"The University of Minnesota as a Public Good"

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What role should the University of Minnesota play to ensure that the state's economy does not falter and that the state maintains its economic vitality? This was one of the key questions that motivated the university's economic summit on the future of the state's economy in September 2000, a forerunner to this year's conference.

Many of the conference attendees were concerned the state's economy was beginning to falter. Some argued that Minnesota's economy was already falling behind the rest of the nation in developing high-tech companies. They noted the increasing number of corporate headquarters that had left Minnesota in recent years. And they pointed to a precipitous decline in venture capital funding going to Minnesota companies. Others, however, were not convinced that prospects were as bad as asserted, questioning the accuracy and relevancy of the data presented. A recent study by the University of Minnesota's Humphrey Institute of Public Affairs suggests that fears of falling behind have indeed been exaggerated. It showed that Minneapolis-St. Paul ranks ninth in the nation among U.S. cities in high-tech employment. (Markusen et al., 2001)

Nevertheless, most agreed the university should take a more direct and active role in promoting economic development and productivity in the state. They argued for an explicit partnership between the university and the local business community, with the objective of turning out more commercially oriented research, research that would result in more marketable products, more new businesses and more high-paying jobs. While this line of reasoning at first appears measured and persuasive, a closer examination raises doubts about the net benefits from such a partnership. Indeed, we think the

recommendations that follow from this point of view can compromise the long-run vitality of the state's economy.

That vitality depends on a university that produces basic research and well-educated students. Because these products are types of public goods, unfettered markets will fail to produce enough of them. Public universities are designed to correct this market failure by providing more education and basic research than the market would yield on its own; these are the fundamental roles of a university and the argument for government support.

In general, evidence suggests that the spillovers to local economies from these public goods are substantial. And in particular, the evidence on the University of Minnesota's impact on this state's economy is impressive. Encouraging the university to do commercially oriented research, therefore, can be costly in terms of the resources that are diverted from its fundamental mission.

Moreover, not only are the costs high, but the benefits of having the university pursue commercially oriented research are likely to be small, if not illusory. Government attempts to promote commercially oriented research, either directly or through universities, have yielded mixed results. And a comprehensive look at these efforts reveals a disturbing outcome: Government-sponsored research appears to simply substitute for privately sponsored research. In other words, the government's attempt to increase commercially oriented research – even if it is commercially successful – may fail because it drives out research that would have otherwise come from the private sector.

A call for the university to provide more commercially oriented research

Many of Minnesota's business leaders have concluded that the road to economic prosperity is through a university that is tightly involved with the private sector, particularly through conducting commercially oriented research, licensing patents and providing assistance to new technology-based companies. They contend that transferring university resources directly to businesses creates a more vibrant economy with more technology-based companies and high-paying jobs.

Proponents of direct involvement argue that the University of Minnesota can do a better job promoting economic development in the state. In spring of 2000, the *Star Tribune* published a commentary titled "Smug too long, state starts to fall behind." The authors argued that other states and cities are spending more on their universities to bolster university-spawned technology and attract new companies and talented workers. Meanwhile, Minnesotans have become too complacent. (Berg and Hage, 2000)

At least partly in response to the concerns that Minnesota's economy is falling behind, more than 1,200 business, government and academic leaders convened for the University of Minnesota's economic summit in September 2000. A working group of these leaders continued the discussion that began at the summit. They concluded that the university needs to take a stronger role in promoting the state's economic well being and made the following recommendations (Working Group Report, 2000):

- Establish a mechanism by which investment in higher education can better align with current and future business needs, and within which progress can be monitored.

- Participate in a public-private coalition to identify and support key research areas critical to Minnesota businesses.

A call the university should not answer

The arguments for a more commercially oriented university appear persuasive. How can we argue against the University of Minnesota doing a better job commercializing new technology? Nevertheless, we do. We think this road to success is not only bumpy, but also headed in the wrong direction. The flaw in the argument begins with a misunderstanding of the fundamental role of a university. And this misunderstanding in turn stems from confusion about the public-goods aspect of research and education.

A public good is distinguished from a private good by a special feature known as the nonrival property: One person's consumption of that good does not subtract from another person's. By this definition it should be clear that an apple is not a public good; nor is an automobile, or a cigarette, or a seat at a baseball game or a stay at a hotel. In each example, consumption by one person precludes consumption by others. Now consider the consumption of a lighthouse, an often-cited example of a public good. The beam of light that is seen (consumed) by one ship on a foggy night does not use up the

light; other ships still have the same beam of light to consume. Similarly, consider research (both basic and commercially oriented). Once produced, the research can be consumed without diminishing its availability. Other examples of public goods include national defense, clean air, a constitution or a legal system, and TV broadcasts. These goods all satisfy the condition that any one person can consume the good without subtracting from what others can consume.

Besides pure public goods and pure private goods there are private goods that have some degree of "publicness." For example, the health care provided to an individual is a private good because other individuals cannot consume it; nevertheless, health care can have spillover effects that benefit all individuals. Having one person inoculated for some communicable disease makes for a healthier environment, and a healthier environment is a good that any person can consume without subtracting from the consumption of any other person. Similarly, an educational service consumed by one individual precludes consumption by others. However, the education of even one individual increases the literacy of a community, which enhances the functioning of a democracy and benefits all individuals.

Economists have found that while the production of private goods is best left to market forces, the production of public goods may not be. In general, the market fails to produce enough of these goods because, once produced, people cannot be easily excluded from consuming them. As a consequence, private producers of public goods face a difficult pricing problem: Charging people for what they consume is virtually impossible. For example, how much benefit does one attain by consuming a healthy environment, or the national defense system or a lighthouse beam? A private firm producing a public

good might try to survey the citizens of its community to uncover how much they gain from consuming a public good and charge accordingly. But such a survey is fraught with problems. Knowing they will be charged based on how much they say they benefit from the public good, and knowing they will get to consume as much as they want regardless of their true preferences, people will tend to understate their consumption. It follows that left to the market, too few public goods, if any, will be produced. Consequently, we turn to the government (the entity that has the power to tax all consumers) to decide which public goods should be produced and in what quantity. With respect to research, government must decide what type and how much should be publicly funded.

Basic vs. commercially oriented research

We have argued that research is a public good and that unfettered markets may not produce enough of it. However, we think it is important to distinguish between research that the public cannot (or should not) be excluded from consuming and research that it can be excluded from consuming. The former we define as basic research; it has the property that once produced it is virtually impossible to prevent someone from consuming. The latter we define as commercially oriented research; it has the property that, even though it is a public good, it is relatively inexpensive to prevent someone from consuming.[1]

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[1]Most of the literature on this discussion distinguishes between basic and applied research. For example, applied research facilitates practical problem-solving in such fields as health, agriculture and civil industrial technology, whereas basic research is more distant from immediate, practical concerns (Rosenberg and Nelson 1993). It also seems that basic research becomes applied research at the point where fundamental theories begin to be used to develop a new technology or application. However, this point is sometimes difficult to pin down.

In this paper we don't distinguish between basic and applied research, but use the economic concept of public goods to determine whether research is basic or commercially oriented. Note that the public cannot (or should not) be excluded from consuming much of what scientists consider as applied research, and therefore for this paper we consider

Basic research is often research that aims to understand phenomena at a relatively fundamental level and typically has no obvious practical or marketable benefits. Basic research is a classic example of a public good and a market failure, because it is virtually impossible to capture the resulting benefits. When a mathematician publishes a theorem, for example, she cannot prevent others from seeing and building on her results. Of course, she could choose not to publish her results, but then it is arguable whether she has produced any research. The problem here is that it is virtually impossible for the mathematician to directly capture the benefits of her work. More generally, our definition of basic research is that its benefits cannot be captured; hence, there is a market failure.

What about commercially oriented research? Clearly, not all research is difficult to exclude others from using. Those who spend their lives trying to build a new mousetrap, if successful, can legally protect their new product and capture the benefits of the research through a government patent. Patents are a relatively inexpensive way to exclude people from consuming the benefits of research that has a commercial application. They allow those who invested in commercially oriented research to capture the benefits.

While we distinguish between basic and commercially oriented research by how readily their benefits can be captured, we should also note that there is a symbiotic relationship between the two. (See Ruttan, 2001, pp. 534-538, for a discussion of how complex this relationship has become.) On the one hand, basic research is the foundation for commercially oriented research. The fundamental principles of mathematics and science underlay most of the commercially oriented research that results in everyday

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such research as basic. Policymakers can use our definitions of basic and commercially oriented research to test whether

products. Without this foundation, new and improved products would be fewer and less frequent. Indeed, a recent study by the National Science Foundation ("Industry Trends in Research Support and Links to Public Research." National Science Board, 1998) found that public investment in basic research often serves as a precursor to private sector investment in many areas of commercially oriented research and development. The study specifically noted that U.S. patents granted to U.S. inventors were increasingly citing publicly funded basic research from academic institutions.

On the other hand, much has been learned about the fundamentals of science by doing commercially oriented research. Discoveries found in commercially oriented research can comment on theories developed in basic research. While both basic and commercially oriented research are complementary, the question is to which type of research the university should allocate its resources?

A high economic return to a university education and basic research

We can think of public universities, therefore, as agents of the government that provide two important public goods that unfettered markets would not provide enough of: education and basic research. While we cannot say whether universities are providing the right amount of these goods, we do have compelling evidence that these goods contribute to the economic well being of the local community.

The most direct contribution a university makes to its local economy is by improving the quality of the local workforce through adding more educated workers.

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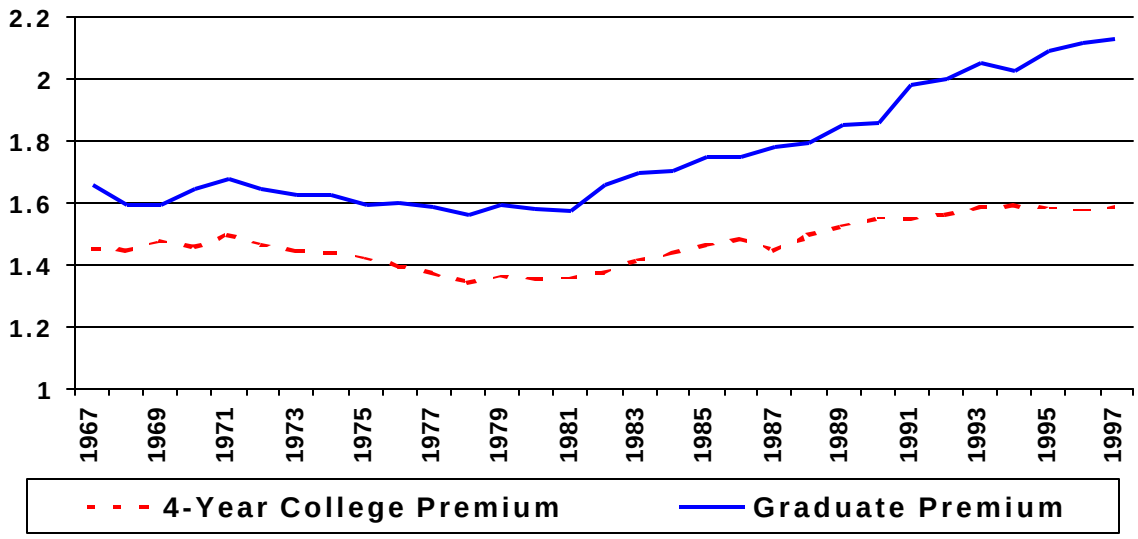
particular research projects are appropriate for the university or are better left to the private sector.

Consider the results of a 1998 survey of 1996 graduates from the Twin Cities campus of the University of Minnesota.[2] The survey found that over 80 percent of resident students who earned a baccalaureate degree were living and working in Minnesota. It also found that over 50 percent of the nonresident students who earned a baccalaureate degree were living and working in Minnesota. (These percentages are somewhat lower for graduate and professional degrees but they are still high.)

Furthermore, the economic value of a college degree is substantial and has been increasing dramatically over the last 15 years. (See Chart 1.) Prior to 1983 the wages of a worker with an undergraduate degree exceeded a worker with a high school degree by roughly 40 percent. Today that difference is close to 60 percent. The wage premium for an advanced degree has grown even more. Prior to 1985, the wages of a worker with a graduate degree exceeded those of a worker with a high school degree by roughly 60 percent. Today that difference is over 100 percent.

[2] Office of Institutional Research and Reporting, University of Minnesota.

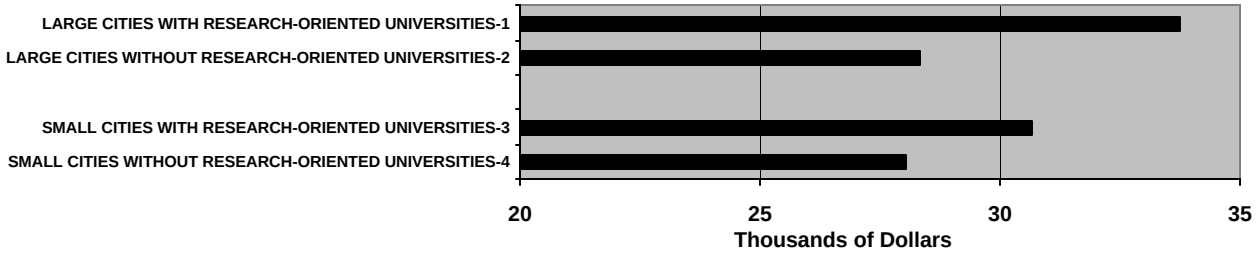
Chart 1 -- College and Graduate Degree Wage Premiums 1967-1997



Source: Kevin Murphy, University of Chicago

The overall economic impact of a university is the result of both its contributions to a higher quality workforce and to basic research. By its very nature, however, the economic impact of basic research is often indirect and difficult to quantify. A study that was successful in isolating some of the impact of basic research found that there was a positive association between basic research and industry research and that it was basic

Chart 2 -- Per Capita Personal Income, 1999



Average of :
1-Minneapolis-St.Paul, Minn.; St. Louis, Mo.; San Diego, Calif.; Seattle, Wash.
2-Kansas City, Mo.; Milwaukee, Wis.; Orlando, Fla.; San Antonio, Texas
3-Austin, Texas.; Chapel Hill, N.C.; Rochester, N.Y.
4-Jacksonville, Fla., Louisville, Ky., Toledo, Ohio
Source: Bureau of Economic Analysis and National Science Foundation

Large cities are MSAs with population between 1.5 million and 3.0 million; small cities are MSAs with population between 500,000 and 1.5 million. In 1999, research expenditures at large cities with research-oriented universities ranged between $300 million and $500 million and in small cities betweeen $150 million and $275 million.

research that appeared to cause industry research. (Jaffe, 1989) Another study showed that spillovers from university research are more localized than knowledge gained from other firms within the industry. (Adams, 2001)

We can, however, estimate the total impact that a university has on a local economy by comparing cities that have research-oriented universities to those that do not. We took a sample of large cities (Metropolitan Statistical Areas with population between 1.5 million and 3.0 million) and small cities (Metropolitan Statistical Areas with population between 500,000 and 1.5 million) that had universities with high levels of research expenditures and generally large student bodies. Annual research expenditures at the universities in large cities ranged between $300 million and $500 million and in small

cities between $150 million and $275 million. We compared each sample to cities of relatively the same size without research-oriented universities. In the year 2000, large cities that are home to research-oriented universities generated roughly 20 percent more income-per-capita than other large cities; for small cities, this difference was 10 percent. (See Chart 2.) While we admit this is a rough first look at the data, the results suggest that an active research university is associated with a stronger local economy than an economy without a research university.

The University of Minnesota is no exception

What can we say about the impact of the University of Minnesota on our economy? The available evidence suggests that the university is no exception to the general finding. This is not to say that one can easily identify all the economic spillovers emanating from the university. Nevertheless, the data we have make a compelling case that the university has been critical to the success of Minnesota's economy.

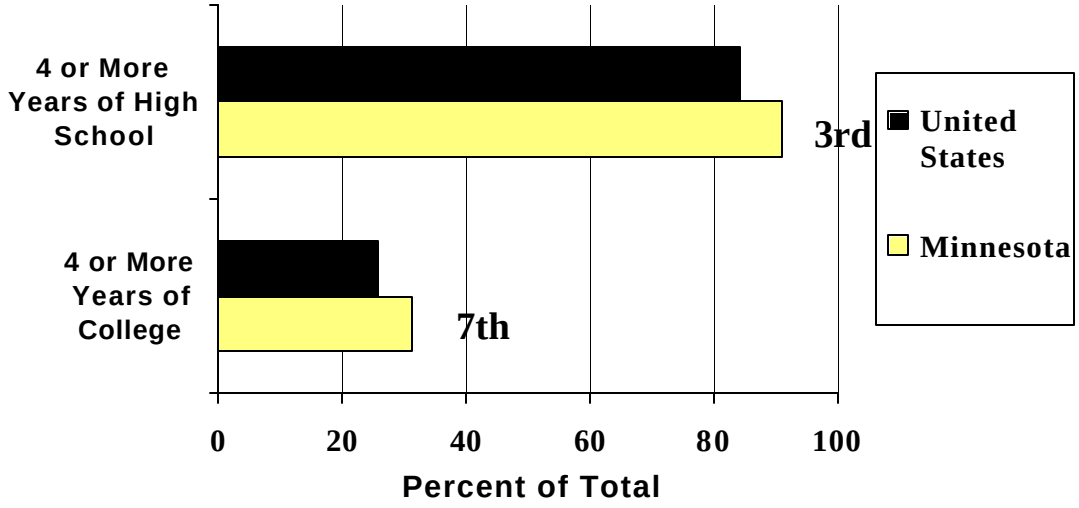
Consider what the university produces**.** It annually ranks among the top 15 public and private universities in research and development expenditures; in 2001 expenditures reached over $400 million. Last year it graduated 4,900 students from its four-year program and 4,100 students from its graduate and professional programs, which include Business, Law, Medicine, Dentistry, Economics, Political Science, Agriculture, Engineering, Computer Science and many others. And as we noted, a high percentage of university students live and work in Minnesota for at least two years after their graduation.

Over the years, we have seen some of the more successful spillovers to the local economy. Many argue that Minnesota's medical technology industry, which employed 20,400 workers[3] in 2000, would not exist without the people and the basic research coming out of the university. In fact, from 1990 to 2000 the number of medical technology employees grew 67 percent in Minnesota, while increasing only 17 percent nationally. Other industries have benefited from university spillovers from research in computer science, engineering and agriculture, to name but a few.

Besides the anecdotal evidence that suggests the university has been a key element in our state's economic success, the broader macro data are impressive. Because of the university and the other higher-education schools in our state, Minnesota has one of the most educated workforces in the country. In terms of per capita income and low unemployment, our state ranks among the top in the country. (See Chart 3 on education ranking and Chart 4 on per capita income and unemployment.)

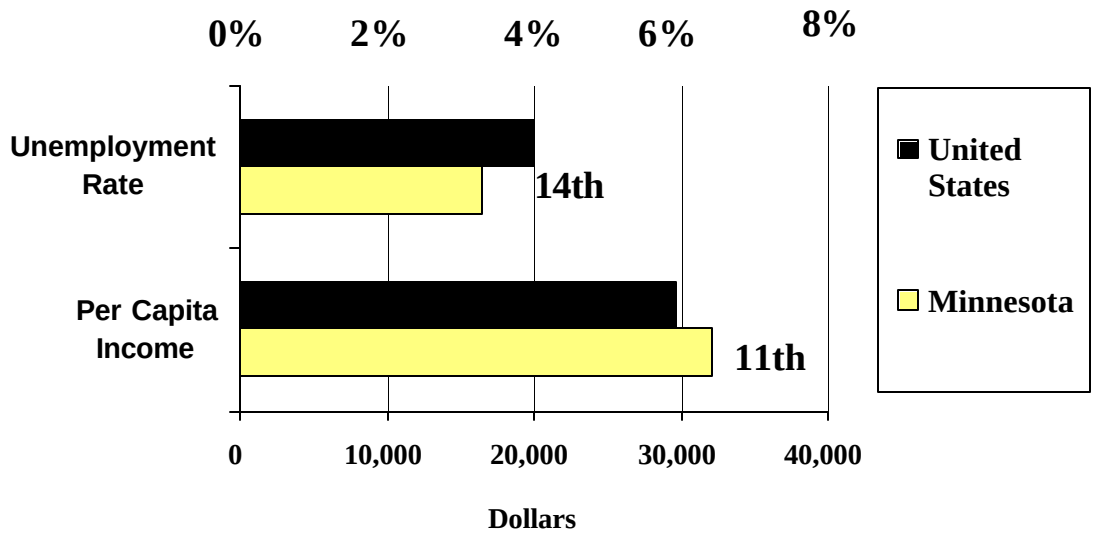
[3] Medical Instruments and Supplies. Source: Bureau of Labor Statistics

Chart 3 -- Education Attainment, Percent of Total Population and State Rank, 2000



Source: U.S. Census Bureau

Chart 4 -- Unemployment Rate, Per Capita Income and State Rank, 2000



Source: Bureau of Labor Statistics, Bureau of Economic Analysis

A low return to university-sponsored, commercially oriented research

Economists often preach that there is no free lunch. What the government spends on public goods, the public cannot spend on private goods. What the government spends on education, the government cannot spend on crime prevention. The time a student spends in school is the time the student cannot spend working. If a university decides to spend resources on consulting with businesses and doing commercially oriented research, it will have less time to educate students and produce basic research. Hence the cost of university-funded, commercially oriented research is what is forgone in the way of education and basic research. While it is difficult to document these costs precisely, as measured only by their economic impact on the local community, they appear to be substantial.

Not only do the costs appear high, but also estimates of the benefits from university-funded commercially oriented research are low; they may even be zero. As mentioned earlier, basic research is associated with motivating private industry to do more of its own research. It is possible that by having universities do more commercially oriented research at the expense of basic research, the amount of research private industry funds declines.

A more disturbing outcome is that overall research could decline because any increase in commercially oriented research by universities appears to be offset by a decrease in similar research conducted by private industry; that is, in effect, universities fund the commercially oriented research that private industry would have done on its own. The irony here is that this substitution is more likely to occur when the university-funded commercially oriented research is financially successful. That is because research

projects with the most potential for financial success are those that the private sector would likely have pursued if the university had not.

A recent study addressed the question of how much government-subsidized research simply substituted for private research and found it was virtually one-for-one. In other words, the net result of the government's attempt to directly increase commercially oriented research was zero.

The federal government has tried in numerous ways to directly increase the amount of commercially oriented research. One such program, established by Congress in 1983, is known as the Small Business Innovation Research Program (SBIR). Today over $1 billion of federal grants are allocated by the SBIR. Under this program, small businesses apply for research grants to fund proposals that the SBIR program managers judge to have a high degree of commercial success.

While these dollars are clearly spent on commercially oriented research, it is not clear if there is an increase in total research expenditures. To try to determine the net impact of SBIR grants, Scott Wallsten compared firms that received grants to firms that did not. After devising a test that would take account of an important feedback effect, he found that there was a dollar-for-dollar substitution. (Wallsten, 2000) His results strongly suggest that firms that received the research grants would have done the research without the grant and that the government financing did not induce any more research than it replaced.

Proponents of the university taking a more direct role in promoting local economic activity, whether by funding more commercially oriented research or by making its professors more available for consulting, should be concerned by these results.

They suggest that the net benefits may not just be small, but are likely to be negative. And ironically the more successful the university might be in turning out patents and financially successful products, the more likely the returns are negative. The returns are positive (and we estimate to be quite large) only when the university is educating the local workforce and doing basic research, research that private industry would not do on its own.

Conclusion

The university can best promote the economic vitality of the state of Minnesota by focusing on producing basic research and educated students. Consequently, we think it would be a mistake to transfer university resources to commercially oriented research. We do not mean to suggest that the university cut its links with the private sector and rest in an ivory tower. Rather, this paper suggests that policymakers carefully weigh the costs and benefits of policies that give the university a more direct role in promoting the state's economy. Some policies require few resources relative to benefits, such as providing channels for communication between university researchers and the private sector. Even some incubator programs that transfer university expertise to start-up companies may not require substantial resources. When the university sets out to conduct commercially oriented research, however, the costs are high and the public benefits are suspect.

The road to a strong Minnesota economy to keep the university producing what the private sector will not produce enough of – education and basic research. To that end, we should judge the university not by the number of patents it produces, but by the

quality of the scholarly journal articles its faculty publishes and the quality of the students it graduates.

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