Stufacr) + \alpha_3 public + \alpha_4 Locale + \alpha_5 tier (1)$$

$$log(Applcn) = \lambda_0 + \lambda_1 log(Tuition3) + \lambda_2 log(Stufacr) + \lambda_3 log(k\_mean) + \lambda_4 Locale + \lambda_5 tier (2)$$

All continuous data were recorded in the form of logged value. All discrete data are presented as it is. The average expected income (k mean) will serve as the instrumental variable as expected income should only positively aect tuition through application num ber. As per our hypothesis, the parameter of Applcn should have a positive sign. All else held constant, should negatively impact Applcn according to the law of demand. Stufacr should negatively aect tuition as a high student to faculty ratio suggests low faculty salary per student. Public universities should have lower average tuition in comparison that of private schools. We expect the parameter of Locale to have a negative sign for both equa tion (1) and (2) as less urbanized areas (high Locale score) should generally cost less to maintain and are less popular as a destination. We expect the parameter of tier 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 identiable.

3.3 Data Source

Apart from tier,Locale and k income, all other variables are from The Integrated Postsec ondary Education Data System(IPEDS). This is an enormous dataset involving more than hundreds of statistical variables on 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 as control variable.Our important in strumental variables are collected from ”Mobility Report Cards: The Role of Colleges in Intergenerational Mobility”. We collected average income of graduates(k_mean) and public dummy variable from this report.

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

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

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

4 Result

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 signicant. This was consistent with our central 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 signicant. 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 insignicant result. College ranking and prestigiousness do not directly aect 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 coecient of -0.796 indicates that a 1% increase in tuition will, on aver age, 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 aects appli cation numbers, with a coecient of 2.04. That is, a 1% increase in expected income will increase demand by 2.04%. High expected income indicates that the school oers quality education, or has excellent career service. The coecient 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 insignicant in equation 1, but signicant in equation 2. Tier has a coecient 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 aect tuition costs positively through the demand channel, rather than the supply side. T-test shows that all these results are signicant, in equation 2.

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 pa rameter of 0.28, roughly a 3.5% increase in application numbers will result in a 1% increase in tuition on average. Another notable nding is that prestigiousness (ranking), gradu ates future income, and location only aect 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 dis courage 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 auent consumers of education, who nd 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 ination, 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 nding 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 nonprot should be more accountable as they enjoy the benets of such status.

As for the regulator of the education market, it may be in the publics 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 ecient as smaller gap indicates a more accurate reection 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 ination and CPI ination. Many other non-quality related factors of tuition, such as non-academic 8 faculty-to-student ratio, the number of majors oered, advertisement costs (for-prot uni versities), etc. requires a similar examination. The aggregate eect of all such variables combined will be much more convincing than the application number alone. On the other hand, many other factors could also inuence 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 Reference

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