ABSTRACT
The United States academic research market is an important contributor to the economy of the United States and the world. Vast wealth has been created from the research conducted in universities which, in 2003, amounted to more than $40.0 billion. The competition among universities for these funds is intense and, in such circumstances, the use of strategy and strategic processes is important. Thorough strategic processes require a clear understanding of the structure of the market because competitive markets require creativity, risk taking, and other market stimulants.

Based on an application of micro-economic theory, which was chosen because of its predictive quality, this paper forwards the current understanding of the structure of the academic research market by describing various attributes of the market that might not have been previously presented in one place, in this context, or for the purpose of informing the strategic formation processes of universities that are engaged in research. This paper concludes that the academic research market is not perfectly competitive.
INTRODUCTION

Competition for research funding is intensifying among universities in the United States (Feller, 2000). While several factors are contributing to this intensification, including the insatiability of scientific exploration (Rosensweig, 1992), perhaps the most important strategic factor underlying this phenomenon relates to Lang’s (2004) and Geiger’s (2004) argument that institutional reputation is directly related to the value of research performed. Since institutional reputation is such an important differentiator in higher education, which over time is driven by the value of research performed, universities are strongly motivated to generate as much research as possible (Clark, 1992). The limited size of the academic research market forces universities to increasingly compete with each other to win research funding and declining rates in the proportion of successful federal funding proposals is evidence of this trend (Newman & Couturier, 2001).

In competitive environments, strategic processes are engaged by enterprises to inform their resource allocation decision making and there is no shortage of literature to be found in popular media or scholarly publications that can be used for this purpose. Virtually without exception, developing strategy requires an analysis of the nature of the market in which competition is intended and an environmental scan is required for this purpose.

Comments made by writers such as Zemsky (2000) suggesting that this market, valued at more than $40.0 billion in 2003 (NSF a.), is less advanced than many similarly sized markets in other sectors in its use of external data to develop strategy raises suspicions as to whether universities undertake a sufficient degree of external analysis in their strategic development processes. Even if the suspected condition is not prevalent, it remains the case that all competitors can benefit from enhanced knowledge of their markets.

A review of the literature suggests that more can be done to enhance the understanding of the academic research market. Leslie and Johnson published an economic analysis of the higher education market in 1974 in which they attempted to dissuade governments from treating the university market as perfectly competitive. However, Leslie and Johnson did not provide a theoretical support for his argument and, as well, their focus was primarily on the teaching component of university operations, only mentioning research in passing. In 1969, Galper and Dunn made an econometric attempt to derive the short-run demand curve for the student market. Analyses of university markets have been presented by writers including Dill (2003, 1997), Geiger (2004), Johnes (1997), Massy (1990), Zemsky (1997), Tiexeira, Jongbloed, Dill, and Amaral (2004), and numerous others, however, these typically relate to the contribution that universities make to various parts of the economy or to society generally, or they are an attempt to analyze public policy in order to influence it or to inform universities of changes and their potential impact. The literature suggests that it is rare for an author to go beyond presenting evidence or describing how the nature of the market might be causing or has caused participants to behave, particularly in relation to academic research.

One exception is Feller’s (2000) chapter in Strategy for Competitiveness in Academic Research where ten specific strategic positions are presented. Yet, while Feller’s strategies are as valid as any, he does not provide the theoretical foundation from which these strategies might naturally emerge. Another exception is Tornatzky’s (2005) chapter in Creating Knowledge, Strengthening Nations: The Changing Role of Higher Education which forwards Etkowitz, Webster, and Healey’s theories and evolutionary tale of university-industry interaction (1998), which is an example of work that provides strategic advice for the research market that is well grounded. Yet, an economic analysis has yet to be presented.

Based on an application of micro-economic theory, this paper forwards the current understanding of the structure of the academic research market in three ways. Firstly, an economic argument can provide predictive ability in that, if a market is identified as a certain economic type, then the buyers and sellers in that market can be expected to behave according to a theoretically established pattern. Alternatively, if a market is not a certain archetype, certain behaviours can be discounted as probable. This information can be invaluable to the competitive planning process. In addition, envisioning the market through a new lens might stimulate creativity, risk taking, or other market stimulants.

Secondly, this paper forwards the understanding of the academic research market by developing the conclusion that it is not perfectly competitive. This conclusion raises a variety of accountability questions because it means that there is a potential for universities to earn profits by conducting research. For example, as the
primary purchaser of research, why should the government allow universities to earn profits; or enrich some universities but not others?

Finally, this paper describes various attributes of the market that might not have been previously presented in one place, in this context, or for the purpose of informing institutional strategic processes. It demonstrates a method of analyzing a market that is large, sophisticated, and a major stimulant of economic activity in the United States and the world.

THE MARKET

While funds used to finance university-based research originate from federal and state governments, from industry, and from the institutions themselves, in this paper the academic research market is defined to include only federally financed research. This selection was made for the following four reasons, described here in brief:

The first reason relates to the high degree of plurality of the federal system of research funding wherein any researcher from any institution can submit proposals for support (Geiger, 2004). This promotes the widest possible range of exploration and intensifies competition, attributes that strengthen the system as a whole (Ben-David, 1972; Birnbaum, 1983) while maintaining the public interest. Institutional, state and most industrial funded research is not subject to these competitive forces.

The second reason compares the risk that universities take when they invest in the capacity that supports their research; investments that can take decades to yield a full return. Since 1980, the value of federally financed research to academia has grown at a consistent rate (NSF b.) so that universities can reasonably predict what the size of the market will be in the future. Long term market assurance mitigates systematic risk. To varying degrees, state and institutionally sponsored research also meets this criterion. However, funding from industry must be considered as volatile if for no other reason than businesses that supply the funds are themselves volatile. In addition, businesses are not likely to undertake research projects whose duration spans more than a couple of years (Feller, & Roessner, 1995) and, as such, this funding source must be considered as the greater risk.

The third reason measures which stream of research revenue constitutes a strategic imperative. One way of understanding this question is to speculate as to the consequences of cutting off any single stream. While it may be an over-simplification to suggest that, at seven percent of total research income (NSF a.), industry sponsored research is not as important as the 67 percent proportion that is financed by the federal government, the reality is that, as the Carnegie Foundation defined it in 2000 (Carnegie Foundation, 2000), there would be no research-intensive universities without federal involvement.

The fourth reason suggests that the research revenue stream that contributes to a university’s national and international reputation to the greatest extent is more strategically important. In this case, the determining factor is whether research is peer adjudication because this is the common denominator upon which international reputational comparisons are based (Liu, & Cheng, 2005; O’Leary, 2004; The Center, 2003). Simply put, most state, institutional, and industry sponsored research does not meet this condition and federally sponsored research, by virtue of the method used to award funding, is peer adjudicated.

It should be clarified that these reasons are not intended to suggest that research income is not important from all sources or that investments in capacity do not enable competing for multiple income streams, it is only meant to describe a market which can be reasonably argued to represent the academic research market for the purposes of this analysis. In this paper the academic research market is comprised of the federal government which, acting in some respects as a monopsonist, is the sole buyer of research (the purchaser or principal), and hundreds of universities that sell research services to the purchaser (the performers or agents).

This is a highly competitive market and, among the larger performers, the market shares of individual universities have changed significantly both while this market was in its formative years prior to 1972 as well as during a more mature period in the decade ending in 2000

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Evidence of changing market shares in the early years of the research market is reflected in the fact that, in 1972, the NSF shows a wide variance in the market shares of universities that participated in this market. Since all universities began at very low levels of research performance at the end of World War II, it can be inferred that institutional market shares changed during the period.
can be thought of as attached to the research infrastructure. That, from an operating perspective, the actual acts of teaching and research are separate enough that, from an operating perspective, the activity of research can be thought of as attached to the research infrastructure.

In 2002, the top 100 universities accounted for 82 percent of the market. Geiger and Feller (1995) indicate that, in the 1980’s, no single university had a share of the research market that was greater than 2.5 percent and that the share of the 20 largest performers declined as the number of academic institutions participating in the market for the first time increased. With regard to the existence of a colluding group, Taylor and Massy (1996) refer to the, “federal peer review processes,” (p.19) which resembled an attempt by a group of the most research intensive universities to raise barriers to entry for smaller institutions. However, given the loss of share by the largest recipients, this strategy appears to have failed. As a consequence of these factors, it is reasonable to suggest that the research market is highly fragmented and there is no evidence that it is consolidating.

Segregating the research function of universities can be difficult in that it represents only a part of their overall operations. In very low level performers, there may be no supporting infrastructure, no strategic commitment to research, and may represent the effort of a few people or even one person in the institution that has won funding for a project. The largest performers have substantial infrastructure that often includes logistical support, management, large investments in fixed capital and specialized equipment, even people who lobby the purchaser to favour their institution’s bids more often. There were 55 universities that performed more than $100.0 million and 140 universities that performed more than $25.0 million of federally financed research in 2000 (NSF d.).

In addition to research, the primary function of universities is teaching. There is a struggle in the minds of many researchers (Slaughter, 2001; Slaughter, & Campbell, 1999) and as forcefully described by Massy and Zemsky (1994) and many others as to the conflict between these functions. What does seem somewhat clear is that the actual acts of teaching and research are separate enough that, from an operating perspective, the activity of research can be thought of as attached to the research infrastructure.

In the academic research market, competition occurs in an exceptionally open and exposed manner. The principal is intimately aware of the rules of engagement since it is responsible for oversight, and it knows the agents, including their histories, their strengths and weaknesses, and, by virtue of their proposal submissions, their near term intentions. The agents are well informed, or are able to be well informed about the principal because the principal’s intentions are, to a great extent, a matter of public record as are the types and values of awards it is funding and has funded. The agents are also well informed, or are able to be well informed about their competitors through the principal’s records (including NSF publications), by monitoring the activities of competitors through their strategic statements, faculty lists, faculty publication records, technology transfer activities, philanthropic and industrial relations initiatives, recruitment activities, and capital projects.

There are two basic components of the research transaction. The qualitative component of the transaction is controlled by a peer review process. The quantitative component of the transaction is comprised of overhead.
costs and direct or variable costs. Overhead costs are determined by a formula provided by or negotiated with the purchaser and are generally a proportion of the variable costs (OMB Circular A-21). Variable costs include faculty, students, technicians that are involved in the research, certain types of equipment, a variety of allowable expenses, and consumables. While no markup is allowed in the pricing, ranges in the wages of researchers and in the number of students that can be included, or choices in equipment and methodologies impacts the variable costs of a project and since overhead is usually a percentage of the variable cost, a certain degree of pricing variability is apparent in this market.

In addition, and despite the ideal of equal access, institutional reputation is a factor in funding success rates (Teich, 2000), as is the reputation of the proposing researcher, a reality that is evidenced by the requirement by various funding agencies for the researcher’s recent funded research history and curriculum vitae to be included with each proposal submission (NSF e.). Since the wages of the most senior and prestigious researchers are generally the highest, an idiosyncrasy of the research market is that proposals that are the highest relative price are more likely to be funded. In other words, signaling (Spence, 2001) is an important aspect of this market in that the purchaser can buy an increased level of performance assurance by paying more for the product. In a certain sense, a university can maximize its research income by employing the most prestigious researchers (Clark, 1992). More importantly for the purposes of this analysis is the notion that market participants understand that the research product is differentiated by quality and that quality is measured by, among other things, the research history of the researcher and the sponsoring institution.

Among existing universities, barriers to exit are high not so much because it is difficult to physically terminate employees (even tenured faculty) and retool buildings, but because, like every enterprise, downsizing is a last resort: nobody wants to admit defeat. In addition, decisions are often made slowly; most programs also serve the public good; financial considerations go beyond research and; even once decisions are made, programmatic momentum can keep departments alive while students complete curriculum. The reality is that university capacity is sticky (Massy, 1996); once it is in place, it is likely that it will remain in place for the long term.

Overcapacity in the research market is reflected in the emphasis that universities have put on attracting research from all sources which is evidenced by the placing of a high value on faculty that help satisfy this need (Slaughter, 2001). If a university was nearing its maximum ability to deliver research services, it would more likely take on a “seller’s market” demeanor which could include demanding more stringent terms from potential research sponsors. Aggressively promoting the generation of research, both internally and externally, is more reflective of the reality. In addition, the deepening of the research relationship with industry can be viewed as revenue diversification, a technique often employed to more fully utilize existing capacity. Lastly, overcapacity is a chronic symptom of markets with high exit barriers (Porter, 1979).

In any given year the demand curve in the research market is downward sloping. The main factors leading to this assumption are firstly, that the federal government determines the dollar value of the market each year; it does not predetermine the number of research projects that it is prepared to fund (NSF f.). Secondly, the demand for research funds has, in recent decades, always exceeded the supply and, as such, it is presumed that virtually all of the available funds were absorbed into the market. Given these conditions, if the average value of research projects rises, then the number of research projects purchased would be lower. Likewise, if the average value of research projects falls, then the quantity of research projects purchased would be higher. This inverse relationship translates to a downward sloping demand curve in the academic research market; a curve with a slope with a value of less than zero. Since the slope of the demand curve is negative, the slope of the marginal revenue curve is also negative and the degree of steepness of the marginal revenue curve is twice the steepness of the demand curve. Notably, in recent decades, the demand curve has shifted to the right each year as total available funding for research, in real terms, has increased.

In the academic research market, a downward sloping marginal revenue curve also translates into individual universities, a condition supported by Massy (1990). Downward sloping marginal revenue indicates that universities face a negatively sloping demand curve, although a high price elasticity of demand can be argued.

MARKET ANALYSIS

The primary source used to inform the economic components of this analysis was Douglas (1992). It should be noted that this is a qualitative analysis and not intended
to be an econometric study. In this regard, the arguments support the most likely condition rather than providing exact values. Descriptions of these trends are presented by statements that indicate whether the slope of a line or curve is upward or downward sloping or whether it is positively or negatively sloped. Any reference as to the degree of steepness of the slope of a line or relative steepness of a line is explicitly stated.

Perfect competition describes a market situation whereby the product being sold is completely undifferentiated and, as such, every firm’s product is a perfect substitute for that of every other firm. In addition, the number of competitors is sufficiently large to prevent any single competitor from having any influence on market conditions such as price. As theory holds, each firm can sell all it produces at the market equilibrium price and decides how much it will produce based on its own costs. In this regard, each firm has to accept the price as a given.

As a price taker, where price is constant regardless of output, the firm’s marginal revenue is equal to price, which is represented by a horizontal line with a slope equal to zero. If any firm raises its selling price, even by a small amount, it will lose all of its business because price elasticity of demand is infinite. Alternatively, any firm that lowers its price would be expected to gain a vast share of the market. Given the importance of signaling in generating research funding, these phenomena are not apparent in the research market. In other words, a university that lowers its prices would not likely increase its research revenue substantially and therefore, price elasticity of demand is not infinite. The more probable reality is that price elasticity of demand is highly elastic and, in some instances, might be positively related to price in that, considering the signaling that occurs, higher prices could generate increased unit demand and ultimately a higher volume of research performed at a university.

As an example, moderate pricing fluctuations did not have a significant effect on the value of research performed during the era prior to the imposition of fixed overhead rates where some universities that were charging high amounts of overhead continued to gain market share (NSF c.). This would suggest that, under a less regulated regime, neither the variable or overhead component of the research transaction is perfectly competitive. In 1994, when the federal government finally imposed overhead rates on the market, it was not because some universities were gaining or losing market share, rather it was done to prevent some universities from earning excess profits (Energy and Commerce Committee, 103rd Congress). These events imply that the research market is not naturally perfectly competitive and that the imposition of fixed overhead rates left the variable cost part of the transaction more free to operate in open market conditions.

In perfect competition, reactions to changes in market conditions occur in the short term in that increases in demand are filled by entering firms and reductions in demand results in firms exiting the market. In other words, there are very low barriers to entry and, more pertinent to this analysis, there are very low barriers to exit the market. Thus, another factor as to why the research market is likely not perfectly competitive is the reality that, as previously described, research capacity is sticky. The consequence of high barriers to exit is a tendency for overcapacity to develop in the short run. Overcapacity results in a declining marginal revenue curve, not a condition that would be expected in a perfectly competitive market.

Importantly for the purchaser of research, perfect competition ensures the most efficient allocation of resources which is most often interpreted to mean the lowest prices for the product; the lowest average price paid in the short and long term. This is because, in all time horizons, the firm’s marginal cost curve equals marginal revenue and price at the lowest point on the firm’s “U-shaped” average cost curve. If any firm produced more or less quantity, its average cost per unit of production would be higher. Since all firms are producing at this point, the purchaser is paying the lowest average price and because average cost is equal to price there is no economic profit.

In higher education, the question of what constitutes the lowest average cost is not easily defined. In regard to teaching, it is difficult to imagine being able to maintain the exactly correct number of students in every section and the exactly correct number credit hours delivered by each professor so that any reduction would result in a higher cost and any increase would result in a reduction of quality (which is a future cost). The issue of quality is a fundamental uncertainty. Notably, the objective of performance indicators usually encourages institutions to operate at the lowest possible cost, not the lowest average cost.

Identifying the lowest average cost for research may be even more difficult. The problem is that there may be no maximum value of research that can be performed by a researcher. That is, over the span of a 20 or 30 year
career, any given researcher could be continually winning larger and larger awards with greater frequency. In the history of performance indicators that measure, in one form or another, the value of sponsored research performed per researcher, no maximum or ideal has yet to be established. If this continues to be the case, than the lowest average cost of research operations may never be achieved and this situation would generate an average cost curve that is perpetually downward sloping. An inverse relationship in some form of \( y = x^2 \), where \( y \) is a university’s average cost of operating its research business and \( x \) is the value of research performed, can be expected.

Applying this notion in the example of a perfectly competitive market, where price and marginal revenue are represented by a horizontal line with slope equal to zero, in all cases where the short and long run average cost is greater than price, firms will exit the market and in all cases where short and long run average cost is less than price, firms will enter the market. An equilibrium exists where the average cost equals price. However, since the average cost curve is perpetually declining, equilibrium can only be approached after the ratio of the cost of supporting a university’s research operation to its value of research performed causes its average cost curve to “flatten out.” In this regard, the market price can be thought of as the asymptote of the average cost curve where the average cost approaches price from above.

The first derivative of the aforementioned relationship is \( y = -x^2 \), yielding a perpetually increasing marginal cost curve that approaches its asymptote at price from below. This is important because, in the example of perfect competition, the marginal revenue and marginal cost curves for the academic research market will never intersect and, as such, there would be no ideal amount of research for an institution to perform. A normal interpretation of the theory of perfect competition would suggest that if there is no minimum average cost there cannot be a perfect competition equilibrium point because firms will never be satisfied with their level of output; they will always want to produce more. In addition, the purchaser can always reduce its average cost by increasing its volume of purchases. That is, the more that the purchaser buys, the lower will be its average cost. This situation is unsustainable in the research market because, even though performers will want to continually produce more, the value of the market is not unlimited and, as a consequence, while the purchaser may or may not be paying the lowest average cost for the quantity it is purchasing, it is definitely not paying the lowest possible average cost. This instability leads to oversupply and a declining marginal revenue curve for the performers, a situation that more closely resembles actual academic market conditions than it does perfect competition.

In addition, since it has already been established that the marginal revenue curve in the research market is declining, there will be an intercept with the marginal cost curve at a point that will be a university’s ideal point of output. Importantly, not only is this point not at the university’s lowest average cost, but it is also at a level of output that is less than the output that would equate to a university’s lowest average cost.

Another issue to be addressed is that different relative prices for research could be interpreted as first price discrimination whereby each firm’s exact cost is paid for each transaction even though the cost of each transaction is different. This situation would manifest as variable pricing paid for research reflecting the differing content of each funded proposal. Indeed, this scenario may fit the monopsony-perfect competition model very well in that the monopsonist, having perfect knowledge of the performers’ costs, would alter market conditions to ensure that it earned all available profits, thereby removing welfare loss from the market.

The main justification for discounting the probability that monopsony-perfect competition is the primary operational model in the research market is that universities can earn profits by conducting research. A closer examination of the mechanism underlying the claim that short term profits can be realized in the research market may add credence to this position.

Comparing the research productivity of the faculty at the University of Arizona and Ohio State University exemplifies one source of profit that universities can earn from conducting research. In 2005, the average value of research performed by full time equivalent (FTE) faculty at Ohio State (Ohio State University) was $184,784 and was $242,301 at the University of Arizona (University of Arizona). Assuming that each institution had an indirect cost recovery rate of 45 percent, the University of Arizona collected $17,850 more per faculty than did Ohio State. Since the University of Arizona has 1612.98 FTE faculty, it generated almost $29.0 million more in gross profit than it would have had it realized Ohio State’s gross profit ratio. Compounding this difference is the fact that Ohio State paid its professors, associate professors, and assistant professors $108,000, $72,000, and $60,000 respectively.
for nine months of the 2004-05 year while the equivalent rates at the University of Arizona were $95,000, 67,000, and $60,000 (National Center for Educational Statistics, 2004-05). This means that the gross profit earned from research expressed as a ratio of dollars of wages paid was even greater than the ratio expressed in terms of the number of faculty. From the perspective of researcher productivity, it is likely that the University of Arizona’s research business is more profitable than Ohio State’s. Given that Ohio State had 2,991.6 FTE faculty, it lost potential earnings of several tens of millions of dollars. Mechanically, the University of Arizona earns a portion of the extra gross profit every time a research project is undertaken and, as such, these profits are short term.

The second scenario that demonstrates the short term profitability of the university research business is one in which the productivity of researchers across institutions is equated but where the relative cost of supporting research differs. Many universities, particularly larger research performers, track process indicators such as the “Number of Protocols Processed Per Full-Time Employee (FTE), 2004,” (Pennsylvania State University) however, the measure that would more accurately describe the profitability of the research business is to measure the actual indirect cost of research in a given period and divide this amount by the number of funded research projects that occurred during this period. This calculation produces the average indirect cost of research per funded project. Where the productivity of researchers is similar, that is, in the instance where the gross profit earned per research project across institutions is similar, those universities that have a lower value of indirect cost per project are enjoying higher profits. In addition, these are short term earnings because the more profitable universities will earn those profits every time a research project is funded.

The two examples given, those being the variability in researcher productivity and the variability in relative indirect costs, demonstrates that universities can earn short term profits in the research market. As more prestigious researchers are often the most productive and as institutional reputation can positively affect funding awards, the argument that a moderate level of long term profits are available in the research market is also supported. These factors further suggest that the research market is not perfectly competitive and that the monopsony influence is weak.

The final part of the argument refers to the importance of signaling in winning research awards. Signaling is reflected in the reputations of the researcher and sponsoring institution, as well as in the wide variances in research capacity that exists within disciplines across universities (Atkinson, and Massy, 1996) or even across disciplines within a single university. These factors of production provide universities with the capability of assembling a unique set of outputs for each transaction in which it is bidding. In the research market, this constitutes product differentiation because it enables an institution to offer the buyer potentially more reliable results by adjusting inputs. Gaining a market advantage by using a differentiation strategy (Porter, 1985) is contrary to the principles of perfect competition where the product is utterly undifferentiated.

CONCLUSION

Short and long term overcapacity manifested by a declining marginal revenue curve, the ability to earn short term profits, an environment in which sellers demonstrate variable gross profits and operating cost structures, and the use of a differentiation strategy to gain market advantage provides a strong underpinning for the position that the academic research market is not perfectly competitive. Notably, it is important to recognize that this market is not a pure manifestation of any economic archetype and these impurities may have strategic consequences.

If the market behaves more like an oligopoly or monopolistic competition than it does like perfect competition, then universities can earn profits from research. While many accountability issues arise from this conclusion, institutional strategic processes could be more completely informed by determining which economic archetype most closely describes this very important market. The type of analysis used in this paper can be extended for this purpose.

If profits are available to universities in the research enterprise, then it is likely that more universities will want to do it. This will tend to intensify an already highly competitive market and, as the level of competition rises, so will the lengths that universities go to win funding. Increased vigilance will be required.

Perhaps the most important issue raised by this paper is the notion that the academic research market has reached a level of importance to individual universities, to the higher education system, and to the economy generally that demands greater study and understanding. Much as Keller (1983) made a call to arms to higher education in
the 1980s, so now does the academic research market call to us.

REFERENCES


Buckingham, United Kingdom and Bristol, Pennsylvania.


