Beyond Humboldt: Emergence of Academic Entrepreneurship in the U.S. and Sweden

Henry Etzkowitz, State University of New York
Patrik Asplund, Dep. of Economics, Umeå University
Niklas Nordman, Dep. of Economics, Umeå University
Beyond Humboldt: Emergence of Academic Entrepreneurship in the U.S. and Sweden

Henry Etzkowitz, State University of New York
Patrik Asplund, Dep. of Economics, Umeå University
Niklas Nordman, Dep. of Economics, Umeå University
Contents

Introduction, 5

The Emergence of an Entrepreneurial Paradigm in Academia, 7

From the Endless Frontier to the Endless Transition, 9

Networks of Innovation, 11
  * The Emergence of Knowledge-Based Economic Development in New England, 11*
  * The Invention of the Venture Capital Firm, 12*
  * The Lineage of Knowledge-based Economic Development, 13*
  * A Common Model?, 14*
  * A Divergent Model?, 16*
  * The Challenge to Swedish Universities, 17*
  * The Third Mission Study, 18*

Third Mission Issues, 19
  * First Axis: Conflict among Goals, 19*
    * Conflict of time, 19*
  * The Impact of the Third Mission on education, 20*
  * Impact of Third Mission on Research, 20*
  * Involvement in Firms, 21*
  * Critical Mass, 22*
  * Second Axis: The Third Mission as the Capitalization of Knowledge, 22*
    * The Effect of Firm Size and Type on Relations with Universities, 23*
    * Loss of Personnel, 23*
    * The Disposition of Intellectual Property Rights, 24*
    * Informal versus “Embedded” Technology Transfer, 25*
    * The Emergence of Academic Entrepreneurship, 26*
    * Toward Mode 3, 27*
    * The Changing Role of the Swedish University, 28*

References, 31

Documents, 32

Notes, 32

CERUM Working Paper, 33
Introduction

The university has become a factor of production in a knowledge economy and an increasingly direct source of economic development at the national and regional levels. The role of universities, in particular MIT and Stanford, in stimulating regional economic development, has been widely recognized. New England’s use of its extensive academic base to systematically create new firms from scientific research is especially relevant to the renewal of Sweden’s innovation system. Despite a partial recovery, Sweden faces blockages to growth, and wishes to turn investment in university research into innovation activities much like New England earlier in the century.

Contemporary Sweden has certain structural similarities to early 20th century New England. Both Sweden and New England had a highly developed R&D base located largely in universities. In both cases, older mid-tech firms had moved activities out of the country or region. New England’s major industries had moved west to be closer to sources of raw materials, convenient transportation networks and more efficient distribution channels, leaving the region with older, financially strapped, small firms that were not technologically innovative. On the other hand, Sweden still has large technologically innovative firms and is increasingly the site of foreign direct investment by multi-national firms as well as firm formation, often from an academic base, especially in the information industries.

This chapter compares and contrasts the emergence of an entrepreneurial academic paradigm in two scientifically advanced countries that differ greatly in size, culture and academic tradition. Nevertheless, common driving forces of economic and innovation dilemmas also produce similar responses. In the 1930’s and 40’s, MIT acted as a “regional innovation organizer (rfo), identifying and creatively filling gaps in the New England region. A mandate for universities to play a broader role in Swedish society including, but not limited to, making a greater contribution to economic and social development at the national and regional levels is presently under debate.
The origin of the modern research university is rooted in efforts to achieve national social and economic development, the former providing support for historical and humanistic investigation; the latter for the scientific and technological disciplines. Indeed, Alexander Von Humboldt’s principles of freedom of teaching and learning and the unity of teaching and research were accepted in the reform of the Prussian universities because of their contribution to economic development. Thus, “The Prussian government perceived the linkage between scientific training in the universities and the application of science to and in industry, and so they sponsored the emergence of the research university” (Muller, 1984, p. 10). But then autonomy for research universities may be important for them to fulfill their mission in economic development.

During the 19th century, the development of the chemical industry from academic research in Europe, and of a research-based agricultural industry in the United States were the exemplars of knowledge-based economic development. Nevertheless, despite the strength of the Humboldtian model, a bifurcation between teaching and research solidified in many European universities and between research and economic development in most US universities. Indeed, the Humboldtian tradition was often interpreted to mandate the latter distinction.

Transcending its medieval origins in the conservation and transmission of knowledge, the university became a protean institution, with multiple missions and shifting boundaries. Each mission has been an impetus to the next. The goal of conservation of knowledge encouraged the development of research in order to restore lost classical learning. The serendipitous results of research were sometimes found to have practical implications, initially in pharmacy in the 17th century and then in other fields. Teaching students research techniques led them to discover new knowledge of various kinds, both theoretical and practical. Each new academic mission folded over into an old one, recursively making the university an efficient institution of reproduction and production of knowledge, and therefore the paradigmatic institution of a knowledge-based society.

Nevertheless, there is a tendency to assume that a university in one country is basically similar to a university in another. However, strong differences can also be found. They especially exist between countries in which universities are basically elements in a state bureaucracy, with basically similar levels of prestige and funding across schools, like Sweden. By contrast, in the US, even state universities operate as relatively
independent entities in competition with their peers, and aspiring peers, in their own region as well as in other parts of the country.

Despite differences, commonalities emerge as universities make the transition from teaching to research institutions and from “Ivory Tower” to entrepreneurial universities. These transitions are taking place at different rates in various countries and regions, sometimes successively, other times simultaneously. They may even occur in seemingly counter-intuitive reverse order, for example, when the introduction of an economic development mission stimulates the development of research projects, initially focused on local problems.

In the late 19th and early 20th century US academia went through the first academic revolution, introducing research into the academic science and making it more or less compatible with teaching, at least at the graduate level. Many universities in the US and worldwide are still undergoing this transformation of mission. At the same time, the increased salience of knowledge and research to economic development has opened up a third mission, the role of the university in economic development.
From the Endless Frontier to the Endless Transition

The Endless Frontier of basic research funded as an end in itself with only long term practical results expected is being replaced by an “Endless Transition” model in which basic research is linked to utilization through a series of intermediate processes, often stimulated by government. In the US these include the SBIR, STTR, IUCRC and Engineering Research Centers at NSF that bring faculty into closer relationships with firms. In Sweden, the beginnings of a movement in this direction has occasioned a debate similar to the one that took place in the US in the early 1980’s when Harvard University proposed to form a firm jointly with one of its professors, based on his research results.

Until quite recently most academic scientists and research universities abstained from commercializing research. This stance is changing due to pressures on the university to contribute to economic development and opportunities to gain personal wealth. In the past companies exchanged resources for trained personnel and advice across well defined boundaries. It is now becoming more common for teachers to exploit knowledge themselves and for administrative arms of the university to assist them. The transfer of technology has been accepted as an administrative function of research universities even as publication of research was earlier accepted as a responsibility of faculty members.

A frequent assumption made by those alarmed by recent developments is that there is a conflict between internal (university) values and external (economic) values. These critics hold that certain kinds of activity must occur in a setting which is apart from the economic sphere of efficiency and profit making (National Academy of Sciences, 1999). Once that barrier is crossed, they fear, it becomes extremely difficult to stop the corruption of values which they believe is entailed in the accommodation of universities and the other institutions of science to the market.

There is a strong analogy between some of the initial fears of critics of recombinant DNA research and the fears of these critics of entrepreneurial scientists and entrepreneurial universities. In both cases, the fear is that the breaching of a barrier, whether natural or moral, will lead to catastrophic results: the risk of catastrophe is too great to take a chance on breaching this barrier.

The debate over the appropriate role of the university in technology and knowledge transfer, and the alternatives posed, are not peculiar to Sweden. They are echoed in the critique of academic technology transfer in the US by economists who argue that technology transfer mechanisms create unnecessary transaction costs by encapsulating knowledge in patents that would, they argue, otherwise flow freely to indus-
try. But would the knowledge be efficiently transferred to industry without the series of mechanisms for identification and enhancing the applicability of research findings by carrying the development process further, through special grants for that purpose or in new firms formed for that purpose in university incubator facilities?

Some Swedish academics argue that the two worlds of industry and academia should be kept apart. As one put it, “The, academy should be the academy, carry out basic research, open up understanding between worlds rather than changing. The alternative perspective is that academic research should change dramatically, open up to business.”

When an economic crisis occurs, basing an economy on knowledge and research may make for a recovery. Knowledge-based regional economic development, joining together venture capital with an entrepreneurial university to create new start-up firms, was invented in a declining United States region, early in the twentieth century.
Networks of Innovation

After the failure of traditional models of regional development, and having suffered more than thirty years of economic contraction before the depression of the 1930’s, New England business and political leaders were willing to consider new ideas. In this context, MIT President, Karl Compton, proposed that New England’s comparative advantage, its concentration of academic research, is the basis of a new mode of economic development.

The traditional thesis of what to do in a declining, or even growing regional economy, which still holds today, is to improve the business climate. The typically strategy is to reduce taxes, which is believed to be the best way to attract or retain firms. A second related tactic is to offer subsidies, either to induce firms to relocate or to retain a firm threatening to move elsewhere. For example, in the New York metropolitan area, New Jersey offers a subsidy to move a firm from New York’s financial district across the river and, to retain the firm, New York offers a higher subsidy. The cost of the competition may place the “winning” area at an economic disadvantage.

In the 1930’s, Karl Compton, the President of MIT developed an alternative thesis of science-based economic development. He first proposed encouraging the formation of new technology-based firms in order to induce economic growth on the national level as an answer to the depression but these ideas did not resonate well. At that time, technology was held to be the cause of unemployment through use of labor saving devices. A Neo Luddism was in the air and slowing the pace of technological advance was thought to be the best way to deal with economic decline. Although Compton was commissioned to produce a major national report, his proposals were basically tabled.

The Emergence of Knowledge-Based Economic Development in New England

Compton returned to New England and attempted to implement his ideas at the regional level through an organization representing a trilateral interaction among academia, business and government. State governors founded The New England Council in the 1920’s to deal with the persisting effects of economic downturn. Representing the academic, business and political leadership of the region, their objective was to reverse the economic decline that had started earlier in the century. They attempted to improve the business climate by lowering taxes and encouraging firms to relocate but they found, for example,
that it was uneconomical for an automobile company to locate a branch plant in New England.

Compton suggested that they focus instead on creating new products from advances in technology. A “New Products” Committee was formed within the Council to investigate this idea. He proposed that new product, that could be turned into new firms, could come out of academic research. This was not entirely an abstract notion at the time. During the 1920’s several firms had been formed out of research and out of consulting work that MIT professors had engaged in with existing companies. Meetings were held to analyze the elements lacking in the region to create new technology-based firms from academic research.

In this particular instance, the topics focused upon were “seed financing” and business expertise to complement and assist technology innovators. New England had considerable sources of wealth in insurance companies and investment banking and a concentration of academic resources. There had been some instances of firm formation and the thesis was that this could be done on a more systematic basis by linking technical and business networks. The technical networks had their node at MIT; the business networks at the Harvard Business School.

In undertaking these activities, Compton carried forward the vision of William Barton Rogers, MIT’s founder, who had envisioned an academic institution integral to the development of technology-based firms. Compton translated that vision from the textile mills and metal working industries of the mid-19th century to the emerging electronics and computer industries of the mid-20th century.

The twin goals of regional and academic development were combined in his recruiting effort for the physics department. Compton had brought onto the MIT faculty scholars such as Van der-Graaf who combined theoretical investigation with technology development that had practical implications, in this case, advanced generators. Beyond the internal renewal of MIT, Compton played a broader public role in the New England region as a regional innovation organizer.

The Invention of the Venture Capital Firm

Compton proposed to establish a new type of enterprise, familiar to us today as a venture capital company, in order to stimulate firm formation. Three elements (financial capital, business advice and technical knowledge) were brought together in a new company, the American Research and Development Corporation (ARD), established in 1946. The concept was to create a hybrid organization, linked to financial and technical networks, that would seek out technologies and help make them into businesses.

ARD brought business and technical networks together in a new framework. To found ARD, Compton drew upon MIT’s endowment and that of sister technological schools such as Rice University as well as funds from Boston financial institutions. An alliance with the Harvard
Business School provided a professor as chief executive of ARD, and graduates to assist with business development in new companies. MIT was also a source of technically knowledgeable employees, who sought out firm founders, and professors to evaluate potential technologies.

A lobbying effort to change the laws governing for capital formation had to be organized. The existing “rules of the game” made it difficult for financial institutions to investment in a risk taking entity such as a venture capital firm. Rules to prevent financial and insider collusion precluded financial institutions from each making very small investments in a single entity such as ARD. The civic-minded business leaders who helped found ARD persuaded several state legislatures to change the rules for investments from pension funds and insurance companies, making investment in venture capital more broadly possible.

The other inhibiting factor was the so-called “prudent man rule” which held that financial institutions, such as insurance companies, should invest conservatively to protect their beneficiaries. A firm with a fiduciary responsibility to so-called “widows and orphans” could not fund an entity that was going to invest in risky new companies, where nine out of ten investments were not expected to be worth very much, if anything. However, one of them would be expected to be worth a considerable amount, not only making up for any losses but generating a large profit.

During the first decade of its existence, ARD helped start several moderately successful technology companies but the validity of the venture capital concept was not proven until it established the Digital Equipment Corporation (DEC) in 1957. DEC produced computer parts, and then the mini-computer, spawning a series of mini-computer firms in the Boston region. ARD’s investment in DEC was worth so much that the funds were distributed to the stockholders and ARD started over again. This time it was organized on a partnership model, through which senior members could benefit from the firm’s success. Former ARD employees also formed a series of new firms which became the basis of the contemporary venture capital industry.

The Lineage of Knowledge-based Economic Development

The New England case suggests that the key to knowledge-based economic development is to create the base of networks and hybrid organizations, from which firms are then created. The links made among networks (business, financial and technical) were incorporated into ARD along with financial capital. When ARD made a financial investment in a new firm, it also gave the firm founders access to a network of financial, technical and business sources to draw upon in developing their business.

A venture capital firm is a repository of social as well as financial capital and a venture investment typically includes both forms of capital. Indeed, a firm founder in Silicon Valley recently explained that he sought a venture firm investment, not so much for the funds since he
had capital available from a previous successful “start-up”, but rather for the connections that the venture firm’s network would supply. The new company can use the access to these links to create joint ventures and arrange marketing representation. Assistance may also come from the venture firm’s portfolio of companies or from the portfolio of another venture capital firm with whom they have ties.

To attain momentum, a high tech start-up needs to bring together technical and business expertise. Partners representing both spheres initially found some firms; others begin with a marketing or technology concept and need to find their opposite number. Entrepreneurial synergy is created when the two essential elements in high-tech firm-formation make a good fit. Facilitating organizations, such as incubators and venture capital firms, can play an important role in correcting imbalances in companies that begin from one side of the firm-formation spectrum or the other.

Drawing upon academic research and other sources, technology can be found and systematically formed into companies through the venture capital mechanism. This model for knowledge-based regional economic development had been created before the war but the wartime expansion of research put in place a larger base to work from, expanding a phenomenon that was already underway.

The science-based regional economic development model also had independent roots at Stanford University in the early twentieth century as a strategy for development of an underdeveloped region in contrast to the New England experience of renewing a declining industrial region. There was a close relationship between Stanford and industry from the early 20th century. It was an article of faith that you could not build a great engineering school unless there was a close relationship to industry. Otherwise the graduates would move elsewhere in the country.

A Common Model?

Route 128 and Silicon Valley have evolved a common model of science-based regional economic development, despite some cultural differences. This is contrary to Saxenian who argues that there are two cultures, the MIT and Stanford, Boston and Silicon Valley, which are quite different, leading to different results. Just as the genealogy of Silicon Valley semiconductor firms can be traced from Shockley Semiconductor, the lineage of US venture capital firms descended from the alumni of ARD.

Continuity in the origins of the model of science-based regional development between Route 128 and Silicon Valley (MIT and Stanford) can be discerned in the work of Vannevar Bush and Frederick Terman, who were respectively teacher and student at MIT. The model of science-based economic development from academia through the mechanism of the venture capital firm was transplanted from MIT to Stanford in the early post-war. Some of the model was transferred as a result of
Terman's being around MIT during the war as director of the Radar Counter-measures Lab at Harvard and picking up some of its elements there.

One sign of early intention is Terman's 1943 letter to the treasurer of Stanford, where as head of the Radar Counter-measures Lab at Harvard, he had the opportunity to observe MIT's mode of academic development and to propose an even more intensive replication for Northern California. Terman advised his friend, that 'what I have seen about the way that MIT operates in connection with industry, this is what we have to do as soon as the war is over. We have to form research centers, we have to establish firms. We must make this a central thrust of Stanford if we are to become a major university'.

New firm formation is characteristic of both regions and their universities. Perhaps the process of firm formation has become more routinized at Stanford where it has been integrated into the curriculum of the business school. However, in recent years Harvard Business School has not been far behind in developing a broader focus on entrepreneurship.

There are some coastal cultural differences. There is more of a tendency to wear suits in New York than open-necked shirts but even that is changing. In the multi-media industry in New York today, the so-called Silicon Alley, located in the East Village and elsewhere in lower Manhattan, is a fairly informal scene in which many people look like they just came off the casting call of Rent.

Conceived well before the Second World War in both regions, the strategy for science-based economic development that was initially realized after the war in Boston and then expanded upon in Silicon Valley is one and the same model. The vision that Bush and others at MIT were working from goes back to the ideas of William Barton Rogers. The founder of MIT wrote a document in 1846 propounding the idea of a university, not a technical school, which would be involved in basic research and technological development.

Rogers' idea was that science would infuse industry, not merely with low level consulting from engineering design work but with longer-range results. MIT always had a broader scheme of education than merely technical subjects. The goal was to encourage its graduates to take a broad view appropriate to an organizational leader rather than a technical assistant. Thus, MIT established a Humanities department which was oriented to the technical areas.

Some historians have interpreted the recruitment of basic researchers to MIT during the 1930's as a sign that MIT was moving toward the general research university model in the US. Actually, Compton was recruiting a particular subset of physicists had an interest not only in basic research but in the utilization of results. Thus, when Van der Graaf was recruited from Princeton, MIT also arranged to have his patent rights transferred from Princeton to MIT.

The integration of academic and business goals is the basis of the entrepreneurial university and knowledge-based regional economic development. The Cambridge area has the largest concentration of biotechnology activity in the US. demonstrating that the region's early success
with high-tech innovation in mini-computers was not a one-time phenomenon (New York Times, 1999). The biotech firms in the Boston and Bay areas have a common quasi-academic mode of operation. Advertisements for post-doctoral fellows come both from firms in both regions. Similar networks that go back to college and grad school, bring together the business side and the technical sides of these firms.

A Divergent Model?

High-tech firm concentration in connection with physical artifacts such as the Science Park at Stanford or the ring road around Boston are after the fact superficial characteristics, rather than an underlying cause of high-tech economic development. Some observers, such as Saxenian (1994) have emphasized discontinuities of organizational style between these two leading high-tech regions. The broader significance of this debate lies in the issue of whether these two regions represent unique historical instances or essentially replicable phenomenon.

The issue is structure vs network, vertical organization vs. lack of hierarchy and openness vs secretive operation. Tracy Kidder’s volume about Data General is a story of a free wheeling alternative development group in an old-line mini-computer firms. Saxenian’s “Route 128” model fits the later years of ossification at DEC and the recent past at Hewlett Packard in Palo Alto, a hierarchical “buttoned-down” operation before its recent renascence. As one observer noted, “Resource allocation (a focus on traditional bureaucratic procedures rather than unconventional ways of unleashing new ideas) is just as likely to hobble creativity in large and vibrant Silicon Valley companies as it is in boring, old industrial age companies.” (Hamel, 1999)

If Silicon Valley and Route 128 were phenomena that arose in particular circumstances and can not be duplicated, policy measures are fruitless. The question is which policy measures are appropriate for individual regional circumstances. Merely to take a mechanism that has been highly successful in one area assume that it is the way to recreate the phenomenon may not work.

A typical response is to mimic an existing format without undertaking an analysis of the local strengths and weaknesses of conditions for innovation. Thus, in many regions the response has been to build a science park first, as a set of buildings, and to expect the firms to magically appear. This is the equivalent of a Melanesian Cargo Cult.

A more appropriate approach is to make an analysis of the strengths and gaps in a region and then design new networks and organizations to bridge those gaps. That is the model created in New England where the venture capital firm was invented in response to that region’s problems and opportunities. In New York, at present, a different approach would be warranted since the area has a concentration of venture capital firms, most of whose investments go to other parts of the country. The missing link in the New York region is a lack of networks between the institutional spheres.
The Swedish innovation dilemma is part of a broader small country innovation problem in which even success can ironically create loss. Sweden's economy has become too narrowly based on a limited set of large, typically mid-tech, companies who are strongly motivated to extend, and sometimes move, their operations abroad in order to increase their access to markets. On the other hand, new firms are often limited in their growth by their limited focus on the relatively small national market. The gap in the Swedish innovation system is two-fold: (1) means to upgrade low tech industry to make it more competitive before it disappears in the face of low-cost international competition and (2) a strategy to identify and encourage new high tech candidates for growth.

The Challenge to Swedish Universities

The Swedish academic system is noteworthy in Europe for incorporating different types of courses and activities in a common university framework. Rather than opting for a bifurcated system as in Germany, Sweden has emphasized variety in a common framework. Although there are differences in research intensity, and regional focus between universities and university colleges, the possibility of institutional mobility toward full university status is open (Teichler, 1994).

Recently Swedish universities have been given a third mission by law, a role in economic and social development that is still being given form and content. Lacking the direct incentives of the U.S. Bayh Dole Act, Swedish universities, taking up the challenge of the new Mission, are attempting to achieve many of the same goals as their US counterparts in technology transfer and regional economic development. In Sweden as in the US various universities see their role differently and interpret the new mission accordingly.

The idea of directly introducing a fairly abstract goal such as the Third Mission into academia by government fiat may seem strange in the US. Nevertheless, the federal government, taking an indirect approach in the Bayh-Dole Act, revising US patent law, gave universities specific responsibilities for technology transfer as a condition of accepting federal research funds. A more intensive involvement of universities in economic development was the common hoped for result of these initiatives undertaken in the contexts of quite different academic systems with contrasting histories of governmental relations.

The Swedish academic system differs from the US in many ways, not the least of which is the close ties to the state. Before recent decentralization initiatives, the higher education Ministry decided, on the basis of national needs, how many places in each discipline would be made available at different universities. Even without detailed top down planning, each university has a liaison person within in the Ministry. The assumption of the university as a sphere largely within the domain of the state also makes it more difficult for Swedish universities, where the professor is a “civil servant” to embrace expanded definitions of the academic role.
A defining feature of the Swedish University is that it combines a system of hierarchical chairs with egalitarian features such as lack of salary differentials among disciplines. Even more distinctive in contrast to the US academic system in which mobility is emphasized, from undergraduate to graduate school, for example, is the tradition of remaining at a single university, not only for training but to pursue a subsequent academic career. These structural conditions of Swedish higher education lead to contradiction and ambivalence over the third mission.

Sweden has begun an experiment in combining multiple goals in its academic system, hopefully enhancing rather than detracting from their achievement. At present, Sweden has twenty-nine facilities for higher education, including nineteen university colleges like Örebro and Ronneby. Does the Swedish population really constitute a sufficient base, large enough to create a demand that matches such a large supply? Higher education is apparently used as a political tool for many purposes, for example to fight unemployment and to level out regional differences. Is there a contradiction between the use of the university as a political instrument and gaining of the best terms possible for research that stands out in international competition?

The Third Mission Study

An investigation based on interviews with researchers and personnel in leading positions in four different departments, conducted at seven universities in Sweden, is presented. The sample was selected to include exemplary cases of virtually all major types of institutions of higher education in Sweden, including old universities, new universities, technological and specialized universities, and regional colleges, both those oriented to regional development and those focused on attaining university status.

The “third mission” brings into focus the classical discussion between “academic freedom” within independent universities and “the university in service of society”, although in a new environment. The regional colleges and some of the new universities have embraced the third mission as a means to develop research capabilities. They draw some of their professorate from among industrial practitioners and researchers, even as MIT appointed consulting engineers to its faculty for a similar purpose in the late 19th century. They utilize courses and research to advance both causes, academic and economic, at one and the same time. Projects that combine academic advance and industrial innovation, not routine testing, are taken on.

Older universities and new universities emulating the traditional foundations resist this new role or confine it to activities related to the public understanding of science. Senior academics at these universities, along with many of their colleagues in the US, uphold a view of the university as making its contribution to economic development at a distance, through intermediary organizations and across strongly defined boundaries.
Third Mission Issues

The Third Mission mandate has raised several controversial issues that can be arrayed along two axes of “inclusion” and “capitalization.” Issues such as Conflict of Time, Loss of personnel, and Impact on Education and Research can be displayed along the axis of “including the broader public” in academia. Informal versus “Embedded” Technology Transfer, the disposition of intellectual property may be arrayed along the axis of “the capitalization of knowledge” from academia.

First Axis: Conflict among Goals

The structure of the Swedish academic system affects how the third mission is carried out. Academic activities are performed as individual responsibilities and thus activities related to the third mission seem to be carried out in the same fashion. A conflict of time arises in connection with the “third mission”, where a specialized senior professoriat is expected to assume this new role. Approximately one half of the interviews indicated that there might be a problem in separating working time between the industry and the department.

The strains of the first academic revolution were handled in Sweden by creating a second rank of professors to concentrate on teaching, in contrast to the US model of attempting, more or less, to have the same individuals balance the several roles.

Conflict of Time

One over-riding theme cut through most of the interviews: academics typically viewed the third mission as a conflict of time, arguing that they don’t have enough time to accomplish the first, second, and third missions simultaneously. At Lund, for example, the problems concerning contacts with the industry seems mainly to be related to the scarce time resources among the staff. The most significant negative argument is that intense relations with industry might interfere with the service at the department. The problems that might arise from these connections are that projects often are demanded to be carried out instantly and it is possible that such projects risk requiring too much time and effort from the teachers.

“Role overload” has been defined as the overburdening of tasks, which can lead to the breakdown of functioning. Several resolutions of this dilemma of role performance are possible such as 1. Pretense to
meet formal requirements, 2. Concentrating on one aspect to the exclusion of others, 3. Integrating tasks so that performance serves multiple functions at one and the same time and, 4. Giving up and leaving the role altogether. Alternatively, a low-level state of tension may persist, with continuing time conflicts.

The Impact of the Third Mission on Education

The “third mission expands the educational mission of the university from an internal student population to people outside of the university, with varying educational backgrounds and interests. It also presumes to bring the student population into closer contact with the external world as part of their university education. However, a time conflict is expected as a result of this expanded educational mission. On the one hand, the regular students are assumed to benefit from closer connections through better and reality-adjusted education and get increased opportunities to work with real world oriented problems. It is also expected that education and popular-oriented information conflict because the burden of work will be too large.

In general, students are believed to gain from expanded relations, at the undergraduate as well as at the postgraduate level. An implication of the Third mission is a better climate for contacts, and increased prospects for interesting final papers. In addition, it might imply increased possibilities for students to achieve lucrative employment in the future. The thought that, “The college has much to gain when it comes to the recruitment of competent people from the outside. The best teachers are often those with experience from relations with the industry” was a common theme.

Close links with industry had a positive effect on teaching, student recruitment, fund raising and students’ employment chances. A respondent at a leading research university held that, “…The best teachers are those who are involved in relations with the industry.” At another university it was said that, “The students respond enthusiastically to outward connections. They experience good relations with the industry, at least in our discipline, physics.” In general, increased relations are also expected to aid students. It is easier to gather external funds and the education will be improved through closer contacts with potential employers. The students are also able to establish valuable contacts during their learning period and create networks. However, it was felt that the negative aspect is that the staff probably will face difficulties in how to spend their already scarce time.

Impact of Third Mission on Research

The third mission also expands the research role of the university, with mixed positive and negative effects, according to the respondents. Balancing the time difficulties, it is often held that useful contacts may
create long run effects and provide for a research based on real problems, suited for real conditions. It also widens the skill of the teachers and creates additional money, which is important to the development of other fields of research.

One positive effect of extended relations is that the close links to reality brings the research to a new level. However, there is a risk that the research activity will be forced into certain directions, and this is the case for education as well. Projects initiated by the industry are not always particularly stimulating to work with. Moreover, The Third Mission may also compete with fundamental research, which then will suffer a loss.

Involvement in Firms

For many, if not most, Swedish academics, interaction with firms when it occurs at all takes place through their regular academic role. The usual relations involve transferring different inquiries to people that are suited for answering them and dealing with matters concerning students. Ph.D. students are expected to gain from co-operation with the industry due to larger networks, while students at the undergraduate level probably remains rather unaffected. A large share of technological university respondents have private relations with enterprises, but most of them are in contact through their duties only. These connections are often established on the personal level and through involvement in different research teams.

The positive aspect of this engagement with economic life involves deeper knowledge about more effective methods of research for the staff, increased understanding in how companies work and the possibility to apply theoretical knowledge. The negative impacts are less accentuated but involve a fear for that such company relations may threaten academic freedom. Thus, “Connections outside the university are both essential and positive. But there may be a risk that the academic freedom will become violated if the companies get too much influence.” The negative part relates to increased lack of independence and the risk that researchers will become too narrow-minded in their activity. A small fraction even finds this subject uncomfortable to talk about.

A minority of the respondents has some kind of business on their own. Swedish constrictions on the professorial role have largely limited professorial firms to part/time one persons consulting operations. Swedish academics are going to keep their external involvement on the level of a consulting activity because to go further they have to make a decision to leave and few want to do that. This partly explains conflict of time since firms are dependent upon the efforts of a single person. The traditional Swedish academic model makes it difficult to revise procedures for academic leave to allow professors to organize firms as has become commonplace in the u.s.
Critical Mass

On the one hand, 85% of Swedish non-military research is conducted in universities. Individual professors who, even with their students, seldom constitute a critical mass carry out most of this research. The accepted justification for academic expansion traditionally led universities to establish new professorships in areas that were distinctly different from existing appointments, reducing the possibility of a viable concentration of research strength, a necessary, if not sufficient condition, for industrial linkage.

The converse of the critical mass issue is the center/periphery dilemma. As the future is increasingly high-tech, there is a need to spread educational resources to local areas that previously lacked institutions of higher education in order to include heretofore-excluded segments of the population. It is also expected that some these new universities will help improve the technological level of local industries or even be the source of new companies. On the other hand, to compete internationally, it is necessary to develop a “critical mass” of scientists and engineers in key areas. This would seem to mandate a strategy of concentrating resources at the country’s historic elite institutions.

Among the new university colleges, established to distribute higher education across the country, two strategies of institution building can be identified. Not surprisingly, one is to emulate the existing universities and seek academic excellence in their image. The goal is to create a university defined in terms of breadth, representing the entire disciplinary landscape.

An alternative strategy is to concentrate resources and make bets on a few areas, typically multi-disciplinary in focus and relevant to local industries. In both cases the new universities are built-up by merging smaller higher education institutions, such as schools of “caring science,” social work, restaurant and culinary arts, more or less, amalgamating whatever is available in the region. Often there are problems of fit between the fields in which these universities currently offer and intended future direction, irrespective of whether a strategy of “status emulation” or “industrial relevance” is pursued.

A way out of this dilemma lies in the strategy of the Karolinska Institute, a medical university that is pursuing a strategy of forming networks with other biology and medically related departments in a large region of the country extending out from Stockholm. Some new hires will be “network professors, jointly employed by more than one university, in order to help create a critical mass through linkages.

Second Axis: The Third Mission as the Capitalization of Knowledge

Sweden pays for approximately one per cent of the world’s total expenses in research and development (R&D). The country has held a leading position in terms of amount GDP invested compared to other
countries. This rather delicate situation is however expected to change over the next years and the Swedish research society now faces some difficult structural problems.

First, a large share of the Swedish R&D expenses are financed by the private sector, represented by large companies of international character. There is a substantial risk that parts of this research will be moved to foreign countries, for various reasons. The present merger between the Swedish pharmaceutical company Astra and its British counterpart Zeneca constitutes an example of this kind of development. Another familiar example is the merger between Pharmacia and Upjohn, also in the medical sector, which took place last year.

Second, the Swedish military industry has also contributed to a large share of total R&D. These figures are expected to decrease since the development of JAS39-Gripen (the new high-tech fighter aircraft) determines, together with the fact that the defence budget faces a substantial cut-down.

The Effect of Firm Size and Type on Relations with Universities

Swedish universities interact with all different sizes of enterprises but a majority of the connections are with firms of large or medium size, both private and public. The typical partner for co-operative actions are domestic enterprise of large and medium size. Small firms are in general not able to make use for the specialised knowledge and may not provide for projects of satisfactory interest.

Generally speaking, small firms are only interesting for collaboration if highly specialized. It is sometimes said that small firms seem to show lack of routine and are more skeptical to co-operation with the university. On the other hand, a respondent held that, “Large companies are hard to work with. Their organization is slow and circumstantial.”

Nevertheless, co-operation between industry and university faces a strong demand from both sides. A majority of the researchers believe that firms demand intense relations and show a strong need for up-to-date knowledge. An administrator said that, “We have connections with small as well as large private enterprises, and our co-operation with foreign firms is rather large.” There is no typical pattern for making these connections, the flow runs in both directions.

Loss of Personnel

There are mixed feelings about the opening to industry with regard to attraction and retention of faculty. On the one hand, some view industry as a source of teachers with real world experience while others fear the loss of existing faculty members to industry, given the availability of higher salaries that universities cannot match. The only negative
aspect is that the industry always gets a grip of the best resources, such as skilled personal, equipment and housing.

Computer science is a discipline, closely related to industry, but with significant opposition to the third mission. As they move closer to industry, their people are hired away. They wish to distance themselves more from industry in order to preserve academia. At a minimum, computer science departments want a change in the way that salaries are established in universities but they have no authority over that decision. This is an area in which a decision by the state is a constraint within which they operate.

The Disposition of Intellectual Property Rights

Sweden is in a pre Bayh-Dole condition of largely dormant academic research resources with commercial potential. At the Karolinska Institute, legal rights to potential discoveries were considered a minor problem, although there is an awareness that intellectual property rights emanate from research. Thus, one respondent said that, “Before entering a specific project you have to work out the details in advance. A potential difficulty that might arise relates to projects that involve several researches as a team.” A recurrent opinion is that the Swedish system for patents is rather blurred compared to the regulations in the US. A respondent said, “…my experience from the US gives me the impression that the Swedish policy for the legal rights to scientific findings sometimes feels lose and indistinct.”

As a respondent at the KTH put it, “Our way to handle patents creates problems when is confronted to international practice.”

On the other hand, at the Karolinska Institute, a majority of the respondents are fairly satisfied with the rules concerning the legal rights to research findings. There is a similar response at the KTH, a leading technological university, where almost all respondents agree upon the current patent system which gives the researchers exclusive rights to their findings. This matter has not been brought up to any debate and people seem to take this arrangement for granted. The faculty members at a new university concurred.

The general opinion is that the terms for patents are very generous, but that it is a juridical question beyond discussion. However, a large share claims that they never get in touch with such matters.

Nevertheless, a share of the staff interviewed are familiar with discussions concerning patents. The discussions are usually concentrated on the jurisdiction surrounding patents. Today problems might arise if a team of many researchers wants to share a patent. In general, it is considered to be too difficult and expensive to apply for the legal rights. A typical opinion is that, “There is a trade-off between patents and the ability to publish scientific results, which works as a dampening factor for potential growth. No one wants secret science.” The ability to combine both goals by the introduction of an administrative office to patent in a
timely fashion, thus not interfering with normal publication practices, is at an early stage of development in Swedish universities.

Since the disposition of intellectual property rights to academic research is legally tied to the principles of Swedish academic freedom, a change in the legal framework governing academic intellectual property is difficult to achieve. Informal transfer can work but with the absence of a central office, there is no search mechanism to find who is the best user of intellectual property. Without a formal evaluation mechanism to mediate between the discoverer and a range of potential end users, a potential piece of intellectual property may not find its appropriate home when an informal connection between the inventor and a relevant firm is lacking.

This situation arose as an unintended consequence of the 1949 law guaranteeing academic freedom, placing intellectual property rights emanating from their research entirely in the hands of faculty members. Swedish policy differs from the U.S. since the individual researcher gets the patent on her own, instead of the university or the department. Swedish universities had little incentive to become involved in technology transfer although some government subsidies exist to help them establish technology-transfer offices.

Since most professors have little interest in commercializing their rights, or naively presume that discovery should somehow automatically produce rewards, relatively little use is made of these rights.

Informal versus “Embedded” Technology Transfer

There are two types of technology transfer: informal transfer, through personal connections and, “embedded transfer”, through an organizational mechanism established for that purpose. Swedish Industry is felt to favor the informal approach. Thus, an academic said that, “Industry is very keen on close relations, but these matters are best handled between special persons, on first name basis. A central unit for external relations is highly overrated.”

Not surprisingly, in academic systems, such as Sweden and Japan, where intellectual property rights are left with individual professors, informal connections to enterprises are preferred over university technology transfer offices.” It is commonplace to transfer technology through personal connections between people in two institutions. For example, a respondent at Örebro said that, “Private contacts are definitely viewed as the best source to development…” Most of the relations are based upon private connections and firms usually make contact with acquaintances within the university.

This system works well when there is an interest on the part of the firm. However, if a fit is not found, the lack of a formal “search mechanism” to identify alternative partners can leave the innovation as an orphan, without take-up (Kneller, 1999). Lacking such connections or if the people at the intended receiving end don’t need the technology, then very often, nothing happens. Given these limitations of the infor-
mal process, all schools have created some kind of unit for interacting with industry. Although these have taken various forms, their functions are often limited since the individual professor, rather than the academic institution, controls the disposition of intellectual property rights.

The Emergence of Academic Entrepreneurship

The start-up venture capital model of knowledge-based economic development predominates in the U.S whereas a “learning model” based upon applying new technology to existing businesses is dominant in Europe. This different emphasis in growing the knowledge economy in the U.S. and Europe is reflected in government policies and programs. In the U.S., the emphasis on encouraging start-up firms and this is reflected in government policy and programs such as SBIR.

In Europe, the emphasis is on upgrading existing firms through the infusion of new technology, often aided by consulting firms and government programs. Nevertheless, considerable convergence can be discerned in recent years, exemplified by the growth of NASDAQ like financial markets in Europe and government programs to upgrade the technology of low and mid-tech industries in the U.S.

In recent years, the U.S has established programs such as the Manufacturing Extension Program (MEP) oriented to upgrading the technology of older mid-tech firms. Local units around the country assist small and medium sized manufacturing firms to upgrade their technology and improve their organizational practices, through subsidized consultation. On the other hand, the start-up phenomenon is taking hold in various European countries, often led by European academic and business persons with U.S. experience, for example, as a visiting Professor at Stanford or as a participant in a Silicon Valley start-up.

On return to Europe, these individual sometimes attempt to create organizational innovations to create the climate for firm-formation. For example, a biologist at Helsinki University with experience in a biotech firm in California organized a course to introduce students to entrepreneurship. A former official of Philips, with similar U.S. experience, started a technology incubator, with Dutch government support. This individual has been named the first Professor of Entrepreneurship at Twente University to infuse the entrepreneurial paradigm into the student body (Red Herring, 2000).

Increasingly, in the U.S. Europe and elsewhere, an entrepreneurial university, integrating, teaching, research and economic development is a common element in the development of knowledge-based regional economic growth (Etzkowitz et. al. 2000). In the U.S. the entrepreneurial university engaged in economic development is an overlay on an academic entrepreneurial system where universities and researchers search for research resources. This established an entrepreneurial substrate in the Research University that was available to build upon when eco-
economic development issues became salient to a broader range of universities.

Toward Mode 3

The international reception of concepts of knowledge based economic growth varies according to two main and related factors: (1) the extent of universities and other public or private research capabilities and (2) willingness to translate intellectual property capabilities into economic activities. A large amount of research resources is only a potential indicator of receptivity since in many instances researchers are not interested or may even be actively opposed to utilizing research resources to promote economic development.

Nevertheless, a secular trend can be identified of a shift in attitude and behavior from viewing research resources as divided into two separate categories: one dedicated to theory and the other to practice (sometimes defined as mode One and mode two) (Gibbons et. al 1994) to a synthetic view of research objectives and outcomes which sees the possibility of attaining both objectives simultaneously (mode 3).

MIT was founded according to this synthetic mode 3 principle in the mid-19th century and began to realize this goal early in the twentieth century, once resources were attained to begin the pursuit of research (Etzkowitz, In Press). For example, Physicist Van der Graaf was attracted to MIT from Princeton in the 1930’s to pursue theoretical objectives and the practical implications of their research at one and the same time. Since such researchers were best known for their publications, their interest in patenting and in pursuing the industrial applications of their work was not readily apparent.

Once mechanisms, such as the venture capital firm, were put in place after the Second World War, to assist the capitalization of research, academic research projects, and the intellectual property rights associated with them, became a source of firm-formation. The entrepreneurial university, originated at MIT, and then transferred to Stanford, was a minority model in the U.S. research university system.

The dual view of research, encapsulated in a relatively small number of universities in the US spread rapidly after the founding of Genentech encouraged researchers in molecular biology to consider the practical as well as theoretical implications of their discoveries. Nobelists James Watson, Joshua Lederberg and Arthur Kornberg, as well as less known figures, pursued the economic implications of their research, both personally and on behalf of their institutions. For example, Watson's Cold Spring Harbor Laboratory, with support from New York State's Economic Development Corporation is completing construction of a multi-million dollar incubator facility. Firms will be established on the basis of Cold Spring Harbor research locally, rather than having intellectual property rights licensed to companies in other parts of the country.
The Changing Role of the Swedish University

European universities are often in the situation of establishing a liaison office to link with industry while simultaneously attempting to build a research base at institutions traditionally devoted to teaching. With most research conducted in Institutes in France and Italy, and much in Germany, Sweden is an exceptional case in having early-integrated research into the academic structure and mission.

Nevertheless, the introduction of an explicit third mission has introduced strains among the older universities and emerging regional colleges and led to a debate over the purpose of the university. One thesis is to strengthen and maintain the older foundations as centers of basic research. Another is to support the development of regional colleges as foci of applied research oriented to local economies (Sorlin and 2000).

Paradoxically, the separation between basic and applied research appears to be reinforced by the introduction of the third mission as an explicit task. Indeed, some leading academics strongly feel that basic research has been downgraded as a result of funding shifts. There is little evidence to date of the appearance of a new synthesis in which dual goals of fundamental advance and practical relevance are believed to support each other. When and if such a synthesis arises, many of the contradictions between different academic missions that are now strongly felt should abate.

On the one hand, 85% of Swedish non-military research is conducted in universities; on the other, individual professors who, even with their students, seldom constitute a critical mass carry out most of this research. The accepted justification for academic expansion traditionally led universities to establish new professorships in areas that were distinctly different from existing appointments, reducing the possibility of a viable concentration of research strength, a necessary, if not sufficient condition, for industrial linkage.

Another problem in stimulating academic-industry relations arose as an unintended consequence of the 1949 law guaranteeing academic freedom, placing intellectual property rights emanating from their research entirely in the hands of faculty members. Swedish universities had little incentive to become involved in technology transfer although some government subsidies exist to help them establish tech-transfer offices. Since most professors have little interest in commercializing their rights, or naively presume that discovery should somehow automatically produce rewards, relatively little use was made of these rights.

Sweden is in a pre Bayh-Dole condition of largely dormant academic research resources with commercial potential. Since the disposition of intellectual property rights to academic research is legally tied to the principles of Swedish academic freedom, a change in the legal framework governing academic intellectual property would be difficult, if not impossible, to achieve.

Research 2000 proposes a slight alteration in the paragraph of law concerning higher education in Sweden. The universities three missions ought to get a more distinct design, where the Third mission is reduced to include information to society alone. The universities will be
responsible for preserving scientific findings and make sure that they becomes suited for practical use. In brief, this implies that relations focused on the industry and economic life will be given a new meaning. Research directed towards commercial innovations will no longer receive financial backup from the universities basic share of funds, which places new restrictions upon the firms involved. Thus, projects directed by firms must get proper financial guaranties from the beginning until the end.

As government support for research becomes more stringent and military requirements for science recede, economic contributions become the basis for a restructuring of the academic enterprise. The growth strategy for many emerging research universities is to determine areas of regional need where corresponding local government and industrial sources of support can be identified as an initial step to making faculty members credible competitors for research council funds.

In any event, the Humboldtian paradigm, based on an elite model of higher education, has been superceded, not only by the massification of higher education, but though the incorporation of a variety of entrepreneurial elements in academic practice. Even though traditional academic ideology often lags substantive organizational change, an expanded role for the university in regional and national economic and social development is underway in the U.S. and Sweden. The two cases illustrate the importance of making a local analysis the basis for filling gaps in regional innovation environments.

The formation of tri-lateral networks and hybrid organizations represent the pre-conditions for creating a dynamic trajectory of knowledge-based economic growth, as opposed to the construction of a Science Park, road, bridge, tunnel or even a campus. These latter tactics are secondary and only become actualized as regional innovation forces when they are embedded in the networks discussed above. In the network model of innovation, new sources of economic growth arise from those interactions (Castells, 1989).
Beyond Humboldt: Emergence of Academic Entrepreneurship in the U.S. and Sweden
References


Documents


Högskolan Örebro [1997], “Högskolans tredje uppgift”, Wellins tryckeri AB, Örebro. (in Swedish)


Kungl tekniska högskolan [1997], “Patentpolicy”, Stockholm. (in Swedish)

Linköpings universitet [1999], “Linköpings universitet i samverkan med det omkringliggande samhället –ett handlingsprogram”, Linköping. (in Swedish)

Person- och adresskataloger för universiteten och högskolorna [1998]. (in Swedish)

Umeå universitet [1998], “Umeå universitet och den tredje uppgiften”, Umeå. (in Swedish)

Notes

Seventy-eight interviews were conducted at Umeå University (umu), The Technical University of Linköping (liu), Örebro University College (öh), The Royal School of Technology (kth), Karolinska Institutet (ki), Lund University (lu) and Karlskrona/Ronneby University College (rh). Our primary interest, concerning the level of suitability for outward relations, has been focused on the following actors: Department of Computer science, Department of Physics, Department of Biology together with representatives for administrative units. Further, the selected persons within the sample are drawn from the following populations: Heads of departments, Directors of studies and officials responsible for administrative issues.
1 Einar Holm och Ulf Wiberg (Red.), *Samhällseffekter av Umeå universitet*, 1995.
3 Jeanette Edblad, *The Political Economy of Regional Integration in Developing Countries*, 1996.