Economic Analysis of Carnegie Mellon University

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RUNNING HEAD: CARNEGIE MELLON

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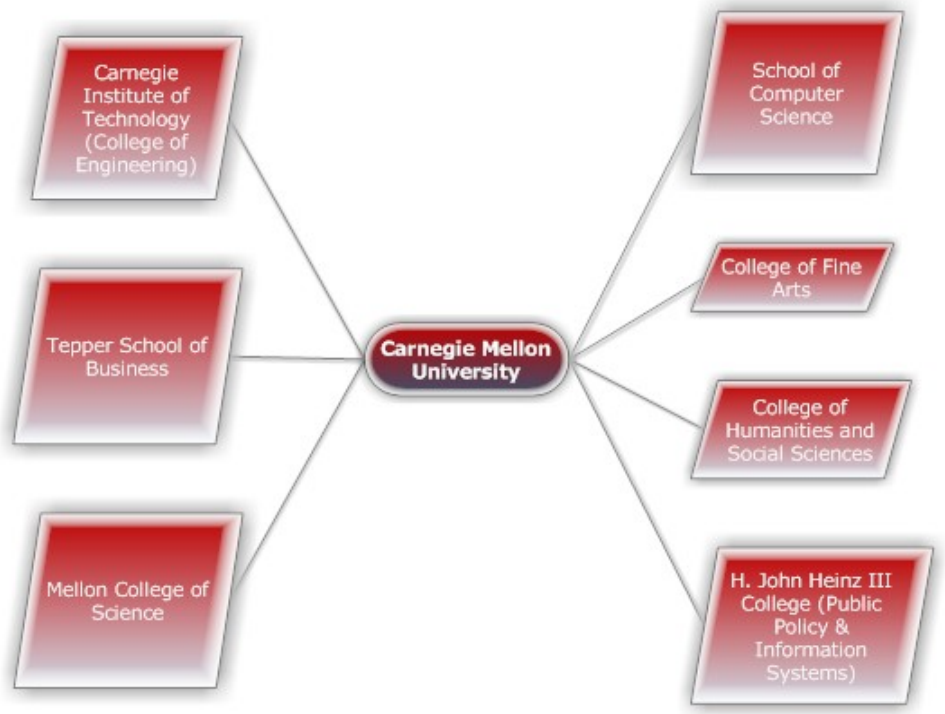
Directory

Introduction to Carnegie Mellon University

Carnegie Mellon (CMU) is a global university with a main campus in Pittsburgh, Pennsylvania, and branch campuses in the Silicon Valley of California and Qatar, as well as programs offered in North Hollywood, California; Athens, Greece; Adelaide, Australia; and Kobe, Japan (CMU, 2010). Founded in 1900, CMU has evolved from a small technical school to an institute of technology, and then ultimately to a preeminent private research university (CMU, 2008). As with many other dominant research universities, the organizational structure is decentralized, and therefore the strategic plan assists in harmonizing an organizational culture in an otherwise college- and program-specific environment. Within the university, there are seven schools and colleges, displayed in Figure 1.

Figure 1: Carnegie Mellon's Seven Schools and Colleges



In academic year 2010-2011, there are over 1,300 members of the faculty, close to 6,000 undergraduates, over 5,400 graduate students, and an alumni base of more than 84,000 (CMU, 2010). Table 1 displays the percentage of graduates, in academic year 2008-2009, according to their major.

Table 1: Majors of Graduates by Percentage at Carnegie Mellon in academic year 2008-2009 (based on data from the National Center for Education Statistics)

Major	Major of Graduates by Percentage in 2008-2009		
	Bachelor	Master	Doctor
Physical, biological, biomedical, and health sciences	9.6%	4.7%	7.4%
Business and related support services	10.6%	24.1%	4.9%
English, communications, and languages	4.3%	2.1%	2.5%
Humanities and liberal arts	5.4%	0.1%	2.9%
Architecture, visual and performing arts	13.6%	8.4%	1.2%
Social sciences, mathematics and public services	12.1%	10.5%	8.6%
Engineering and engineering technologies	27.3%	21.9%	44.5%
Computer and information sciences	11.0%	27.4%	28.2%
Multi/interdisciplinary studies	6.2%	0.0%	0.0%
Total	100%	100%	100%

Top leadership at CMU is split amongst three constituents: The Board of Trustees, currently chaired by Raymond J. Lane, is charged with governance of the university, including appointing the president of the university; Jared L. Cohon became the eighth president of CMU in 1997, and he is charged with all other appointments; the leading academic affairs officer is the provost, Mark S. Kamlet, who has held that position since 2000 (CMU, 2010).

The Higher Education Market

Local and State Level

CMU is part of the Pittsburgh Council on Higher Education (PCHE), which includes ten accredited colleges and universities in the region (PCHE, 2010). While the local higher education market is competitive, CMU is a global university that seeks students from all locations of the world. International students represent 15 percent of undergraduates, 46 percent of Master's degree-seeking students, and 52 percent of doctoral students (CMU, 2009). In the U.S News & World Report Best Colleges 2011 National Universities Rankings, CMU ranked 23rd. The only other Pittsburgh area institution included in the rankings is the University of Pittsburgh, which is ranked 64th. However, none of CMU's self-determined peer institutions are located in the Pittsburgh region.

At the state level, there were 159 colleges and universities and 92 private licensed schools that were legally authorized to grant degrees in Pennsylvania (PA Dept. of Education 2010). Of these, the only peer institution is the University of Pennsylvania, which is ranked fifth (US News & World Report, 2010). The highest ranked public institution in the state of Pennsylvania, at 47th, is the Pennsylvania State University. For information on rankings, see Appendix Item 2.

On the local and regional level, Pittsburgh was once a city heavily invested in the manufacturing sector, particularly the steel industry. In the 2008 Strategic Plan, CMU cited regional impact as a pillar grounded in the interdependence of CMU and Pittsburgh (p. 13).

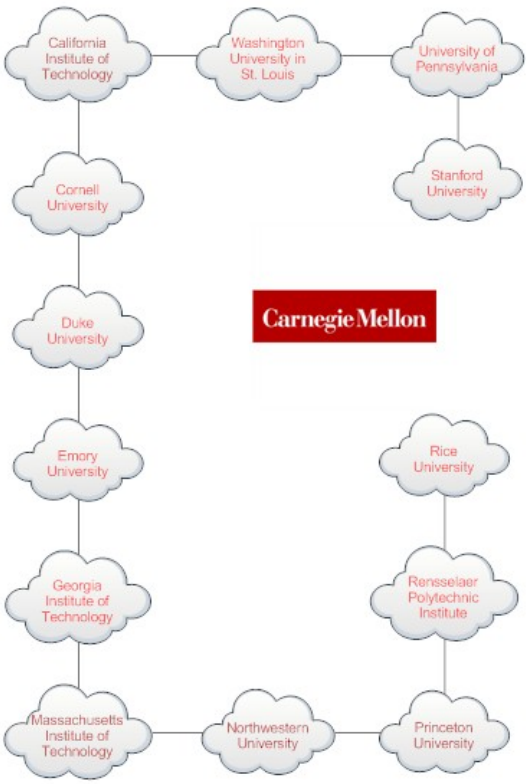
Through institutional strength and comparative advantage, CMU seeks to "help the region maintain a vibrant economy and an improving quality of life" (p. 13).

National and Global Level

Public and private institutions of higher education are non-profit organizations that usually operate in competition within an economic environment (Raines & Leathers, 2003). However, competition varies, with the market segmented by quality, prestige, degree level, geography, and tuition. Garvin (1980) argues that the relative sub-markets tend to be so small that an oligopoly exists. An oligopoly exists when firms are price-setters and each firm has a significant share of the market (Begg & Ward, 2007). While we could argue that an oligopoly exists at the local level for CMU, the local oligopoly is weak in the sense that: technology has made distance learning almost ubiquitous in higher education; globalization and access to education has increased, opening doors for CMU to be transnational and shifting national markets (University of Warwick, 2010); ease of domestic travel opens doors for students to select schools outside of the local market; and the level of public support for higher education in individual states makes tuition competitive on a national level.

The administration at CMU has created a self-imposed oligopoly – as have other institutions of higher education – through the identification of peer institutions. As CMU is a global private university, its peers, listed in Figure 2, are of similar and higher caliber.

Figure 1: Carnegie Mellon's Peer Institutions

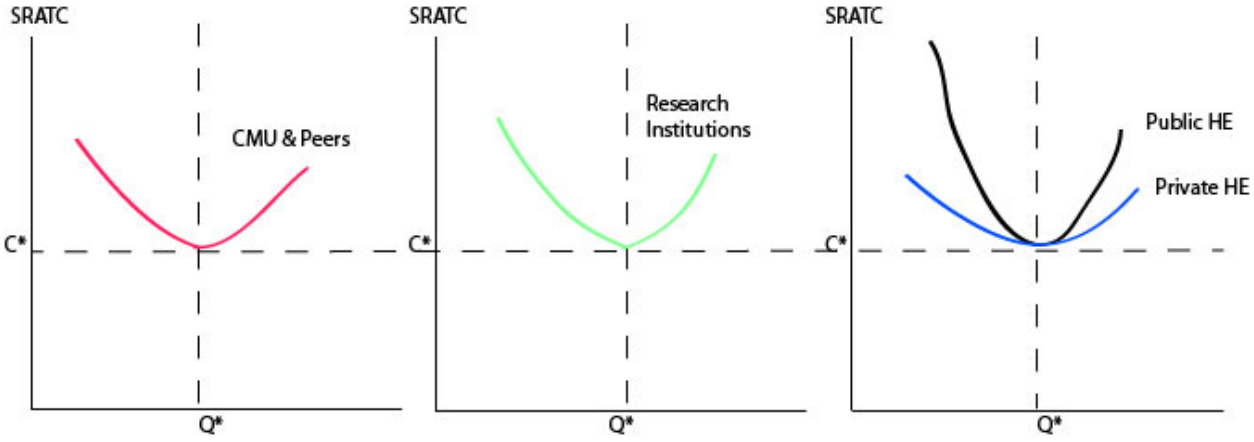


Geographic proximity affects affordability, predominantly at the undergraduate level, and thus we see a dichotomy between prestige and price. At the national level, CMU attracts students from all 50 states, with only 17 percent of undergraduates coming from Pennsylvania, and close to 60 percent from other states (NCES, 2010). Yet, at the global level, as mentioned earlier, 15 percent of undergraduate students are international, while roughly half of all graduate students at CMU are international. From this view, we can see that CMU is not only in competition with its peer institutions, but students from around the world are in competition with each other. In this light, CMU is focused on obtaining the highest quality students and a diverse student body, rather than just filling seats.

Vulnerability and Costs

Carnegie Mellon's services are primarily focused on educating students and research. Since their workforce is highly skilled, CMU is faced with a large Type 1 vulnerability. However, since private institutions of higher education derive less of their funding from the government, and thus are slightly less influenced by politics, the short-run average total cost (SRATC) curve of CMU is flatter than that of public institutions. Figure 2 displays the SRATC of CMU and its peers, research institutions, and public and private institutions of higher education. In Figure 2, Q* is the minimum cost level of output, and C* is the minimum point of the SRATC curve. Approaching Q*, these colleges and universities will produce with increasing returns to scale, and then beyond Q*, there are diminishing returns, such as an overabundance of faculty or researchers in relation to the amount of students or research funding available, respectively.

Figure 2: SRATC of CMU and Market



From Figure 2, we can see that private institutions, on the whole, are the least vulnerable because they receive the least amount of research funding from the federal government, and thus are largely reliant on tuition. Public institutions are the most reliant on government funding, and thus they are beholden to politics and budget restrictions, including faculty salary. Research institutions, both public and private, are slightly less vulnerable, yet still shaped like a champagne flute, as they tend to rely on governmental research funding, yet on differing levels. CMU and its peer institutions tend to be less vulnerable than the overall market of research

institutions, largely because of their prestige and ability to use tuition and endowment as a buffer, but they are also beholden to the government for research funding, and thus lie between the flute and saucer shapes.

The institution's largest expense is personnel cost, which was $551.9 million in 2009, which equates to almost 65 percent of operating expenses (CMU, 2010). Accordingly, not only did salaries increase in 2009, but the costs of health care and expenses associated with retirement plans increased across most, if not all, higher education institutions (Stanford, 2010).

Faculty are a quasi-fixed cost because they are expensive to recruit and maintain, and with tenure, potentially even more expensive to terminate. Colleges and universities are enterprises of knowledge, and thus their human capital costs are extensive. CMU is able to keep itself competitive by offering salaries at the level of the private sector of nonprofit education, yet below the levels of elite institutions. In this light, CMU is able to offer an enticing contract to public university employees, and thus take away superstar professors. For instance, CMU was able to lure Randy Pausch, a well-known computer scientist best known for his *Last Lecture*, from the prestigious, yet public, University of Virginia (UVA, 2007). Yet, it must be noted, once again, that prestige in higher education serves as quasi-goodwill, and thus professors may be willing to transfer to CMU for status, alone.

All institutions of higher education are vulnerable to economic conditions, with younger students fighting for positions in good economic conditions, and older workers or those who did not complete their degrees going back for training in poor economic conditions. As a Type 2 vulnerability, it could be argued that CMU and other research-intensive institutions have high electricity and fuel vulnerability, in the sense that their human-capital intensive environments require power for offices, labs, residential living, recreation centers, and other structures that are part of the community of colleges and universities. Lastly, since colleges and universities tend to carry heavy debt burdens, another Type 2 vulnerability would be the cost incurred from borrowing, such as interest rate increases. Overall, though, Type 1 vulnerability from human capital is the most critical vulnerability at CMU.

Endowment Comparison with Stanford University

In FY09, CMU reported an almost 23 percent drop in net assets, and endowment losses of almost 27 percent (Schnackner, 2009). In the same period, Stanford University's net assets decreased by 21 percent, and its endowment decreased by 27 percent (Stanford, 2010). Figure 3 displays the percent change in endowment between 2001 and 2009 for both Carnegie Mellon and Stanford Universities. For comparison purposes, Stanford's endowment data does not include hospital data. For the actual endowment figures, see Appendix Item 3.

Figure 3: Endowment Change, by Percentage, of CMU and Stanford from 2001-2009

As evident in Figure 3, CMU's endowment changes between 2001 and 2009 largely followed the same trend as that of Stanford University, although Stanford appeared able to better recover from losses in 2003 and 2005, while both suffered great losses from 2007 onward during the financial crisis.

Market Exposure

Faculty Salaries

Of peer institutions, the average salary for the position of professor is close to $160,000 (AAUP, 2010). However, for CMU, the average salary for the position of professor is a little less than $138,000. This means that CMU is very much exposed to the possibility of losing professors to its peer institutions. The highest average salary of peer institutions is that of Stanford University, which is $181,400. In this light, professors being lured to Stanford from CMU have the potential to increase their salary by a third.

Admissions Competitiveness

CMU has a comparative advantage at the local and regional level, which is primarily prestige and resources. Raines & Leathers argue (2003) that tuition at both public and private higher education institutions is lower than cost, which implies that such nonprofit institutions are not profit-maximizers; rather, there is excess demand, and rationing exists through attributes beyond price. From Table 2, we can see that CMU, compared to its peer institutions, receives 25.7 percent fewer applicants, admits 12.7 percent more students, and enrolls 16.2 percent fewer students. This means that while CMU is a top regional and national university, its admission prestige, among its peer institutions – other top national research universities – is near the bottom of the group. In large part, many of these institutions are aspirational, while others are peers.

Table 2: Undergraduate Enrollment at CMU and Peer Institutions in Fall 2009 (based on data from the NCES)

Institution	Fall 2009 Undergraduate Admissions		
	Applicants	Percent Admitted	Percent Enrolled
Carnegie Mellon University	14,153	36%	28%
California Institute of Technology	4,413	15%	37%
Cornell University	34,371	19%	48%
Duke University	18,774	22%	41%
Emory University	17,446	27%	28%
Georgia Institute of Technology	10,258	61%	42%
Massachusetts Institute of Technology	15,663	11%	64%
Northwestern University	25,013	26%	32%
Princeton University	21,963	10%	60%
Rensselaer Polytechnic Institute	12,351	42%	26%
Rice University	11,173	22%	36%
Stanford University	30,429	8%	70%
University of Pennsylvania	22,808	18%	61%
Washington University in St. Louis	23,105	22%	30%
Average (not including CMU)	19,059	23.3%	44.2%

Price Elasticity

Heller (1997) found that a tuition increase of $100 in the entire higher education sector equates to a drop of enrollment in the range of 0.5 to 1.0 percentage points (p. 631). This implies that higher education has inelastic demand at best, and unit elastic demand at worst. Using data from Rouse (1994), Heller notes that an 8 percent increase in tuition at community colleges results in price elasticity of 0.9, while the same 8 percent increase in tuition at comprehensive colleges, which would include CMU, results in a price elasticity of 0.6. Compared to other comprehensive institutions, CMU, due to prestige and resources, should have a price elasticity of <0.6, while some of its peer and aspirational institutions could be assumed to have a price elasticity even closer to zero. In this light, while tuition costs affect enrollment at institutions of higher education, CMU is largely protected through governmental financial aid, affluent students, and the overall demand of a CMU degree.

Comparative Advantage

Once again, we see that the prestige and resources of CMU are instrumental in its success. Accordingly, government funding in the form of financial aid for students and grants for research make the cost of a higher education less insurmountable to students, even in times of economic hardship. However, this reliance on the government does keep institutions exposed to both the risk of losing funding and the political aspects of increased regulation. As CMU largely focuses on engineering, business, information technology, and computer science, it has created a comparative advantage through prestige and quality. Ultimately, the market is altered as CMU is able to select students based on many other aspects than price, including the level of diversity desired in race and gender, academic potential of students, and the student's overall ability to contribute to the SMU community.

Macroeconomic Exposure

Aggregate Demand

Higher education is a service industry in the knowledge sector of the economy, and the quality of institutions affects the economy on the whole. CMU, as with other national research institutions, produces tomorrow's leaders through quality training and networking, especially in the disciplines of engineering, business, and computer science. Also, through research, CMU is an innovator, largely funded through government grants, aiming to create new products and services which benefit society. In this sense, there is a reduced profit motive because CMU is focused on providing for a better society, rather than seeking profit to redistribute to investors as dividends. CMU, like other nonprofits, has an ambitious vision of changing the world, but the difference between CMU and other nonprofits is that it has the human capital and resources in order to foster innovation.

As we've found that the demand for a CMU degree is relatively price inelastic, we know that an increase in tuition, or a subsequent drop in the salary of consumers, will do little to change demand. Government subsidies and grants to the institution, and grants and loans to the student body, make CMU more affordable, even in poor aggregate economic conditions. However, as the government continues to tighten its budget in the realm of higher education, even public colleges and universities are forced to look for private investors – predominately investors and alumni donors – who will be willing to step up where the government has stepped back. Also, when GDP decreases, certain parts of the economy are faltering, but higher education provides an entry path to the parts of the economy that are surviving, as well as those that are excelling. Essentially, a higher education is an opportunity to match individuals with industry, according to the needs of the market on an aggregate level.

Exchange Rates

CMU is exposed to exchange rates in the financial markets. As an institution which prides itself on diversity, foreign students must be willing to bear the risk of exchange rate fluctuations. With a weak dollar, CMU has benefitted because more foreign students are willing to pay tuition at CMU since their home currency will reach farther than it has in the past.

As an international university, CMU has to worry about exchange rates where it houses branch campuses and exterior programs. Currently, CMU offers a branch campus in Qatar, and programs in Australia, Japan, and Greece. Particularly in Greece, where there has been an extensive financial crisis, CMU is exposed to this occurrence because the revenues of the programs offered will suffer. By expanding slowly and selecting markets where CMU will have a clear competitive advantage, the institution is able to hedge its exchange rate vulnerability.

Non-economic Macro Exposure

CMU is exposed to the politics of governmental regulations. In a time of rising costs and decreased government funding, all higher education institutions are suffering. However, as a private institution, CMU is a little less beholden to politics because of its ability to self-sustain

and accumulate revenue through private support, tuition, and auxiliary services. Duderstadt (2000) argues that auxiliary services, including residential housing, assorted food services, and bookstores have been the "fastest growing component" (p. 171) of the resource revenue base of colleges and universities since the 1990s through the turn of the century.

Figure 4: 2009 CMU Unrestricted Operating Revenue, $ in thousands (CMU, 2010)

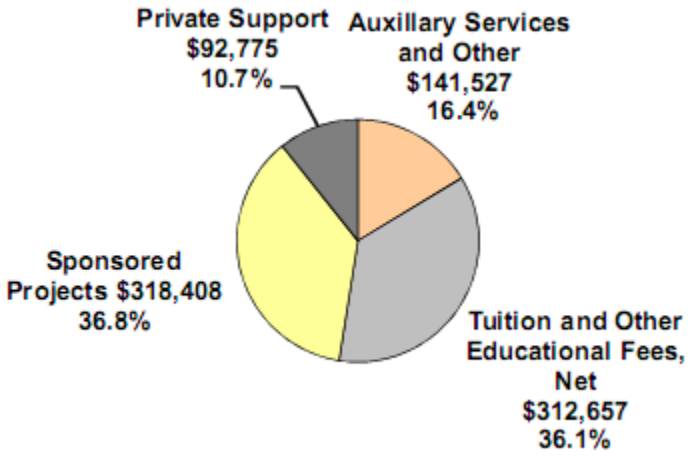


Figure 4 displays unrestricted operating revenue at CMU in 2009. It is apparent that, at 16.4 percent – an increase of 3.1 percent over the previous year (CMU, 2010), and with no hospital system, auxiliary services play a crucial role as an additional revenue source. However, as a nonprofit institution, CMU administrators have to be sure that federal funds do not mix with profit-seeking services. For instance, although CMU is exempt from income taxes under Section 501(c)(3) of the Internal Revenue Code of 1986, auxiliary services are generally taxed as unrelated business income (Harvard University, 2003), and the source of the business income cannot be housed within a federally-funded building (Harvard, 2003).

Also political in scope, colleges and universities often find that their most formidable supporters or detractors are governing boards, public opinion, and even their own faculty (Duderstadt, 2000). In this light, alumni could push a change agenda, political candidates could use higher education as a tool for public support, or nearby residents could deter the construction of a new building. As a private institution of higher education, CMU is partially protected from these elements, as only public institutions face the often-required appointments of board members by politicians (Duderstadt, 2000); but, public opinion is important in a city with an economy formerly based in manufacturing and now adjusting to the knowledge sector, and CMU administrators have made a strong effort to have a positive economic impact on the region – explicitly stated in their strategic plan (CMU, 2008). Next, the post-9/11 environment has made it a bit more difficult for foreign students to obtain visas in order to study in the United States. Lastly, assets in higher education can be restricted or unrestricted, and thus donors who tie requests with their donations expect those requests to be honored. This is a political vulnerability that ties to economic initiatives, and thus CMU is just as vulnerable to this occurrence as other institutions.

Conclusion

Carnegie Mellon University is a private research institution of higher education that is housed in a city that has undergone, and is still undergoing, the change from a manufacturing hub to a center of knowledge enterprise. Although colleges and universities are part of a local oligopoly, CMU is a global institution which considers its peers to be among the elite institutions, including the University of Pennsylvania, Stanford University, and MIT. Amongst its peers, CMU is on the lower end of the undergraduate student demand spectrum, and it pays its professors significantly less than other great institutions. While CMU is not at risk of low student demand, it faces the same risk of faculty loss to other elite institutions as public institutions face losing their professors to CMU. As a global institution, CMU is affected by exchange rates, and the weak dollar makes a CMU education cheaper to foreign students. However, with the decrease in government funding, CMU, like other higher education institutions, has been forced to look elsewhere for revenue – primarily through tuition increases, private donors, and auxiliary services, to maintain its strong student body, elite faculty, and abundance of resources. While not entirely shielded from vulnerability, CMU appears to face a sustained future, as long as it is able to continue to adapt to the changing society and economic climate.

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Appendix

1. Carnegie Mellon's Vision, Mission, and Values

Carnegie Mellon University

Our Vision

Carnegie Mellon will meet the changing needs of society by building on its traditions of innovation, problem solving, and interdisciplinarity.

Our Mission

To create and disseminate knowledge and art through research and creative inquiry, teaching, and learning, and to transfer our intellectual and artistic product to enhance society in meaningful and sustainable ways.

To serve our students by teaching them problem solving, leadership and teamwork skills, and the value of a commitment to quality, ethical behavior, and respect for others.

To achieve these ends by pursuing the advantages of a diverse and relatively small university community, open to the exchange of ideas, where discovery, creativity, and personal and professional development can flourish.

Our Values

Dedication, as exemplified by our commitment to the critical issues of society and our uncompromising work ethic.

Collaboration, as exemplified by our interdisciplinarity, our external partnerships, and our capacity to create new fields of inquiry.

Measuring excellence by impact, as exemplified by our focus on issues critical to regional development, national interest, and global welfare.

Entrepreneurship, as exemplified by openness to new ideas, prudent use of resources, and readiness to act.

Depth driving breadth, as exemplified by our issue-driven research, our context-based general education initiatives, and our focus on problem solving and creative production at all levels.

Compassion, as exemplified by our focus on human welfare, on the betterment of society, and on the personal development of the members of our community.

Integrity and inclusion, as exemplified by our attention to the highest ethical standards in all domains, and our commitment to being a community which welcomes talented minds from diverse backgrounds and challenges them individually and collectively to achieve their best.

2. It should be noted that while colleges and universities tend to treat rankings by external sources according to the potential benefits they could receive, I am not assuming that these rankings correctly reflect the effectiveness of these institutions in achieving their respective missions. However, as institutions of higher education in the United States partially use these rankings to ascertain their peer and aspirational institutions, as well as the credibility provided to such rankings by students, parents, and the general public, these rankings do have an effect on an institution's prominence and the perception of the public.

3. Endowment Market Value: Carnegie Mellon and Stanford University, 2000-2009 ($ in millions)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Carnegie Mellon	829	757	668	655	769	838	942	1,116	1,068	754
Stanford	8,886	8,250	7,613	8,614	9,922	12,205	14,085	17,165	17,214	12,619