The Impact of Biomedical Research Funding on the Development of State and Local Economies

Literature Review

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Literature Review

Literature on Biomedical Research

Aerni Philipp, 2000. Public Policy Responses to Biotechnology. Center for International Development, Harvard University. Cambridge: Massachusetts.

The rapid evolution of the biotechnology industry in the last two decades is associated with hopes and fears regarding its impact on health and environment. In the face of a new and controversial technology, such as genetic engineering, public policy is confronted with different world views and scientific uncertainty. An appropriate regulatory system must consider scientific expertise regarding the risks and benefits involved as well as the public risk perception. The public perceives products derived from modern biotechnology to be very risky compared to conventional products. Scientists, in general, cannot find evidence for this assumption and emphasize the potential benefits of this technology for agriculture, health and environment.

Public confidence is necessary to improve communication between experts and the lay public in order to narrow this perception gap and to ensure a cost-effective and sustainable regulatory system. However, in the last few years, in particular in Europe, this confidence in regulatory agencies has been undermined because of several food scandals and the release of controversial publications regarding health risks. The lack of public confidence led to more polarization in the public biotechnology debate and hinders effective risk management and risk communication regarding biotechnology. This article investigates the reasons, which led to the increasing public opposition towards agricultural biotechnology in developed and developing countries, shows how public policy and the market are responding to the increasing opposition, and presents ways for policy-makers to handle the increasing difficulties.

Aries Nancy and Sclar Elliot ;1998. "The Economic Impact of Biomedical Research: A Case Study of Voluntary Institutions in the New York Metropolitan Region" in Journal of Health Politics, Policy and Law v23, n1 (February 1998): 175-93

Anderson Gerard F. et al.1989 Providing hospital services: The changing financial environment Johns Hopkins Studies in Health Care Finance and Administration, no. 2. Baltimore and London: Johns Hopkins University Press.

Examines the effects of new health care financing policies in the United States on four services: (1) complex health care; (2) clinical education; (3) biomedical research; and (4) uncompensated care. Examines factors contributing to higher costs in teaching hospitals, and presents empirical estimates showing the relative importance of each factor. Reviews the historical development of each of the four services. Describes the distribution of each service across hospitals, the cost of each service, and the current method of financing each service. Examines current methods of controlling the scope and level of services provided. For each service, develops a specific policy proposal related to funding, which considers cost of production, alternative funding sources, implication for the distribution of services, and the balance between public and private control.

Audretsch, David B. The Role of Small Firms in U.S. Biotechnology Clusters in Small Business Economics v17, n1-2 (Aug.-Sept. 2001): 3-15

The biotechnology industry poses a particular challenge to analysis because its origins were poorly understood or even noticed at the time. The purpose of this paper is to examine and make sense of recent developments in the U.S. biotechnology industry. The pioneers and subsequent followers in biotechnology came from other fields. They altered their career trajectories in sciences like genetics and medical research to enter an unknown and undefined field, which only subsequently became labeled as biotechnology. Those regions exhibiting the greatest success in developing biotechnology clusters also possessed the greatest ability to unleash the potential commercialization latent in those scientists. To generate a successful regional cluster, the existence of world class scientific talent is a necessary condition. However, it is not a sufficient condition. The ancillary or complementary factors must also be available to translate this knowledge into a commercialized product. The complementary factors include the presence of venture capital and other forms of finance, the existence of an entrepreneurial culture, and transparent and minimal regulations fostering the start-up and growth processes

Audretsch, David B. ; Stephan, Paula E. 2000. How and Why Does Knowledge Spill Over? The Case of Biotechnology Center for Economic Policy Research Discussion Paper: 1991

This paper sheds light on the questions, Why does knowledge spill over? and How does knowledge spill over? The answer to these questions lies in the incentives confronting scientists to appropriate the expected value of their knowledge considered in the context of their path-dependent career trajectories. In particular, we focus on the ability of scientists to appropriate the value of their knowledge embedded in their human capital along with the incentive structure influencing it and how scientists choose to commercialize their knowledge. We use a hazard model to estimate the duration over a scientist's career to starting a new biotechnology firm. We conclude that the spillover of knowledge from the source creating it, such as a university, research institute, or industrial corporation, to a new-firm start-up facilitates the appropriation of knowledge for the individual scientist(s) but not necessarily for the organization creating that knowledge.

Austin, David. 1993. "An Event Study Approach to Measuring Innovative Output: The case of Biotechnology" in The American Economic Review, Vol. 83, No. 2, Papers and Proceedings of the Hundred and Fifth Annual Meeting of the American Economic Association. (May, 1993), pp. 253-258.

The paper estimates the private value of patents and the effect of selected patents on rival firms. Estimates of patent values are used to weigh raw patent counts enhancing the usefulness as indicators of innovative output. Estimates of R & D productivity for which patent statistics are a key source of data. Event study data allows the analysis of single events. The paper uses a Capital Asset Pricing Model to estimate the effect of a firm value on a patent event**.**

Beyers William and Nelson Peter. 1998. The Economic Impact of Technology Based Industries in Washington State in 1997. Seattle WA: Technology Alliance 1998.

Book, Robert. 2002. Public Research Funding and Private Innovation: The Case of the Pharmaceutical Industry. Graduate School of Business, University of Chicago.

The United States has an extensive system of government funding of basic research. The stated rationale for this policy is that due to inappropriability, the private sector provides sub-optimal levels of basic research, and government subsidy of basic research is thought to correct this under provision. In addition, it is likely that higher levels of basic research, whatever the source of funding, stimulate higher levels of private applied research by increasing the stock of scientific knowledge. On the other hand, it is also possible that government funding of basic research \crowds out" private basic research by reducing its private returns.

This effect may mitigate or even reverse the former effect, so that government funding of basic research may stimulate less, and in the extreme case may even reduce, the level of private applied research.

This paper uses data on public and private funding of biomedical research to study the effect of government research funding on private-sector research and development (R&D) expenditures and new product development in the pharmaceutical industry. The main finding is that increases in government research funding appear to crowd out private R&D for approximately the first four years, and then stimulate private research starting in the fifth year after the increase. A reasonable interpretation is that the direct effect of government funding is to crowd out private basic research in the short run, and stimulate private applied research in the long run. The crowding out (substitution) is more pronounced when expenditure levels are measured in constant dollars according the Biomedical Research and Development Price Index (BRDPI), rather than current dollars or constant dollars according to the GDP deflator.

Burkhardt, Jeffrey 2002. Biotechnology's Future Benefits: Prediction or Promise? AgBioForum v5, n1 (2002): 20-24

Much current research and development (R&D) in agricultural biotechnology is focused on the so-called "next generation" of biotech. There is an assumption that this work is ethically justifiable because the expected outcomes are ethically sound. However, people in the agricultural biotechnology enterprise must prove that the "promise of biotechnology" justifies their efforts.

Burton, Mark, Hicks Michael and Puttaiah Asha 2002. "Biotechnology Research: Regional Growth Through Technology Transfer" in The Regional Economic Review : A Quarterly Report from the Marshall University's Center for Business and Economic Research Summer 2002.

This study deals with the biotechnology industry in West Virginia. It explores the different companies/ firms that constitute the sector and assesses the need for an increased support from federal agencies and from the public sector for greater support from the biotechnology industry. The specific country that is being studied here is the Hampshire Country

Candell Amy and Jaffe Adam. 1999. The Regional Economic Impact of Public Research Funding: A Case Study of Massachusetts. Industrializing knowledge: University-industry linkages in Japan and the United States (1999): 510-30 Cambridge and London: MIT Press

Carstensen, Fred, Parr Kathryn and Corona Joel. 2000. The Economic Impact of Continuing Operations of the University of Connecticut Health Center. Connecticut Center for Economic Analysis: Storrs

The University of Connecticut Health Center is both an educational institution and a treatment center. Consisting of John Dempsey Hospital, UConn Medical Group and Dentists, Connecticut Internal Medicine Associates, the School of Medicine, and the School of Dental Medicine, the Health Center provides medical treatment, trains qualified physicians, dentists, and scientists, supports medical research, and disseminates medical information. Through these activities, the Health Center directly impacts the Connecticut economy by providing employment and wages, making direct purchases from other state businesses, increasing state population with both students and graduates, and generating tourism revenue from visitors to the Center.

The Center also serves an important public health function. As the only State sponsored public institution devoted to health care, the center is mandated to serve the public through outreach, education, health professional supply and retention, stimulation

and dissemination of research, and treatment without regard to ability to pay. Finally, the Center's research activities help increase general medical knowledge, which affects individual's health prospects nationwide, not just in Connecticut.

The University of Connecticut Health Center includes John Dempsey Hospital, UConn Medical Group and Dentists, UConn Internal Medicine Associates, the School of Medicine, and the School of Dental Medicine. The Center's original charter outlined a three- fold purpose, to serve: (1) as the State's center for training qualified physicians, dentists, and scientists; (2) as a center for research and (3) as a center providing treatment of medical problems and dissemination of medical information. Today, the Center offers graduate, postgraduate, and continuing education courses for scientists and health professionals, supports research projects in many different medical fields, supplies valuable public services, and provides medical care.

The Health Center has a strong impact on the overall quality of life and labor productivity in the State of Connecticut. The Center's research facilitates the growth of medical knowledge, and because of the synergies between research and cutting-edge treatments, the Center is able to provide a high level of health care and unique services not necessarily available at a non-research institution.

To estimate the impact of the Health Center, we use the REMI model, a dynamic input-output model of Connecticut and its eight counties. The REMI model measures the economy in its present form as a baseline. Because the University of Connecticut Health Center already exists in the baseline model, to single out the Health Center's contribution to the State economy, we remove it from the State economy and analyze how this affects both the local and state economies. Although this method of *removing* the Health Center generates negative effects on key economic variables, we represent these effects as positive numbers because they can conversely be interpreted as the positive impact of continuing operations. We also considered the fiscal effects of the Health Center.

Removing the Health Center from the baseline economy creates a government surplus because of the annual $98.8 million state appropriation to the Health Center. To balance the budget, we return the $98.8 million to the state in the form of a personal income tax cut. This reduction in taxes increases personal income, causing a cascade of changes in other economic variables through REMI models' inter-industry correlation matrices. Finally, to capture the local and statewide impact, this analysis considers two main geographic regions: Hartford County and the entire state of Connecticut.

Chassis 2002. " In Academy for Health Services Research and Berwick, Donald, "Implementing the 21st Century Health Care Health Policy Annual Research Meeting Washington DC, 2002.

This keynote speaker presented data and analysis to address reform needed to deal with both the efficiency and equity of the American health care delivery system. Framed as a response to the Institute of Medicine's "Quality Chasm" report, several appropriate--and researchable--public policy questions were developed regarding cost containment,

while enhancing quality. This presentation suggested that health care reform would require a "big bang" approach rather than the policy of incremental changes currently enacted by policy makers.

Cockburn Iain and Henderson Rebecca 1997 Public-Private Interaction and the Productivity of Pharmaceutical Research. National Bureau of Economic Research Working Paper: 6018

The authors examine the impact of publicly funded biomedical research on the in-house research of the for-profit pharmaceutical industry. Qualitative analysis of the history of the discovery and development of a sample of 21 significant drugs, and a program of interviews with senior managers and scientists reveals a complex and often bi-directional relationship between the public and private sectors of the industry, illustrating the difficulties inherent in estimating the rate of return to public support of basic research. This analysis also highlights the importance for private sector firms of maintaining close connections to the "upstream" scientific community, which requires them to make significant investments in doing in-house basic research and adopting appropriate internal incentives and procedures. The authors measure the extent and nature of this "connectedness" using data on coauthorship of scientific papers between pharmaceutical company scientists and publicly funded researchers. These measures are significantly correlated with firms' internal organization

Cooper, Leisl M., Boyd Gilman, Geoffrey Joyce, and Stephen Soumerai 2002. "Financing New Technologies: Concepts and Challenges," In Academy for Health Services Research and Health Policy Annual Research Meeting Washington DC, 2002.

This panel discusses the results of a study, funded by CMS, which provided early and preliminary evidence that access to outpatient prescription drugs in a timely and consistent manner may result in substitution of pharmaceutical for non-drug medical care, particularly inpatient services. The analysis further suggested that a reduction in medical services among newly insured low-income beneficiaries may lower average Medicare expenditures for this population. Policy implications are that the net cost of a Medicare outpatient drug benefit targeted at low-income beneficiaries who lack coverage may be less than previously estimated if access to outpatient drugs lowers the use of other Medicare-covered services.

Goldfarb, B. The Effect of Government Contracting On Academic Research. SIEPR Discussion Paper No. 00-24. Stanford, California, U.S.A.: Stanford Institute for Economic Policy Research, Stanford University.

Health & Bioscience as an Engine of Economic Growth: Selected Case Studies, Implications for Rochester, New York
(http://www.cgr.org/areas_of_impact/economic/#1033668521.02)

An economic impact analysis for the University of Rochester Medical Center. The market for health services and bioscience products (particularly pharmaceuticals) is exploding. New drugs and therapies make it possible to address physical conditions that would have been left untreated only a few years before; dramatic new discoveries have increased lifespan and improved quality of life. Furthermore, the pace of innovation in life science continues to accelerate. This industry can contribute significantly to the economic growth and prosperity of metropolitan economies. CGR examines the experience of six communities with large and expanding life science clusters—Houston, Raleigh-Durham-Chapel Hill, Rochester (MN), Pittsburgh, Cleveland and Birmingham.

Cooke, Philip 2002. Biotechnology Clusters as Regional, Sectoral Innovation Systems. International Regional Science Review v25, n1 (January 2002): 8-37

Today, knowledge economies area key asset for global competitiveness. Biotechnology is a knowledge-driven sector because it consists of knowledge working on knowledge to create value, decoding in genomics and proteomics being paradigmatic knowledge-based economic activity. Like many other new economy industries such as information and communications technology, new media, and advanced finance, firms cluster in proximity to knowledge sources. In the case of biotechnology, universities are key magnets. But to transfer science from the laboratory bench to the market involves complex, interactive chains of transactions among scientists, entrepreneurs, and various intermediaries. Chief among the latter are investors and lawyers. Proximity to such services and, in biotechnology, research hospitals for clinical trials creates an innovation system. This is best analyzed regionally and locally. This article anatomizes the functioning of regional sectoral innovation systems in Germany Cambridge, Massachusetts, and Cambridge, U.K.

Cooke, Philip. 2002. Regional Innovation Systems: General Findings and Some New Evidence from Biotechnology Clusters. Journal of Technology Transfer v27, n1 (January 2002): 133-45

This paper focuses on interactive innovation. It starts by operationalizing Regional Innovation in the context of multi-level governance. It shows how regional and external innovation interaction among firms and other innovation organizations is important for regional innovation potential. The ability to access and use funding for innovation support for regional firms and organizations is crucial for regional innovation promotion. Equity investment funding is more important than public funding, which tends to be cautious and otherwise risk avoiding, except in circumstances of market arrest or failure

to develop. Regional systems of innovation are broader than single sectors or clusters but some of these will be strategically privileged recipients of policy support because of their growth performance or potential, rather than, as in the past, their uncompetitiveness. The paper devotes space to exploring biotechnology clustering from a regional innovation systems viewpoint, as an instance of rather strong sectoral, regional innovation systems capabilities, though integrated also to global knowledge supply and markets. Illustration is provided of the way such sectoral innovation systems work at local regional level by reference to cases from Cambridge, Massachusetts and Cambridge, England.

Cooper, Leisl M., Boyd Gilman, Geoffrey Joyce, and Stephen Soumerai. 2002. "Financing New Technologies: Concepts and Challenges," In Academy for Health Services Research and Health Policy Annual Research Meeting Washington DC, 2002.

This panel discusses the results of a study, funded by CMS, which provided early and preliminary evidence that access to outpatient prescription drugs in a timely and consistent manner may result in substitution of pharmaceutical for non-drug medical care, particularly inpatient services. The analysis further suggested that a reduction in medical services among newly insured low-income beneficiaries may lower average Medicare expenditures for this population. Policy implications are that the net cost of a Medicare outpatient drug benefit targeted at low-income beneficiaries who lack coverage may be less than previously estimated if access to outpatient drugs lowers the use of other Medicare-covered services.

CURE 2000. Fifth Annual Economic Report: Connecticut's Bioscience Cluster, April 2002. (http://www.yale.edu/ocr/indust_studies/docs/cure_report_2000.pdf)

This report talks about the government's initiative in helping to bring a cluster of firms together to compete and help growth in the regional economy. The initiatives have brought about a substantial impact with the government's attempt to create a cluster, state support for biomedical activity including the creation of a facility, supportive tax benefits and future planning to assist private and academic sectors. The report indicates that in 1999, the jobs created through R and D surpassed expectations, and helped increase the amount that has been invested in research. The report looks at four pharmaceutical firms, and how much they have spent on research including a scorecard that talks about the economic activity for the biotechnology companies, pharmaceutical companies and academic institutions. Since the creation of the cluster, the R and D expenditure has increased by 75% and the employees have risen by 42%. This cluster model is being described as a national model. The report also talks about the ripple effects in the economy including improvements in the job situation, improvements in the real estate and finance of the state and in the transportation sections. The report also points to an increasing rise in job creation- most of which are not in the biomedical sector.

Case Study of Spokane and Inland Northwest.
http://www.spokane.wsu.edu/News&Events/docs/SpokaneBiomedical_RecommendationsforAction.doc

This case study explores the potential for growth of Spokane and Inland Northwest for the local economy. The region currently benefits from several key assets:
It has an existing academic biomedical and life sciences research base, centered at Washington State University (WSU) and the University of Idaho, but also comprising other institutions of note, such as Eastern Washington University and Pacific Northwest National Labs (PNNL). It is home to two significant tertiary healthcare systems, providing clinical care and diagnostics at a scale and sophistication that few other regions of this population density possess. These systems have a super-regional, multi-state reach. It is home to a small, but growing, cluster of medical technology, instrumentation, device, and pharmaceutical and biotechnology companies.

The paper looks at specifically at the case of Spokane and Inland as case studies of research and development. Looks at their contributions to the local economy and constraints faced by them and how to improve them

Connolly, Laura S. "Does External Funding of Academic Research Crowd Out Institutional Support?" in Journal of Public Economics v64, n3 (June 1997): 389-406

Nonprofit organizations receive revenues from a variety of sources. The amount of support provided by each source is often dependent on the level supplied by the other(s). Empirical evidence regarding crowding out among alternative sources of revenue in nonprofit organizations is mixed, but most studies find that an increase in funding from one of the sources tends to decrease contributions from the other(s). This paper investigates the relationship between internal and external funding of academic research. I find evidence that there is not crowding out in this case. Instead, additional funding from each of these sources enhances the amount provided by the other over time. This is consistent with the hypothesis that external sponsors wish to allocate funding to those universities that do the highest quality research, and that funding from either source provides information about quality. The results of this study also imply that a one-time change in funding from one source has a multiplier effect on subsequent levels of both sources. The potential for feedback effects is usually ignored in studies of this type, meaning that the total impact of funding changes may often be understated. This suggests that relatively small decreases in academic research funding can have a larger-than-anticipated effect that may persist for many years. The presence of feedback effects also indicates that existing models of nonprofit behavior, which are primarily static, need to be modified to incorporate a dynamic structure.

Daniel, Janet B. 2001. An Economic Analysis of the Allocation of Research Funding at the National Institutes of Health Dissertation of a Doctoral Student from Louisiana State University

Delaney, Edward J.1993. Technology Search and Firm Bounds in Biotechnology: New Firms as Agents of Change. Growth and Change v24, n2 (Spring 1993): 206-28

Eastaugh, Steven R. 1990. "Financing the Correct Rate of Growth of Medical Technology" in Quarterly Review of Economics and Business v30, n4 (Winter 1990): 54-60

This article suggests ways to preserve innovation while partially restraining the impressive growth rate in new medical technology. Health care will soon consume 12 percent of GNP. There is a wide range of opinions as to whether medical technology is a major source of rising health care expenditures. Given our current fiscal problems, health care providers will be in direct competition with education and other domestic programs for a limited supply of R&D funds. More funding will have to come from the private sector. The challenge for prudent buyers of health care services is to control costs without eroding the biomedical capacity of the nation.

Ernst and Young 2000. The Economic Contributions of the Biotechnology Industry in the US Economy. Summary prepared for the Biotechnology Industry Organization by Ernst and Young Economics Consulting and Quantitative Analysis Group.

The report was written to see how the biotechnology industry has growth between 1993 and 1999 and the financial contributions made by the companies in the US, revenues collected federal, state and local governments. The analysis includes contributions made by publicly traded and private companies and the agricultural biotechnology sector. The report includes direct and induced impacts of the biotechnology sector. The report includes data for every state, a brief history about the biotechnology industry in that area, financing available to that state excluding federal funding, the organizations that support the industry in each state, the specific tax and regulatory policies in each state that support the industry, regional initiatives and the business support initiatives launched in each state.

Feller, Irwin ; Ailes, Catherine P. ; Roessner, J. David 2002. Impacts of Research Universities on Technological Innovation in Industry: Evidence from Engineering Research Centers in Research Policy v31, n3 (March 2002): 457-74

NSF engineering research centers (ERCs) constitute the most upstream performer of R&D among university-industry-government research centers. Findings from surveys

and interviews with 355 firms participating in the 18 ERCs established between 1985 and 1990 indicate that firms participate primarily to gain access to upstream modes of knowledge rather than specific products and processes. Findings also point to problematic continuation of industrial support for ERCs following termination of NSF funding after reaching the maximum number of years (11) permitted under the program, and related pressures on ERCs to direct their research portfolios towards shorter-term, more applied research.

Funk, Mark. 2002. "Basic Research and International Spillovers" in International Review of Applied Economics v16, n2 (April 2002): 217-26

This paper discriminates between basic and developmental research when estimating international research spillovers between nine OECD nations. Using panel cointegration techniques, the estimates show that basic research generates much larger international spillovers than developmental research. Developmental research in turn appears more easily appropriated by the research performer, and thus has a stronger effect domestically. These results suggest growth models should incorporate the firm's choice between basic and developmental research. More importantly, since basic research receives a large proportion of its funding from public sources, the finding of large international spillovers from basic research suggests current public research policies should be reevaluated. The results support the argument in favor of increased international coordination of basic research policies.

Gardner, Kent 2002. Building a New Foundation: The University of Rochester Medical Center in the Regional Economy. Report Prepared by cgr.org Whiteplains: New York.

This is the study of the university hospital in the local economy and specifically the research component of the hospital. The report assesses some of the impacts of the hospital of the regional economy including the employment and services and the indirect impacts of the hospital that includes impacts on the real estate sector, insurance and financial sector. The research facility is a in-house research center that serves as an exporter – bringing money from outside of the community and preventing leakage of money from Rochester to Cleveland or New York. It generates quarter of a billion in direct and indirect payroll and allows for employment of a large number of educated people.

Gelijns, Annetine C. and Halm, Ethan A., eds. 1998. Medical Innovation at the Crossroads series, vol. 2. Washington, D.C.: National Academy Press

Ten papers, from an Institute of Medicine workshop held in December 1989, examine the process by which biomedical research is translated into actual benefits in medical practice, focusing on the economics of medical innovation in the United States,

Europe, and Japan. Essays examine the changing economics of technological innovation in medicine; the diffusion of new technologies; the changing economics of pharmaceutical research and development; public policy and access to new drugs; the impact of public policy on medical device innovation; the dynamics of medical device innovation; reimbursement and the dynamics of surgical procedure innovation; European policies and pharmaceutical innovation; medical device innovation and public policy in the EEC; and Japan's pharmaceutical industry

Gollaher David and Lefteroff Tracy. 2001. The Bioscience Industry in San Francisco: 25 Years of Achievement. A Report by PriceWaterHouse Coopers.

This report looks at the growth of the biotechnology sector in San Francisco. This was spurred by an investment made by a venture capitalist Robert Swanson and a scientist from UCSF named Herbert Boyer. They founded Genetech in 1976. This start of this company attracted a number of firms making San Francisco one of the leading biotechnology areas and areas of innovation in the country. These jobs have created a knowledge base generating knowledge-intensive jobs, generating tax revenues and spurring greater business activity. These high technology industries are the cornerstone for development in San Francisco. The local bioscience industry capitalizes on research development infrastructure, which is in place because of outstanding universities and federal research facilities. Five out the ten largest employers are biotechnology firms. There has been a building boom with growth in construction and with the biotechnology firms occupying some of the largest buildings in the country.

The report assesses some of the economic impacts of the biomedical industry, with the economic impact of funding and Genetech. Additionally it assesses the local business environment that promotes development of biotechnology.

Gray, Mia ; Parker, Eric. 1995. Industrial Change and Regional Development: The Case of the US Biotechnology and Pharmaceutical Industries. University of Cambridge, ESRC Centre for Business Research Working Papers: WP 95

The paper contributes to the debate over the location and organization of innovative firms, industry renewal and regional rejuvenation, by examining the effect of technological break-throughs in the US biotechnology industry on mature and emergent regions such as the North-East and California. Despite losing much of their pre-eminence in R&D, traditional pharmaceutical firms in the USA's mature regions have managed to "capture" much later-stage manufacturing and marketing. This reflects their competitive advantages over small new biotechnology firms in drug development experience, manufacturing capabilities, and marketing.

Guellec, Dominique ; van Pottelsberghe de la Potterie, Bruno "The Effectiveness of Public Policies in R&D" in Revue d'Economie Industrielle v0, n94 (1st Trimester 2001): 49-68

This paper investigates the effect of the major R&D policy instruments on business funded R&D expenditure. The analysis covers 17 OECD countries over the period 1981-96. It is found that government funding of R&D performed by business firms and tax relieves have a positive impact on privately financed R&D. The two policy tools are more effective when stable over time and are substitutes (increasing one of them reduces the impact of the other).

The impact of direct government funding is more long-lived than that of tax relieves. The stimulating effect of government funding varies with respect to its level relative to the level of business funded R&D it increases up to a threshold of about 14 per cent and decreases beyond. Research performed in public labs and universities seems to have a crowding out effect on private R&D. However, this effect of public R&D is mainly due to defence-oriented government funding, while civilian public research is neutral for business R&D.

Hall Brownyn <u>The Financing of Research and Development</u>. NBER Working Paper 8773.

Evidence on the 'funding gap' for R&D is surveyed. The focus is on financial market reasons for underinvestment in R&D that persist even in the absence of externality-induced underinvestment. The conclusions are that 1) small and new innovative firms experience high costs of capital that are only partly mitigated by the presence of venture capital; 2) evidence for high costs of R&D capital for large firms is mixed, although these firms do prefer internal funds for financing these investments; 3) there are limits to venture capital as a solution to the funding gap, especially in countries where public equity markets are not highly developed; and 4) further study of governmental seed capital and subsidy programs using quasi-experimental

Hasselmo, Neils and McKinnell Hank. <u>Working Together, Creating Knowledge: The University-Industry Research Collaboration Initiative</u>

Universities and companies in the United States have worked together to advance the frontiers of knowledge and incorporate that knowledge into new products, processes, and services since the Morrill Act of 1862 established the land-grant college system. For many years, how-ever, the results of university research were not always expeditiously transferred to private companies capable of translating advances into new products and services for customers. The Bayh-Dole Act of 1980 was passed to rectify this situation. Since the Act’s passage, the commercial environment has markedly changed.

The extraordinarily successful growth of the “new economy” has transformed the way business is performed and economic growth is generated, placing even more emphasis on the pursuit, development, and integration of new knowledge. In 1998, corporations sponsored nearly $2 billion in research at universities, or about 9 percent of all research performed at U.S. colleges and universities. Many local and state governments are also

pursuing the economic development benefits of industry-university partnerships. At the same time, concerns have been raised that these partnerships may threaten the integrity, objectivity, and core mission of academic research.

Research collaborations can offer direct benefits for university and company participants. Even when potential partners have the resources and knowledge to accomplish individual goals, working with outside experts can greatly improve the quality and comprehensiveness of the research and can help reduce its costs. Furthermore, many scientific advances are now occurring at the intersection of traditional fields. Industry-sponsored research also allows the university to obtain financial support for its educational and research missions, although the licensing of university technologies has not proven to be a substitute for federal research funding. Barriers to University-Corporate Research Collaborations Corporations and universities are not natural partners. Their cultures and their missions differ. Companies' underlying goals—and the prime responsibilities of top management—are to make a profit and build value for shareholders by serving customers. Universities' traditional missions are to develop new knowledge and educate the next generation. For the university, four factors can prevent research collaborations with industry from being established or successfully accomplished: the practical difficulties of negotiating and managing a collaboration; possible deleterious effects on faculty and students; possible impact on the mission, reputation, and financing of the university; and state or local officials' expectations of university contributions to regional economic development. Hurdles that companies must overcome to foster greater numbers of collaborations include respecting the value of research collaborations; incorporating university research into product development; and management barriers.

Herndon-King, Cinda and Richard Seline. 2000. Prospects for a Bioeconomy: The Biomedical Indistry and Regional Economic Development. November 2000.

Johnson Daniel and Mareva, Milena "It's a Small(er) World: The Role of Geography and Networks in Biotechnology Innovation" Wellesley College Working Paper submitted to Science, Technology and Innovation. Wellesley College: Massachusetts.

Using patent citation data for the U.S., we test whether knowledge spillovers in Biotechnologies are sensitive to distance. Controlling for self-citation by inventor, assignee and examiner, cohort-based regression analysis shows that spillovers are local but that distance is becoming less important with time. Network analysis paints a picture of a stable network between states, but a changing environment between individual actors, with a growing importance of connectedness. The popular maxim that everyone is connected by six degrees of separation is tested with surprising results.

The paper concludes that knowledge flows diminish with distance although this conclusion is receding over time. This has occurred with increasing importance on intra-firm, inter-personal and inter-city connections, the world has become smaller for biotechnology. Although there is electronic transmission of information on a very large

scale, the policy implications of the results of the paper are that geographic clustering innovation will be more expensive and harder if the innovation is farther from the research center. For lesser-developed regions, it might be better to license existing technology or to rent research space and hire researchers closer to the core then perform independent research operations. There is greater importance of communication is being stressed with the "core" The further the center from the core, the smaller the amount of knowledge diffusion unless there is a stronger communication link between the researcher, investor and other researchers.

Lichtenberg, Frank R. 1998. The Allocation of Publicly-Funded Biomedical Research. National Bureau of Economic Research Working Paper: 6601

The authors develop a simple theoretical model of the allocation of public biomedical research expenditure, and present some empirical evidence about the determinants of this allocation. The authors calculate distributions of government-funded biomedical research expenditure, by disease, from records of all research projects supported by the United States Public Health Service; to obtain a reasonably complete accounting of disease burden (indicative of the benefit of achieving advances against different diseases), they utilize data on both the dying and the living. They find a very strong positive relationship across diseases between total life-years lost before age 65 and public research and development expenditure. But the amount of publicly funded research on a disease decreases with the share of life-years before age 65 lost to the disease that are lost by non-whites. There tends to be more research about chronic conditions that are prevalent among people living in low-income households.

Landefeld, J. Steven 1984. Measuring the Returns to Biomedical Research: Issues and Problems. Pharmaceutical Economics: Papers Presented at the 6th Arne Ryde Symposium, Helsingborg, Sweden 1982 (1984): 255-86

Link Albert and Scott John 2001. Public/Private Partnerships: Stimulating Competition in a Dynamic Market in International Journal of Industrial Organization v19, n5 (April 2001): 763-94

This paper sets forth a public/private partnership competition policy that mitigates the appropriability problems associated with innovation that occur in a dynamic market when competitive pressures are present. We illustrate the applicability of our policy proposal using the results from an analysis of research projects jointly funded by the Advanced Technology Program (ATP) and the private partners. Our analysis illustrates that in the absence of ATP funding these projects would not have been undertaken by private-sector firms, and that the social rate of return from the projects is substantial. We also posit a mechanism whereby ATP, or any public agency, can partner with industry to ensure that its public funds are being efficiently allocated.

Kispert Robert 2001. Analysis of the Impact of FY 2001 Federal R and D Investment Scenarios on Economic Growth Update –FY 2001 Final Appropriates. Westborough MA: MIT Collaborative 2001

Kobayashi, Shin-ichi 2000. "Applying Audition Systems from the Performing Arts to R&D Funding Mechanisms: Quality Control in Collaboration among the Academic, Public, and Private Sectors in Japan" in Research Policy v29, n2 (February 2000): 181-92

The Japanese government has recently launched a number of new research funding schemes. We are already familiar with two types of funding mechanisms: non-targeted research funding channeled into the academic sector through a system of peer-review selection, and establishment of independent laboratories designed to meet specific demands in the manner frequently practiced by government laboratories and private firms. The government's new schemes are distinct from both these mechanisms. This paper examines how these schemes differ from their predecessors, and seeks to clarify them generally. In addition, an audition system, a third type of funding mechanism that addresses social needs by channeling research resources in university-industry-government networks, is introduced. This system centers on a producer who unites the sponsors and research community. Sponsors control the research funds devoted to social needs, and the research community contributes its research capabilities. Finally, the system attempts to harmonize social goals with the behavior patterns of researchers.

Mohr, Penny E., Curt Mueller, Peter Neumann, Sheila Franco, Meredith Milet, Laurie Silver, and Gail Wilensky 2001. The Impact of Medical Technology on Future Health Care Costs, Bethesda MD: Project Hope; Center for Health Affairs, 2001.

This report attributes a 9.4% combined annual growth rate increase in per capita health care costs to the increased use of technology. Using a "residual" approach to estimate the contribution of technology to rising health care costs, after factoring out the effects of the aging population and inflation, the researchers selected nine case studies. The researchers acknowledge certain inaccuracies resulting from their methodology. Important in their research is the conclusion that technology's impact on costs is directly influenced by systemic changes in health care reimbursement.

Moon, Marilyn and Cristina Boccuti. 2002. Location, Location, Location: Geographic Spending Issues and Medicare Policy, Washington DC: The Urban Institute, 2002.

This policy paper presents a concise assessment of the geographic issues will likely play a role in the debate over the Bush administration's proposed increase in Medicare Choice plan payments and will continue to be a factor in future debate on broader Medicare reform. Some of the influences on the costs and use of health care are obvious: The average age in a region and the supply of physicians and hospitals affect both the demand for and supply of available services. Other sources of diversity arise

from more subtle influences. These include cultural differences that affect attitudes about disease and health status, differences in climate that may affect care delivery, and local styles of health care practice. Rate of Medigap Premium Increases Slows Dramatically in 2002. Weiss Ratings Inc., 2002.

This report found that the rise in average premium rates for Medicare supplement insurance (Medigap) slowed dramatically in 2002 to only 2.4 percent, compared to an average increase of 10.9 percent in 2001, and 7.2 percent in 2000. Three factors contributed to the dramatic decrease in the premium growth rate: Companies ceased offering certain high-priced plans; insurers left the Medigap marketplace altogether; and companies lowered or maintained their annual premiums due to legislative changes that helped to reduce claims. Significant variation in the rate increases vary among regions.

Meeks Ronald L. Changing Composition of Federal Funding for Research and Development and R and D Plant since 1990. National Science Foundation.

Moses Hamilton III and Martin, Joseph 2001. "Academic Relationship with Industry: A new model for Biomedical Research" JAMA, Journal of Medical Association 285 no. 7(2001) 933-945.

Moy Ernes, Anthony Mazzaschi, Rebecca Levin, Blake David and Griner Paul. 1997. "Relationship between National Institutes of Health Research Awards to U. S. Medical Schools and Managed Care Market Penetration" JAMA, Journal of Medical Association 278, no. 3 (1997) 217-222.

Murphy Kevin and Topel and Robert 1998. Economic Value of Medical Research. University of Chicago. March 1998

Basic research is a public good, for which social returns may greatly exceed private ones. This paper develops an economic framework for evaluating the social benefits of medical research. We begin with a model of the economic value of health and life expectancy, which we apply to US data on overall and disease-specific mortality rates. We calculate (i) the social value of increased longevity that took place from 1970 to 1990 and, (ii) the social value of potential future progress against various major categories of disease.

The historical gains from increased longevity have been enormous, on the order of $2.8 trillion annually from 1970 to 1990. The reduction in mortality from heart disease alone has increased the value of life by about $1.5 trillion per year over the 1970 to 1990 period. The potential gains from future innovations in health care are also extremely large. Eliminating deaths from heart disease would generate approximately $48 trillion in economic value while a cure for cancer would be worth $47 trillion. Even a modest 1 percent reduction in cancer mortality would be worth about $500 billion. Unless costs of treatment rise dramatically with the application of new medical knowledge, these

estimates indicate that the social returns to investment in new medical knowledge are enormous.

Nakajima Eric T. AND Smith Robert 2001. State Economic Development Policy in Massachusetts (1983-1991): A Case Study of Worcester's Biotechnology Industry Department of City and Regional Planning : University of California, Berkeley

Worcester was declared as the Center for Excellence in Biotechnology Research in 1985 by Gov. Dukakis and today, has a thriving Biotechnology Center. This paper outlines Gov. Dukakis's strategy for Worcester with promotion of biotechnology as a means to bring about economic development and the policies that were pursued by the state. Among many of the practices that were followed was the promotion of a biotechnology park. There was a lot of local initiative but the main driver of the industry was the University of Massachusetts Medical College. The research park that was promoted works in close collaboration with the medical school. The funding for this economic development strategy came from the state as well as Massachusetts Biotechnology Research Institute. This paper explores the history of the establishment of this industrial park, the relationship with the university and the impact that it has had on Worcester County as a whole.

Office of Technology Assessment, United States Congress 1991. " Federal Funding of Biotechonology Research and Development" in Biotechnology in the Global Economy. US Government Printing Office : Washington DC.

This section is a part of a report that was published for the US Congress on Biotechnology industry. It includes 23 parts including annexes. The information that this annex includes the various agencies that fund biotechnology projects including what kind of projects the agency funds and some of the aggregates that these specific agencies contributed in 1990. Some of the agency that the report talks about are- NIH, NSF, Department of Defense, Department of Energy, US Department of Agriculture, Department of Commerce, Agency for International Development, Environmental Protection Agency etc.

Office of Technology Assessment, United States Congress 1991. " Federal Funding of Biotechonology Research and Development" in Biotechnology in the Global Economy. US Government Printing Office : Washington DC.

Office of Technology Assessment, United States Congress 1984. Technology, Innovation, and Regional Economic Development: Encouraging High-Technology Development–Background Paper #2 (Washington, D. C.: U.S. Congress)

This report was prepared for the government assessing the roles played by universities, the public sector, the private sector and the state and local governments in

promoting high-technology growth. The paper talks about the relationships that are fostered among different stakeholders and assess how to foster these linkages, their drawbacks and the impacts of these linkages. This paper includes some specific data on biotechnology and biomedical industries in several states for 1980-81 and pre 80. The paper looks at some federal programs that have attempted to promote high-technology initiatives in counties and cities and assess the impacts.

Office of Technology Assessment, United States Congress 1990. Biotechnology in the States. Chapter 4.

The paper looks at the increasing investment in the biotechnology industry as a means of economic development. The biotechnology promises clean sunrise industries, an improved economy and a strengthened higher educational system. The paper examines state investment in biotechnology since 1986 and assesses the level to which they are investing in biotechnology. States have allocated money for biotechnology through centers for excellence, universities, incubators for firms or through funding for basic and applied research. This paper addresses some of the mechanisms for states to promote biotechnology at the state and local level. There are results on the Office of Technical Assistance survey conducted on the state biotechnology centers. There is some data on some of the investments made by states in R and D and some methods/ mechanisms through which states promote economic development (for example, investment in universities as the promotional base for R and D), data on state expenditures in biotechnology and areas/ institutes to which some of these funds are allocated state-wise.

Pavitt, K. 2001. Public Policies to Support Basic Research: What Can the Rest of the World Learn from US Theory and Practice? (And What They Should Not Learn) ***Industrial and Corporate Change*** **v10, n3 (September 2001): 761-79**

The information-based theoretical model for public support of basic research, developed in the USA at the end of the 1950s, has held up well in political practice, in spite of its neglect of training benefits, of necessary prior investment in research infrastructure and of its consequently limited relevance outside the USA. At the same time, US practice in basic research has often been misinterpreted as being driven by short-term usefulness, whereas its key features are massive and pluralistic government funding, high academic quality, and the ability to invest in the long-term development of new (often multidisciplinary) fields. Challenges for the future include greater (and often ill-judged) pressures from governments for demonstrable usefulness of the basic research it supports, the entirely separate development of direct links to application in biomedical and software fields, and more complicated links between national basic research and application resulting from the changes in the internationalization of corporate R&D. And perhaps we can learn as much from successful practices in Scandinavia and Switzerland as from the USA.

Payne, A. Abigail. 2001. "Measuring the Effect of Federal Research Funding on Private Donations at Research Universities: Is Federal Research Funding More

Than a Substitute for Private Donations?" in International Tax and Public Finance v8, n5-6 (November 2001): 731-51

Peterson R. D and Leister D. V. 1969. "Market Structure-Conduct Relations: Some Evidence from Biomedical Electronic Firms" in University of Washington Business Review v. 28 n4 (1969)

Pred Alan. 1965. "The Concentration of High-Value Added Manufacturing" in Economic Geography Vol. 41, No. 2 April 10965. pp. 108-132

Rai Arthi and Eisenberg, Rebecca 2001. The Public and the Private in Biopharmaceutical Research. Paper presented at the Conference on the Public Domain 2001. Duke University Law School.

The three main areas of investigation of the paper are- First, and most obviously, patents on upstream discoveries hinder subsequent research by permitting owners to charge a premium for the use of discoveries that might otherwise be freely (or at least more cheaply) available in the public domain. This inevitably excludes some users who would be willing to pay marginal cost, but not the higher prices that patents permit, a concern that is troubling for biomedical research given the historical and continuing importance to scientific progress of advances made by researchers in nonprofit institutions.

Second, upstream patents may hinder subsequent research when they give a single entity monopoly control of basic research discoveries that enable subsequent investigation across a broad scientific territory. Because the principle constraint on the scope of patent claims is prior knowledge in the field of the invention, this concern is particularly acute for patents on early-stage discoveries that open up new research fields (such as the discovery of pluripotent embryonic stem cells), as distinguished from narrower technological applications that grow out of and build incrementally upon existing knowledge in an established field.

Third, a proliferation of patents on interrelated discoveries in the hands of different owners may hinder R&D if subsequent researchers and downstream product developers have to incur significant transaction costs in getting permission from multiple upstream patent owners before they may proceed. This concern is quite pressing in contemporary biomedical research, which draws upon many prior discoveries made by different people and institutions in universities and private firms.

The paper concludes that Patents on research discoveries impose costs on R&D, and these costs may well exceed any social benefits that they offer in the form of motivating further private investment in product development. It makes little sense to entrust decisions about when to patent the results of government-sponsored research to the unbridled discretion of institutions that are not motivated to weigh the costs against the benefits. A more sensible approach would give research sponsors such as NIH more authority to restrict patenting of publicly funded research when such patenting is more likely to retard than promote subsequent research and development.

A public research sponsor is particularly likely to invoke such authority to promote free dissemination of discoveries made in the course of grants to pursue the development of fundamental knowledge and research tools with the goal of enabling wide-ranging further investigation. As a likely sponsor of such future investigation, the agency will be motivated to keep its costs down, and this goal will often be better served by restricting patents. A conspicuous recent example is "raw" DNA sequence data generated in the course of the Human Genome Project, a fundamental resource for much future biomedical research. Although in this particular setting NIH has had some success, despite the constraints of the Bayh-Dole Act, in its hortatory efforts to restrict patenting of this fundamental information, hortatory efforts that rely on self-restraint by universities may no longer be sufficient.

Rausser Gordon 1999. Private/Public Research: Knowledge Assets and Future Scenarios. Presented to AAEA Annual Meeting Nashville, Tennessee August 10, 1999

The paper looks at R and D as the growth engine for new economic growth specifically examining the Bayh-Dole Act. The paper examines the importance of Public-private partnerships that have made possible critical technologies like the laser that we all benefit from. The paper explores alliances such as the Berkeley/ Novaris alliance where university professors submit RFPs to companies for research. This paper attempts to create a model for market structure, intellectual property and the future for such partnerships.

Schulman, Kevin (Chair), Panelists: Daniel Mendelson and Helen Burstin 2002. "Medical Technology: Where Is It Taking Us? What's It Going to Cost?" In Academy for Health Services Research and Health Policy Annual Research Meeting Washington DC, 2002.

This session focused on emerging areas of new medical technologies, exploring the potential impact of these technologies on the costs of health care and the impact of these technologies on health care and specifically the Medicare program.

Scott, Allen. 1993. Technopolis: High-technology industry and regional development in southern California. 1993. Berkeley and Oxford: University of California Press

Presents an extended series of empirical studies of the genesis and growth of high-technology industry in southern California, its changing technological foundations, its structure and organization, its labor force, its extraregional connections, and its evolving geographical pattern within the region. Inquires into the logic of some of the central building blocks of industrialization processes as they impinge on patterns of regional development. Presents a geographical and historical overview and a structural profile of the southern Californian technopolis. Provides detailed analyses of the workings of three major sectors: aircraft and parts; missiles and space equipment; and

electronics. Presents contrasting case studies of local labor market dynamics: one focusing on engineering and scientific employees at three Lockheed aircraft plants and the other focusing on low-wage workers employed in electronics assembly subcontract shops. Examines subcontracting relations and locational agglomeration in a study of the printed circuits industry. Explores the relationships among technological innovation, new firm formation, and locational structure in southern California's medical device industry. Identifies some serious threats to the long-term viability of southern California's high-technology industrial complex and lays out some policy guidelines to deal with the crisis at hand.

Scott, A., Steyn, G., Geuna, A., Brusoni, S., and Steinmueller, E. (2001) The Economic Returns to Basic Research and the Benefits of University-Industry Relationships: A Literature Review and Update of Findings. Report for the Office of Science and Technology by SPRU - Science and Technology Policy Research. Brighton, U.K.: University of Sussex.

In order to identify appropriate levels of investment in public sector research, it would be useful to be able to identify the rates of return to public research and to identify the benefits of the relationships between public research and the private sector.

It is intuitively attractive to think of the main output of research to be new and freely available information, which is then taken up and used by industry in innovation. In particular, new scientific information leads to new technologies. This simple 'linear model' indicates that it should be possible to calculate the returns to public research. Innovation is not linear. Innovation processes are not that simple, however. They are non-linear, complex and involve a range of interactions with public research. For these reasons and others, some argue that it is impossible to calculate rates of return for public research, and those that try need to interpret their results with great care. To build a full picture of the relationships between public research and innovation requires an understanding of the many benefits of public research for the economy – not just the provision of new information – and the specific mechanisms or channels through which these benefits come about.

This review builds on a wide literature that goes beyond the intuitive approach to examine in detail the complex relationships between research and innovation, science and technology. The existence of this rich set of relationships means that the returns to basic research are probably much higher than those imagined by using the intuitive linear approach. However, paradoxically it also makes it more difficult to calculate convincing and analytically rigorous quantitative figures for the returns to basic research.

Attempts to calculate the returns to public research have generally resulted in high rates of return – from 20-50% and higher. The report reviews recent literature in the field, showing the diverse economic sectors and country circumstances in which studies have been conducted. Most find substantial returns.

However, attempts to calculate the economic returns to public research have faced strong methodological criticism. There now seems to be a wide acceptance of the limits to quantification. As a consequence, few studies now attempt to calculate a rate of return, but some try to give an idea of more specific partial measures, such as measures of the elasticities of public and private R&D – i.e. what effect does public research have on key variables such as private research. It is therefore important to analyze the other ways in which research benefits the economy:

By enhancing capabilities in the economy – and it is important not to forget the vital linkage between research and the supply of skilled graduates – research underpins the knowledge absorption capabilities of the private sector. By creating and maintaining variety, research maintains the diversity of science and technology options vital to a flexible innovation system faced with uncertain future demands and opportunities.

So far as we know, this review is the first attempt to bring together all the recent evidence about the great many channels of communication between the research sector and the private sector. Firms see many of these as important mechanisms for deriving value from public research. Information on many of the channels remains sparse. This restricts the ability of policy decisions to proceed on the basis of evidence. Many benefits. Such evidence as does exist, however, demonstrates the many ways in which research benefits the economy, albeit in ways that are difficult to quantify in economic terms. This leads us to conclude that the benefits of public research are probably significantly higher than narrow calculations of the returns to public research would suggest.

"The Impact of Medical Technology on Future Health Care Costs: The Shortcomings of Technology Case Studies," *Advanced Medical Technology Association,* (2 March 2001), [journal on-line], available from http://www.advamed.org/medtechsaving/,

This online brochure and advocacy group defends medical technology's ability to save lives, reduce health care costs, and stimulate economic growth. Specifically the site rebuts the Project Hope study on Medical Technology and provides interesting counter-points and alternative considerations

Thompson, Tommy 1994. Bioscience Research & Development Funding in Wisconsin in http://www.wabre.org/report_one/chap1.html.

This report looks at the sources of biomedical funding and the share of Wisconsin's budget. Additionally this report looks at the economic impact on the state as a result of biomedical research development.

Toole, Andrew 2000. The Impact of Public Research on Industrial Innovation: Evidence from the Pharmaceutical Industry . SIEPR Discussion Paper # 7. Stanford Institute for Economic Policy Research. November 2000.

This paper examines the hypothesis that publicly funded basic research contributes to product innovation in the pharmaceutical industry. New data are collected on pharmaceutical product introductions, pharmaceutical industry R&D investment, and publicly funded basic science investment. A production framework is used to model the number of new products as a function of private and public research investment in seven technology classes over the period 1978-1994. The elasticity estimates indicate that a 1% increase in the stock of public basic research ultimately leads to a 2.0% to 2.4% increase in the number of commercially available new compounds.

Torrelle, Els. 2000. From Louis Pasteur to J. Craig Center: When Biomedical Scientists become Bio-entrepreneurs. October 2000

Triplett, Jack E. 1997. Accounting for Health Care: Integrating Price Index and Cost Effectiveness Research, Washington DC: Brookings Institution, 1997.

This paper developed the relationship between two bodies of research--price indexes and cost-effectiveness studies--that are important for accounting for health care output and prices. The author introduces possibilities for health accounting in terms of medical effectiveness, indicating that analysts could use effectiveness measures as quality adjustments within price indexes and national health accounts. The author addresses the feasibility of constructing methods to measure the quantity of health care treatments and their related costs more accurately by conducting additional research one medical outcomes.

University of Buffalo 2002. The Economic Impact of the University of Buffalo on the Region and State. Office of the Provost: Buffalo.

This report looks at the economic impacts of University of Buffalo on the region and the state. The main categories that it looks at are revenues, expenditures and returns to the state. Among the broad economic influences that it looks at are employment generated through research, faculty positions, administration, patents, disclosures, university public service and private support

University of Cincinnati. University of Cincinnati Economic Impact Study (http://medcenter.uc.edu/impact.cfm)

This study looks at the impact of the medical center on the economy. The medical center is an area that is primarily involved in teaching and research. The information presented on the website contains information on how the center increases economic well-being in the tri-state region of Indiana, Ohio and Kentucky through the generation of jobs, increase in funding and through the generation of revenues.

University of Arkansas. 2001. No Boundaries: The Statewide Impact of the University of Arkansas for Medical Sciences in Arkansas http://www.uams.edu/today/NoBoundaries/regional.htm

This report looks at the economic impacts made by University of Arkansas on the state. The article reviews the following benefits of the university. Have access to education as an open door for personal and professional advancement through careers in health-care fields. Have opportunities for training and continuing professional education via the Internet and through an interactive video network, both of which enables distance learning and remove the barrier of geographic location. High quality-of-life benefits of medical and biotechnological research Receive quality health care regardless of where people may live in the state. Can participate in the service programs of the university which engage people statewide in one of the strongest outreach efforts in the nation

von Burg Urs and Kenney Martin 2000. Venture Capital and the Birth of the Local Area Networking Industry in *Research Policy* v29, n9 (December 2000): 1135-55

Venture capital has played an important role in funding the development of a number of US high-technology industries. Economists and business scholars utilizing models based in traditional economics have studied venture capital from the perspective of investment decision-making. These models provide significant insights, and yet they do not explain the actual operation of venture capital. This case study of the creation of LAN industry utilizes a synthesis of the dominant design and social constructionist perspectives to create a more nuanced explanation of how the practice of venture capitalists operates to create firms and industries.

Wagner, C.S., and N. Berstein 1999. US Government Funding of Cooperative Research and Development in North America. Washington D.C., U.S.A.: The RAND Corporation.

Walcott, Susan 1999. High Tech in the Deep South: Biomedical Firm Clusters in Metropolitan Atlanta. *Growth and Change* v30, n1 (Winter 1999): 48-74

The relation between biomedical firms and their metropolitan region location in Atlanta, Georgia is examined as an empirical test of both innovative milieu agglomeration theory and place specific strategies for life science companies in the Deep South. This sectoral analysis utilizes questionnaires and targeted interviews to highlight the economic development role of real estate in suburban employment and residence sites (SEARS) and the intra-metropolitan directional migration of firms. Clustering of related industries is fostered by a shortage of appropriately configured laboratory and office space at the intermediate stage of the business growth cycle, encouraging information sharing and cooperative behavior via proximity by necessity. Lack of a key networking individual or mediating organization critically retards development of this potential growth engine.

Zeller, Christian. 2001. "Cluster Biotech: A Recipe for Success? Spatial Patterns of Growth of Biotechnology in Munich, Rhineland and Hamburg". Small Business Economics v17, n1-2 (Aug.-Sept. 2001): 123-41

Literature on Economic Development

Abramovitz Moses 1993. "The Search for the Sources of Growth: Areas of Ignorance, Old and New" in The Journal of Economic History, Vol. 53, No. 2. (Jun., 1993), pp. 217-243

Many economic historians, like most economists, depend on standard growth accounts to provide some quantitative description of the proximate sources of growth, but this is misleading. American growth experience illustrates the difficulty. The seeming major contribution of tangible capital accumulation to nineteenth-century growth was the consequence of scale-dependent and capital-using technological progress. The large twentieth-century contributions of education and R&D conceal technology's new intangible capital-using bias. Additionally, reverse forces run from capital accumulation to technological progress. Without a greater understanding of these interactions, our knowledge of even the proximate sources of growth is incomplete.

Agrawal Ajay and Cockburn Iain 2002. University Research, Industrial R &D and the Anchor Tenant Hypothesis. NBER Working Paper No.w9212, September 2002.

The authors examine geographic concentration, agglomeration, and co-location of university research and industrial R&D in three technological areas: medical imaging, neural networks, and signal processing. Using data on scientific publications and patents as indicators of university research and industrial R&D, the authors find strong evidence of geographic concentration in both activities at the level of MSAs.

The authors view such co-located vertically connected activities as constituents of a local innovation system,' and these appear to vary markedly in their ability to convert local academic research into local commercial innovation. The paper develops and tests the hypothesis that the presence of a large, local, R&D-intensive firm an anchor tenant' enhances the productivity of local innovation systems by making local university research more likely to be absorbed by and to stimulate local industrial R&D. Presence of anchor tenant firms may be an important factor in stimulating both the demand and supply sides of local markets for innovation and may be an important channel for transmission of spillovers. While the empirical results are preliminary, they indicate that anchor tenant technology firms may be an economically important aspect of the institutional structure of local economies.

Anselin, Luc ; Varga, Attila ; Acs, Zoltan Local Geographic Spillovers between University Research and High Technology Innovations in the Journal of Urban Economics v42, n3 (November 1997): 422-48

This paper reexamines the empirical evidence on the degree of spatial spillover between university research and high technology innovations. The familiar Griliches-Jaffe knowledge production function is estimated at both the state and the metropolitan statistical areas (MSA) level and extended with more precise measures of spatial spillover. Alternatives based on the gravity potential and covering indices are formulated for Jaffe's 'geographical coincidence index' and found to provide strong evidence of local spillovers at the state level. At the MSA level, a distinction is made between research and development activities and university research in the MSA and in the surrounding counties. Evidence is found of local spatial externalities between university research and high technology innovative activity, both directly and indirectly via private research and development.

Alston, Julian "Spillovers" in Australian Journal of Agricultural and Resource Economics v46, n3 (September 2002): 315-46

Interstate and international spillovers from public agricultural research and development (R&D) investments account for a significant share of agricultural productivity growth. Hence, spillovers of agricultural R&D results across geopolitical boundaries have implications for measures of research impacts on productivity, and the implied rates of return to research, as well as for state, national and international agricultural research policy. In studies of aggregate state or national agricultural productivity, interstate or international R&D spillovers might account for half or more of the total measured productivity growth. Similarly, results from studies of particular crop technologies indicate that international technology spillovers, and multinational impacts of technologies from international centers, were important elements in the total picture of agricultural development in the 20th Century. Within countries, funding institutions have been developed to address spatial spillovers of agricultural technologies. The fact that corresponding institutions have not been developed for international spillovers has contributed to a global underinvestment in certain types of agricultural research.

Arora Ashish and Gambardella Alfanso 1990. "Complementarity and External Linkages: The Strategies of the Large Firms in Biotechnology" in The Journal of Industrial Economics VolXXXVIII No. 4.

The article argues that large biotechnology firms enter into linkages with university and medium-sized/small research-intensive firms. If any two strategies are complementary to one another; i.e., if undertaking one strategy raise the marginal value of the other, they are positively correlated. The four main types of agreements that are identified are as follows- agreements with other firms, research agreements with other

universities, investments in capital stocks and acquisitions of New Biotechnology Firms. Agreements with the universities tend to focus on more basic research objectives where firms interact with the faculty of the university who have the necessary skill and expertise. The analysis suggests that biotechnology is not the locus of innovative activity. The locus of innovation is the structure of innovation from biotechnology.

Audretsch, David. 1998. Agglomeration and the Location of Innovative Activity . Centre for Economic Policy Research Discussion Paper: 1974

Only a few years ago the conventional wisdom predicted that globalization would render the demise of the region as a meaningful unit of economic analysis. The purpose of this article is to explain why and how geography still matters for innovative activity and ultimately for the international comparative advantage. The comparative advantage of the high-cost countries of North America and Western Europe is increasingly based on knowledge-driven innovative activity. The spillover of knowledge from the firm or university creating that knowledge to a third-party firm is essential to innovative activity. Such knowledge spillovers tend to be spatially restricted. Thus, an irony of globalization is that even as the relevant geographic market for most goods and services becomes increasingly global, the increased importance of innovative activity in the leading developed countries has triggered a resurgence in the importance of local regions as a key source of comparative advantage.

Bartik, Timothy 1995. Economic Development Strategy. W.E. Upjohn Institute for Economic Research. Kalamazoo: Michigan.

This paper provides a guide to economic development policies for local government managers. Local economic development policies today include not only tax subsidies for branch plants, but also job training to provide workers to businesses, advice and support services for potential entrepreneurs, and extension services to help businesses modernize and export. To help local government managers, this paper suggests a number of guiding principles, including: local economic development should be pursued cooperatively across the local labor market; economic development programs should consider the quality of jobs created; tax subsidies are expensive per job created; development subsidies are more effective if the subsidy is frontloaded; high employment areas should be more aggressive than low unemployment areas in promoting job growth; many economic development services can be cheaply evaluated by business surveys.

Basant Rakesh, Fikkert Brian. 1996. "The Effects of R&D, Foreign Technology Purchase, and Domestic and International Spillovers on Productivity in Indian Firms" in The Review of Economics and Statistics, Vol. 78, No. 2. (May, 1996), pp. 187-199.

Using panel data on Indian firms from 1974-75 to 1981-82, we provide estimates of the impact on output of Indian firms' R&D expenditures, their technology

purchases, and international and domestic R&D spillovers. The private returns to technology purchases are estimated to be high and statistically significant, while the private returns to firms' own R&D expenditures are somewhat lower and are often insignificant. There is evidence of both international and domestic R&D spillovers. The estimates permit estimation of total factor productivity growth in the period preceding India's industrial liberalization policies.

For analysis purposes, the firms are divided into scientific and nonscientific firms with the return to technology purchase (TP) for scientific projects 166% while return for R and D is 1% while for nonscientific firms return on TP is 95% and for R and D is 64%. The results show that the greatest loss for Indian firms occurred in the scientific sector because of the number of restrictions on technology purchase. The paper develops an extended model based on the Cobb-Douglas Production function following type I for type t. The overall conclusions indicate that there is a substantial gain with investment in TP. The evidence of domestic spillovers indicates that Rand D is a wise social investment. The results and previous evidence indicates that TP and R and D are substitutes indicating that India's licensing regulations had the desired impact of spurring R and D. These regulations have had a substantial cost, the private returns to TP expenditure being higher than the R and D expenditure. India can also benefit from international spillovers- from imitations of foreign investments.

Berliant Marcus, Peng Shin-Kun, Wang, Ping. 2002. Production Externalities and Urban Configuration in Journal of Economic Theory v104, n2 (June 2002): 275-303

The authors formally explore Jacobs' idea that uncompensated knowledge spillovers are crucial for agglomeration by modeling location-dependent inter-firm production externalities in a general-equilibrium linear-city framework. Good and factor allocation, firms' and households' locational choice, and wages and land rents are all endogenously determined. The unique equilibrium urban configuration may be concentrated (with monocentric firm locations), dispersed (with completely mixed firm/household locations), or a combination, depending on the population of firms, transportation cost, and firm-interaction parameters. Due to distance-dependent production externalities, firms will be clustered together in any equilibrium, thus ruling out the possibility of any multicentric urban configuration.

Blonigen, Bruce and Kolpin Van 2002. Technology, Agglomeration and Regional Competition for Investment. NBER Working Paper No.w8862, March 2002

Develops a model that explores technology development by firms that face regional competition for their investment and examine the endogenous determination of regions' policies, firm technology, and agglomeration externalities. The authors find that regional competition leads firms to inefficiently distort their research and development efforts in hopes of improving their standing in the competition amongst regions for their investment. This loss in efficiency is aggravated by the agglomeration externalities that

are inherently present in many industries. The authors offer several case studies that provide evidence consistent with our theoretical conclusions.

Cortright Joseph and Mayer Heike 2001. High Tech Specialization: A Comparison of High Technology Centers. The Brookings Institution. Center on Urban & Metropolitan Policy

In most high tech regions, high tech employment is concentrated in only a few industry segments. Metropolitan areas that show high concentrations of high tech employment in one technology, like software, will show very low concentrations in hardware (Washington D.C., Denver and Atlanta). Other regions show the opposite pattern: Phoenix is an employment center for hardware, but weak in software. The majority of the patents issued in any given metropolitan area are granted to only a handful of firms specializing in one or more related technologies. For example, San Jose, Phoenix, Portland and Austin show significant innovation in electronics or software technologies, and little activity in biomedical technologies. Washington D.C., Raleigh-Durham, San Diego, Boston and Seattle show significant innovation in biotechnology but produce fewer patents in electronics or software.

Venture capital flows not only to a few high tech metropolitan areas, but also to a specific set of technologies within those areas. Venture capital in Boston flowed more to soft-ware and biotechnology. In Denver, investments were channeled into communications and computer storage firms. In San Diego, venture capital investments went disproportionately to medical industries.

A comparative analysis of 14 "high tech" metropolitan areas found that high technology varies dramatically from place to place. Different metropolitan areas tend to specialize in relatively few products or technologies. This specialization can be seen in three measures: employment concentration, patent activity, and venture capital flows.

Cusmano, L. (2000). Technology Policy and Co-operative R&D: the Role of Relational Research Capacity. DRUID Working Paper No. 00-3. Copenhagen, Denmark: Danish Research Unit for Industrial Dynamics.

Evolutionary theories of technological change and industrial dynamics give primary importance to interaction between heterogeneous agents, endowed with complementary assets and competencies. Accordingly, support to co-operative R&D is central to technology policy, as a mean for increasing system connectivity, triggering virtuous cycles of learning and promoting variety. The paper investigates the "chemistry of technological co-operation", relating its effectiveness and results to the partners' relational research capacity, i.e. their ability to evaluate, integrate, process and exploit knowledge flows generated by the interaction. A functional specification for the relational research capacity is proposed and its properties are investigated. The formal analysis works as a guideline for the statement of research hypothesis related to the effectiveness of co-operative R&D programmes, to be tested on empirical grounds.

David, P. (1999) The Political Economy of Public Science. SIEPR Discussion Paper 99-022. Palo Alto, California, U.S.A.: Stanford University

The relationship between science, technology and economic performance has been a recurring subject of public discussions and policy debates throughout the past four decades, both in the economically advanced countries and newly industrializing economies. Recently, however, a greater sense of urgency has attended consideration of governmental policies affecting science and technology. With decision-making concerning major public expenditure commitments for many purposes held in the tightened grip of fiscal stringencies, resumption of the previous upward trend in the real value of government budget allocations for research, training and development (RTD) activities has been called into question. Even though there has been some abatement of the pressures that developed during the late 1980s and early 1990s for fiscal retrenchment on the part of governments, the situation as regards support for science and technology has not returned to the status quo ante.

Unlike previous episodes of funding cutbacks that temporarily slowed the growth of R&D activities, the latest one appears to have marked a more permanent break in the long-term upward trend. Although historically civilian basic research absorbed a minor portion of non-military public sector funding for science and technology, there is no ground for a sanguine view that its comparative fiscal insignificance automatically insulates this category of R&D expenditures from the adverse developments in the broader public funding picture. Indeed, whereas in former times many government agencies supported long-term basic research that was perceived as relevant to their respective missions, the budgets for such work (whether to be performed by national laboratories and public institutes, or under grants to university-based researchers) have been among the first items to come under hostile scrutiny -- precisely because they could be cut without jeopardizing the ability of the agencies to perform their critical short-term functions.

Furthermore, precisely because their findings are perceived to lie at a farther remove from predictable commercializable results, the case for public patronage of exploratory scientific research has been seriously undercut by the new spirit of "economic instrumentalism" that has come to characterized science and technology policy discussions.

In the first part of this essay the author reviews the economic logic of "open science," upon which rests what is the compelling general case for state patronage of the science base. From those foundations the discussion proceeds, in part II, to critique a number of related trends that have been reshaping the political economy of public sector R&D, especially in the U.S., the U.K. and other Western European economies since the early 1980s.

Darby, Michael and Zucker, Lynne G 1999. Local Academic Science Driving Organizational Change: The Adoption of Biotechnology by Japanese Firms
National Bureau of Economic Research Working Paper: 7248 , 1999

In Japan biotechnology has almost exclusively been introduced through organizational change in existing firms. We show that for the U.S. and global pharmaceutical business the performance enhancement associated with this organizational change is necessary for incumbent firms to remain competitive and, ultimately, to survive. Japan's sharply higher organizational change/new entry ratio compared to the U.S. during the biotech revolution is related to Japan's relatively compact geography and institutional differences between the higher-education and research funding systems, the venture-capital and IPO markets, cultural characteristics and incentive systems which impact scientists' entrepreneurial activity, and tort-liability exposures.

Both local science base and pre-existing economic activity explained where and when Japanese firms adopted biotechnology, with the latter playing a somewhat larger role. Entry and organizational change appear to be alternative ways of exploiting the scientific base. While similar processes are at work in Japan and America, starts in Japan induce entry or transformation of significantly fewer firms than in the U.S. and preexisting economic activity plays a greater role. We find no such significant difference for entry of keiretsu-member and nonmember firms within Japan.

Dasgupta Partha and Stiglitz, Joseph 1980. "Industrial Structure and the Nature of Innovative Activity" in The Economic Journal, Vol. 90, No. 358. (Jun., 1980), pp. 266-293.

The paper attempts to develop an analytic framework that relates the nature of innovative activity to the market structure. The authors argue that the nature of innovative activity and market structure are endogenous in the short-run. The degree of concentration in an industry depends on the basic ingredients such as technology and research, demand conditions, the ability of firms to borrow and finance research and development. The conclusions of the model show that the research and development of an industry is correlated with concentration. High degrees of concentration are not evidence of lack of concentration. Degree of concentration is correlated with the degree of monopoly. R and D expenditure and expenditure per firm increase with the size of the market, R and D expenditure decreases as there are more barriers to entry for firms, if demand is highly inelastic, the total R and D expenditure in an industry with free entry exceeds the socially optimal level. There may be duplication of research efforts in a market implying that the total expenditure exceeds the socially optimal level. The market power of a firm increases as the cost advantage over its rivals increase, there is a presumption that firms are encouraged to participate in overly risky research activities. The risk that firms take in research activity is positively correlated with the pressure of the competition. The number of firms engaged in research activity is not indicator that the level of R and D is low and the pressure from competition may result in the speeding up of the research process.

Doern, G. Bruce ; Levesque, Richard 2002. The National Research Council in the innovation policy era: Changing hierarchies, networks, and markets. Institute of Public Administration of Canada Series in Public Management and Governance. Toronto; Buffalo and London: University of Toronto Press

Reviews and examines the institutional transformation of the National Research Council of Canada (NRC) over the past decade in the context of diverse and contested views of innovation policy in Canada. Based on interviews with more than forty people, including current and former NRC staff and various others in government, business, and academia knowledgeable about the NRC and/or about science-and-technology and innovation policy. Provides a macro perspective on policy and institutional change around and within the NRC. Examines selected NRC institutions and programs, including the Biotechnology Research Institute, the Institute for Research in Construction, the Herzberg Institute of Astrophysics, and the Industrial Research Assistance Program. Analyzes the NRC's position in relation to partner and competitor institutions and agencies, including research granting bodies, universities, the business sector, and new bodies such as the Canadian Foundation for Innovation and the Canadian Institutes of Health Research.

Dumais Guy, Ellison Glenn and Glaeser Edward 1997. Geographic Concentration as a Dynamic Process. NBER Working Paper No.w6270, November 1997

The degree of geographic concentration of individual manufacturing industries in the U.S. has declined only slightly in the last twenty years. At the same time, new plant births, plant expansions, contractions and closures have shifted large quantities of employment across plants, firms, and locations. This paper uses data from the Census Bureau's Longitudinal Research Database to examine how relatively stable levels of geographic concentration emerge from this dynamic process. While industries' agglomeration levels tend to remain fairly constant, we find that there is greater variation in the locations of these agglomerations. We then decompose aggregate concentration changes into portions attributable to plant births, expansions, contractions, and closures, and find that the location choices of new firms and differences in growth rates have played the most significant role in reducing levels of geographic concentration, while plant closures have tended to reinforce agglomeration. Finally, we look at co-agglomeration patterns to test three of Marshall's theories of industry agglomeration: (1) agglomeration saves transport costs by proximity to input suppliers or final consumers, (2) agglomeration allows for labor market pooling, and (3) agglomeration facilitates intellectual spillovers. While there is some truth behind all three theories, we find that industrial location is far more driven by labor mix than by any of the other explanatory variables.

Ellison, Glen and Glaeser, Edward 1999. The Geographic Concentration of Industry: Does Natural Advantage Explain Agglomeration? Harvard Institute for Economic Research Discussion Paper: 1862

Industries' locations are affected by a wide range of natural advantages. About twenty percent of observed geographic concentration can be explained by a small set of advantages. The authors think that this result is particularly notable given the limits on their explanatory variables. For example, nothing in their model can explain why there is no shipbuilding in Colorado, nor can it predict that soybean oil production is concentrated in soybean producing states, as opposed to being spread among all agricultural states. Hopefully, in the future, others will provide better estimates than the authors have been able to give. They conjecture that at least half of observed geographic concentration is due to natural advantages. At the same time, there remain a large number of highly concentrated industries where it seems that agglomeration must be explained by localized intra-industry spillovers. Simple cost differences cannot explain why the fur industry, the most agglomerated industry in the authors' sample, is centered in New York. The authors see the attempt to provide a clearer understanding of the sources of these spillovers as an important topic for future research.

Eicher Theo S. 1996. "Interaction between Endogenous Human Capital and Technological Change" in The Review of Economic Studies, Vol. 63, No. 1. (Jan., 1996), pp. 127-144.

This paper examines how interaction between endogenous human capital accumulation and technological change affects relative wages and economic growth. Private incentives to invest in human capital finance the employment of skilled labor in the education sector, while non-rival technology is a by-product of the education process. The absorption of new technologies into production is skill intensive, creates skill-biased labor demand, and increases the relative wage of skilled to unskilled labor.

In contrast to recent models of endogenous growth, higher rates of technological change and growth may be accompanied by a higher relative wage but lower relative supply of skilled labor. Thus the model provides a theoretical foundation for the empirically observed relation between technological change and relative demand, supply and wages of skilled labor. The model constructed in this paper is a overlapping-generations model where private incentives induce agents to invest in education, non-rival inventions are the by-product of the education process.

Fujita Masahisa and Thisse Jacques Francois 1996. Economics of Agglomeration in Center for Economic Policy Research, Discussion Paper: 1344

The authors address the fundamental question arising in economic geography: why do economic activities agglomerate in a small number of places? The main reasons for the formation of economic clusters involving firms and/or households are analyzed: (i) externalities under perfect competition; (ii) increasing returns under monopolistic competition; and (iii) spatial competition under strategic interaction. We review what has been accomplished in these three domains and identify a few general principles governing the organization of economic space. Other standard lines of research in

location theory are also discussed while several alternatives, new approaches are proposed.

Gertler Meric S. "Being There: Proximity, Organization and Culture in the Development and Adoption of Advanced Manufacturing Technologies" in Economic Geography, Vol. 71, No. 1, Collaboration and Competition in Geographical Context. (Jan., 1995), pp. 1-26.

Recent work on innovation and technology implementation suggests the importance of closeness between collaborating parties for the successful development and adoption of new technologies. "Closeness" is used here both in the literal sense, as allowing more frequent, effective, often unplanned interaction, and more broadly, to encompass common language, modes of communication, customs, conventions, and social norms. Such relationships are said to be particularly important in the case of production process innovations.

These theoretical ideas are subjected to empirical scrutiny through a postal survey and set of interviews with users of advanced manufacturing technologies in Southern Ontario. Given the premise that intensive interaction and collaboration between users and producers of advanced process technologies is necessary for successful technology implementation to occur, then the chronically underdeveloped state of the Ontario advanced machinery sector ought to create major difficulties for manufacturers there trying to implement leading-edge processes.

The analysis indicates that "closeness" between user and producer, defined physically, organizationally, and "culturally," is important for the successful implementation of these advanced technologies. The paper suggests a set of circumstances in which proximity of the user to the producer is most important. In doing so, it offers an interpretation of "culture" that goes beyond common language, codes of communication, and norms to incorporate shared workplace practices and training regimes.

Hanson, Gordon 2000. Scale Economies and Geographic Concentration of Industry. NBER Working Paper No. w. 8013. Nov 2000

In recent empirical literature on spatial agglomeration, many papers find evidence consistent with location-specific externalities of some sort. Our willingness to accept evidence of agglomeration economies depends on how well key estimation problems have been addressed. Three issues are particularly troublesome for identifying agglomeration effects: unobserved regional characteristics, simultaneity in regional data, and multiple sources of externalities.

Two empirical results appear to be robust to problems created by the first two issues: (a) individual wages are increasing in the presence of more-educated workers in the local labor force, which is consistent with localized human-capital externalities, and (b) long-run industry growth is higher in locations with a wider range of industrial activities, which suggests that firms benefit from being in more diverse urban environments. Other evidence is supportive of agglomeration effects related to regional demand linkages and short-run, industry-specific externalities

Harrison Bennett, Kelley Maryellen R., Gant Jon 1996. "Innovative Firm Behavior and Local Milieu: Exploring the Intersection of Agglomeration, Firm Effects and Technological Change" in Economic Geography, Vol. 72, No. 3. (Jul., 1996), pp. 233-258.

Regional economists, planners, and geographers for more than half a century have drawn a useful distinction in characterizing the properties of spatial agglomerations, or growth centers (or, to use the currently fashionable term, "clusters"). They write on the one hand of the presence of same-sector businesses and employees ("localization"), and on the other of a diverse complex of economic and social institutions ("urbanization"). While both processes--sameness and diversity--are relevant to making sense of how economic activity sorts itself out across space, empirically oriented economists and students of organizational behavior are just now providing scientific support for the hypothesis that urbanization is more important than localization in explaining spatial patterns of innovation and economic development.

In this paper, we report on the results of research conducted at the level of individual companies and plants, rather than on the aggregate economies of cities and regions. Across a national size-stratified random sample of almost one thousand manufacturing establishments, we find that the likelihood that managers will adopt new technology--in this case, programmable automation--is significantly associated with the degree of "urbanity" of the counties in which their factories are situated (metropolitan versus non-metropolitan, suburban rather than downtown, urban rather than rural). But, after controlling for establishment size, scale of those production operations for which this type of automation is relevant, product mix, labor relations, and the industry's dependence on sales to the U.S. Department of Defense, we found that innovation was not systematically related to the density of clusters of similar businesses. Subsequent research by Kelley, which resolves certain technical problems encountered in the present work, reports significant effects of both urbanization and localization, with the former continuing to be relatively more important than the latter in influencing innovation. The difficulty in measuring such firm- and plant-specific effects probably explains why the empirical (as distinct from the theoretical) research literature has thus far offered such a weak basis for exploring the nexus between urbanization and localization processes, on the one hand, and technology and business organization, on the other.

Hicks Donald A. and Lee Si-Gyoung 1994. "Regional Economic Impacts of Federal R&D by Funding Source and Performer" Type in *Regional Studies* v28, n6 (October 1994): 619-32

Guided by persistent spatial and sectoral concentration of federal R&D, we find that while defense R&D is stimulative, funds flowing to non-defence, non-profit and educational/research institutions are more so. Effects are stronger in larger metro-scale regions and in local economies in which manufacturing accounts for greater shares of total employment. Moreover, federal R&D flows appear to have local investment effects as indicated by their capacity to accelerate the rate of local employment expansion in the total technology-intensive (TTI) sub sector in which R&D-intensive goods account for significant portions of inputs and final output.

Holmes Thomas, 1996. How Industries Migrate When Agglomeration Economies are Important. Federal Reserve Bank of Minneapolis Staff Report: 219

The Economics of QWERTY suggests that historical accidents can trap economies in inefficient equilibria. This paper suggests that such accidents do not have the force that proponents claim. The paper presents a mechanism that may unravel a locational advantage caused by an historical accident. In the model, there are agglomeration benefits from concentrating industry in a particular location because it enables a large variety of local suppliers to emerge. Firms differ by the extent to which they purchase from local suppliers. Low-tier firms purchase little; high-tier firms purchase more. When the industry migrates, the lowest-tier products move first

Isserman, Andrew M. "Mobilizing a University for Important Social Science Research: Biotechnology at the University of Illinois" in American Behavioral Scientist 44, no. 3 (2000): 310-317

Lazear, Edward P 1997. "Incentives in Basic Research" in Journal of Labor Economics, Vol. 15, No. 1, Part 2: Essays in Honor of Yoram Ben-Porath. (Jan., 1997), pp. S167-S197.

The main questions that are considered are how weight is to be placed on past performance as opposed to the quality of the proposal, which areas of research are to be funded? The advantage here is that the market rewards and punishes people. This forces individuals to pick projects that are private and have a social value because even funding agencies will not fund a project without a social value? Should the criteria be experience adjusted such that it is harder for more senior researchers to obtain funding? Should many small awards be made or are the larger ones better? Should awards be fixed or should they be given as the project progresses?

An overlapping generations model is developed with mathematical models to answer the questions that were being asked. Among the main results that emerge from the paper, under a fixed award structure, less able researchers try harder than the more able ones. There is an increased effort, it does not fully compensate for their lower ability. As a result, the more able researchers win the awards. Increasing the number of awards and lessening the amount per award so as to leave the expected price constant makes the able reduce efforts. The marginal effort in obtaining the award declines. This indicates that smaller awards are likely to be socially detrimental. Young workers are induced to complete their projects and the older researchers are given credit for their past performance. The effect is to induce effort among the young and reduce effort among the old. Efficiency in improved by making the awards age contingent. Holding awards to till the project is complete might induce a more efficient and speedy deliver but on the other hand might hinder the project if the researcher is unable to raise the capital to fund the project on his own.

Lichtenberg Frank1998. The Allocation of Publicly-Funded Biomedical Research in National Bureau of Economic Research Working Paper: 6601

The authors develop a simple theoretical model of the allocation of public biomedical research expenditure, and present some empirical evidence about the determinants of this allocation. The authors calculate distributions of government-funded biomedical research expenditure, by disease, from records of all research projects supported by the United States Public Health Service; to obtain a reasonably complete accounting of disease burden (indicative of the benefit of achieving advances against different diseases), they utilize data on both the dying and the living. They find a very strong positive relationship across diseases between total life-years lost before age 65 and public research and development expenditure. But the amount of publicly-funded research on a disease decreases with the share of life-years before age 65 lost to the disease that are lost by non-whites. There tends to be more research about chronic conditions that are prevalent among people living in low-income households.

Long Ngo Van and Soubeyran Antoine. 1998 "R&D Spillovers and Location Choice under Cournot Rivalry" in Pacific Economic Review v3, n2 (June 1998): 105-19

A model of location choice by Cournot oligopolists is presented, under the assumption that R&D spillovers depend on the distance between firms. It is shown that a variety of patterns emerge. Agglomeration is optimal under certain assumptions. Geographical dispersion in a two-dimensional plane is another possible outcome.

Malecki Edward J 1985. "Industrial Location and Corporate Organization in High Industries" in Economic Geography, Vol. 61, No. 4. (Oct., 1985), pp. 345-369.

High-technology firms are different from other firms in the way they spin off and in their birth. The paper is based on a study of firms in the computer, medical instruments, semi conductors and medical programming industry. The north-east and the west have the large technology firms. The south has an number of single location firms. The birth of new industries tend to be in the areas of agglomeration of the already existing industries. Little dispersal of the industries is taking place away from the core regions. New firms arise in areas where the entrepreneurial conditions are right. The costs of operating these industries might be high but is accepted because of the need for a large number of high-skilled employees who do non-routine work. The agglomeration of each industry tends to retain the capital, labor and infrastructure necessary to retain each firm.

Mowery David and Ziedonis Arvids 2001. The Geographic Reach of Market and Non-Market Technology Transfer: Comparing Citations and Licenses of University Patents. NBER Working Paper No.w8568, October 2001.

The growth of high-technology clusters in the United States suggests the presence of strong regional agglomeration effects that reflect proximity to universities or other research institutions. Using data on licensed patents from the University of California, Stanford University, and Columbia University, this paper compares the geographic 'reach' of knowledge flows from university inventions through two important channels: non-market 'spillovers' exemplified by patent citations and market contracts (licenses).

Neil Bania, Randall W Eberts, Michael S. Fogarty. 1993. "Universities and the Startup of New Companies: Can we Generalize from Route 128 and Silicon Valley?" in The Review of Economics and Statistics, Vol. 75, No. 4. (Nov., 1993), pp. 761-766. (notes)

The paper points that to increase the commercialization of research, policy makers form ties with university research and industry R and D. The paper is based on a hypothesis that there is a link between commercialization and university research. The paper is based on a model of startup firms located in 25 metropolitan areas. The data shows that the firms benefit from hiring graduates from the surrounding universities, faculty as consultants and sponsoring university research. The conclusions show that it is not possible to generalize the impacts of the area that has been studied. The universities have had a positive impact on the development of the microelectronics industry. Recent studies of technological spillovers show that there is a relationship between university research and corporate patenting activity. Previous studies also show that the largest spillover is from drugs and chemicals implying that university research is important for product than for process R and D.

Rauch James E. 1993 Does History Matter Only When it Matters Little? The Case of City-Industry Location University of California, San Diego Department of Economics Working Paper: 93-05

When can we expect an industry subject to agglomeration economies to move from a site in a high-cost country or region to a site in a low-cost country or region? It is argued that the weight of history in preventing such a move is best understood as due to the presence of sunk costs resulting from the operation of many firms at a site, which can cause every firm to prefer to let other firms move first. It is shown that, by acquiring a monopoly on land suitable for the industry at the low-cost site, a developer can overcome this coordination failure by discriminatory pricing of land over time.

This model is shown to be capable of explaining important stylized facts of behavior of developers of industrial parks in the United States. Moreover, this behavior can provide information on the nature of inter-firm externalities. Obtaining a monopoly on suitable land may require cooperation of local government through measures such as restrictive zoning, suggesting a framework for analyzing the effects of local government policy on economic growth at the local level.

Romer, Paul 1990. "Endogenous Technological Change" in The Journal of Political Economy, Vol. 98, No. 5, Part 2: The Problem of Development: A Conference of the Institute for the Study of Free Enterprise Systems. (Oct., 1990), pp. S71-S102.

Growth in this model is driven by technological change that arises from intentional investment decisions made by profit-maximizing agents. The distinguishing feature of the technology as an input is that it is neither a conventional good nor a public good; it is a non-rival, partially excludable good. Because of the non-convexity introduced by a non-rival good, price-taking competition cannot be supported. Instead, the equilibrium is one with monopolistic competition.

The main conclusions are that the stock of human capital determines the rate of growth, that too little human capital is devoted to research in equilibrium, that integration into world markets will increase growth rates, and that having a large population is not sufficient to generate growth. The model that is presented in the paper is based on three main assumptions- technological change or the improvement in the instructions in mixing raw materials lies at the heart of economic growth, technological change is the result of intentional actions taken by people that are driven by market incentives and the third is that working with raw materials is fundamentally different from working with other economic goods.

Once the cost of creating a new set of instructions had occurred, the instructions are used over and over again without incurring any additional cost. Developing new and better instructions is equivalent to incurring a fixed cost. This the main premise of the model. The model that is designed in the paper is that a firm endures R and D cost with the creation of a new good. It recovers those costs through the selling of a new good that is higher than its constant cost of production. With free entry into the activity, firms earn zero profit in the present value sense. The paper additionally explains the reason why very little human capital is devoted to research.

Romer, Paul 1994. "The Origins of Endogenous Growth" in The Journal of Economic Perspectives, Vol. 8, No. 1. (Winter, 1994), pp. 3-22.

Scott, Allen. 1993. Technopolis: High-technology industry and regional development in southern California. Berkeley and Oxford: Oxford University Press.

Presents an extended series of empirical studies of the genesis and growth of high-technology industry in southern California, its changing technological foundations, its structure and organization, its labor force, its extraregional connections, and its evolving geographical pattern within the region. Inquires into the logic of some of the central building blocks of industrialization processes as they impinge on patterns of regional development. Presents a geographical and historical overview and a structural profile of the southern Californian technopolis. Provides detailed analyses of the workings of three major sectors: aircraft and parts; missiles and space equipment; and electronics. Presents contrasting case studies of local labor market dynamics: one focusing on engineering and scientific employees at three Lockheed aircraft plants and the other focusing on low-wage workers employed in electronics assembly subcontract shops. Examines subcontracting relations and locational agglomeration in a study of the printed circuits industry. Explores the relationships among technological innovation, new firm formation, and locational structure in southern California's medical device industry. Identifies some serious threats to the long-term viability of southern California's high-technology industrial complex and lays out some policy guidelines to deal with the crisis at hand.

Stephan, Paula. 1996. "The Economics of Science" in the Journal of Economic Literature. Volume 34. pp 1199-1235.

The essay explores the role of science in the economy. The article looks at the role of science in growth from two strands of research. Firms benefit from knowledge spillovers. Knowledge spillovers are a source of growth and the spillovers are endogenous. Firms contribute towards the growth in R & D, a case can be made that research in the nonprofit sector spills over and has endogenous elements that are set in motion because of profit-seeking behavior. Priority based reward system provides incentives to for scientists to behave in socially beneficial ways. Financial rewards in science are a consequence of priority. Scientists are encouraged by the private firms to publish as a result of which there is encouragement and incentive for scientists to engage in innovative activity.

Stokey Nancy L. "R and D and Economic Growth" in The Review of Economic Studies, Vol. 62, No. 3. (Jul., 1995), pp. 469-489.

The aggregate rate of R&D in a competitive economy is compared with the optimal rate. The optimal rate of R&D is shown to be the same for all preferences in a broad family, while the competitive rate is sensitive to the form of substitutability among products and so can vary dramatically within a family. The second-best level of R&D is

shown to be also common within a family and equal to the optimal rate. Numerical examples suggest that diminishing returns in the innovation technology is the most important potential source for excessive R&D in a competitive economy.

There are two factors that determine whether money will be allocated for R and D. The first factor is on the benefit side where the rate at which new innovations create a level of surplus determine an R an D and the second factor is on the cost side where properties of innovation- the allocation of funds to R and D is determined by the effectiveness of these funds at the social margin, the competitive allocation of the funds in the private margin. This changes however with the crowding out effect. In an environment with continued R and D there is a third factor that is involved. If there is a sequence of innovation each invention builds upon its predecessor, the successful innovation opens up opportunity for further invention that would not otherwise be available.

Tassey Gregory 1992. Technology infrastructure and competitive position. Norwell, Mass. and Dordrecht: Kluwer Academic

Presents an integrated view of technology infrastructure for corporate managers, academic researchers, and government policymakers. Provides an overview of technology-based competition and the related growth policy issues facing industrialized nations in the 1990s. Develops a conceptual model of the technology-based economic process that emphasizes the roles and impacts of the elements of the supporting infrastructure. Analyzes specific elements of technology infrastructure and how these elements interact with industry strategy and structure. Addresses the interaction of corporate and government roles for providing technology infrastructure, some funding issues, and mechanisms for cooperative planning and implementation.

Troyer, Jennifer L. ; Krasnikov, Alexander V. "The Effect of Price Regulation on Innovation in the Pharmaceutical Industry" in the Journal of Applied Business Research v18, n4 (Fall 2002): 87-96

The empirical relationship between pharmaceutical industry revenues and pharmaceutical industry innovation is estimated, allowing for an exploration of the impact of the Medicaid rebate program, a form of price regulation. Using the empirical results, the opportunity cost of the Medicaid rebate program is found to be as high as four new drug approvals annually. Given the increased interest in a Medicare drug benefit, regulators should be aware of the hidden cost of price regulation for pharmaceuticals.

Knowledge flows through market transactions to be more geographically localized than those operating through non-market 'spillovers.' Moreover, the differential effects of distance on licenses and citations are most pronounced for exclusively licensed university patents. These findings are interpreted as reflecting the incomplete nature of licensing contracts and the need for licensees to maintain access to inventor know-how for many university inventions. Such access appears to be less important for inventions that are non-exclusively licensed (e.g. 'research tools').

Tuan, Chyau and Ng, Linda F. Y. 2001. "Regional Division of Labor from Agglomeration Economies' Perspective: Some Evidence" in Journal of Asian Economics v12, n1 (Spring 2001): 65-85

This study aims at elaborating the evolving degree of completeness of outward investment of manufacturing and its consequence from the view of regional development since the People's Republic of China opened her door to foreign direct investment. After two decades of Hong Kong's progressive manufacturing cross-border processing of labor-intensive operations performed in the proximate Guangdong province, a regional division of labor has developed by taking advantages of the agglomeration economies of the Hong Kong-Pearl River Delta region.

The analysis is conducted based on such a perspective using the 1998 data of a population of 2,441 electronics joint ventures in Guangdong. Findings suggested that firms' location (density) distribution, via exploiting the agglomeration economies, followed a pattern well explained by a simple gravity model with Hong Kong as the main core. The existing Pearl River Delta cities and the associated cluster economies have also demonstrated attraction for foreign direct investment. Firm size and age effects were also investigated. The findings confirmed the economic contributions of electronics joint ventures, the small ones in particular, to the development of Guangdong and the Hong Kong-Pearl River Delta region. Some suggestions on regional policy coordination were initiated.

Varga Atilla, 1998. University research and regional innovation: A spatial econometric analysis of academic technology transfers. Economics of Science, Technology and Innovation, vol. 13. London: Kluwer Academic

Analyzes university knowledge transfers and the impact of universities on the spatial distribution of industrial R&D activities to see if the experience of the major high-technology centers, such as Silicon Valley, Route 128, or the Cambridge Phenomenon, is generalizable and applicable to other regions. Based on a unique data set of high-technology innovations and industrial R&D employment in the United States in 1982. Undertakes an exploratory spatial data analysis approach, comparing the spatial distributions of innovative activities, private R&D, and university research to detect possible university effects. Examines evidence of local university knowledge transfers at the state level for forty-three states and evidence of university effects at the sub-state level for 125 metropolitan statistical areas. Models the factors that govern the intensity of local university knowledge transfers; demonstrates the importance of agglomeration for the university effects; and addresses the problem of "critical mass" of agglomeration. Details policy implications of the research findings and outlines directions for future research

Venables Anthony J. 1993 Equilibrium Locations of Vertically Linked Industries CEPR Discussion Paper: 802

This paper considers the locational choice of firms in an upstream and a downstream industry. Both industries are imperfectly competitive, with firms subject to increasing returns. There are transport costs between the two locations. Depending on the level of these costs there may be a single equilibrium with production diversified between locations, or multiple equilibria, some of which involve agglomeration at a single location. Typically the forces for agglomeration are greatest at intermediate levels of transport costs. Reducing these costs from a high to an intermediate level will cause agglomeration and consequent divergence of economic structure and income levels; reducing them to a low level may cause the industries to operate in both locations, bringing convergence of structure and income.

Wallsten, Scott. 200. "An Empirical Test of Geographic Knowledge Spillovers Using Geographic Information Systems and Firm-Level Data" in Regional Science and Urban Economics v31, n5 (September 2001): 571-99.

Most research on economic geography focuses on large geographic areas, such as nations and states. I use a geographic information system and a firm-level dataset to explore agglomeration and spillovers at the firm level over discrete distances. I calculate the distance between each firm-pair to explore co-location, and use these calculations to devise a test of spillovers: is participation in the Small Business Innovation Research (SBIR) program, which provides R&D grants to small firms, a function of whether nearby firms win SBIR grants? I find that the number of other SBIR firms within a fraction of a mile predicts whether a firm wins awards, even controlling for regional, firm, and industry characteristics.

Walcott, Susan.1999. "High Tech in the Deep South: Biomedical Firm Clusters in Metropolitan Atlanta" in Growth and Change v30, n1 (Winter 1999): 48-74

The relation between biomedical firms and their metropolitan region location in Atlanta, Georgia is examined as an empirical test of both innovative milieu agglomeration theory and place specific strategies for life science companies in the Deep South. This sectoral analysis utilizes questionnaires and targeted interviews to highlight the economic development role of real estate in suburban employment and residence sites (SEARS) and the intra-metropolitan directional migration of firms. Clustering of related industries is fostered by a shortage of appropriately configured laboratory and office space at the intermediate stage of the business growth cycle, encouraging information sharing and cooperative behavior via proximity by necessity. Lack of a key networking individual or mediating organization critically retards development of this potential growth engine.

Zucker, Lynne, Darby Michael and Brewer, Michael. 1998. Intellectual Human Capital and the Birth of U. S Biotechnology Enterprises in The American Economic Review, Vol. 88, No. 1. (Mar., 1998), pp. 290-306.

This paper demonstrates the commercialization of biotechnology firms is intertwined with science. There is an impact on agglomeration and in the spread of information. The paper shows that there is evidence between timing and location of the initial usage by both entrants (newly dedicated biotech firms) and subunits of dedicated firms which are explained by the presence of scientists and a particular time where there is a large contribution to science.

The paper quantifies the role of universities and their faculties in encouraging localized effects such as spillovers without really quantifying the concept as knowledge spillovers. Based on historical data, the results show that firms located where there was a large intellectual capital. The main reason biotechnology firms locate where they do is because of a large intellectual human capital. Universities with scientists actively involved with research was the main area where firms located.

Other Literature Sources

Economic Impact Studies

Gardner, Kent 2002. Building a New Foundation: The University of Rochester Medical Center in the Regional Economy. Report Prepared by cgr.org Whiteplains: New York.

This is the study of the university hospital in the local economy and specifically the research component of the hospital. The report assesses some of the impacts of the hospital of the regional economy including the employment and services and the indirect impacts of the hospital that includes impacts on the real estate sector, insurance and financial sector. The research facility is a in-house research center that serves as an exporter – bringing money from outside of the community and preventing leakage of money from Rochester to Cleveland or New York. It generates quarter of a billion in direct and indirect payroll and allows for employment of a large number of educated people.

Fuller Stephen S. 2001. The Economic Impact of the Proposed Community Cultural Center at Lord Fairfax Community College. Prepared for The Lord Fairfax Community College Education Foundation.

This study looks at the advantages of building a community cultural center at the Lord Fairfax Community College at its Middletown Campus. The proposed impacts will occur directly through the creation of new jobs and personal incomes within the college service area. The Center will create the capacity to support and attract a variety of conference, training, and community-based functions that presently are inadequately housed,

inconveniently located or take place outside the area due to the absence of a meeting and performance facility. This local spending will generate additional spending.

The indirect and direct spending associated with the construction phase will generate tax revenue from surrounding areas. The construction will involve local residents and businesses who will supply labor, materials and services that will be used in the construction of the center. Additionally, the quality of life may increase making the area more attractive to live in and do business.

The study assess the potential economic impacts of the community center in the construction phase and in the operations phase and assess how the center can improve the community as a whole.

Fuller Stephen S. 2001. The Economic Impact of the Falls Church on the City of Falls Church

The Falls Church is a major source of economic activity through its direct spending in support of its operations and programs and the spending if its employees and visitors for goods and services from local businesses. The Church acts as a catalyst in brining new money into the local economy to be captured by local merchants and recycled into the local economy. The spending totals $4 million annually. With the proposed construction of the Family Life Center, the economic impact of Falls Church will be increased by 25% or $1 million by 2005. Additionally the local economy will benefit during the construction phase from new spending for food services and incidental retail items by on-going construction workers.

Fuller Stephen S. 2002. The Economic and Fiscal Impacts of the World Bank on the District of Colombia and Washington Area. Prepared for the World Bank Group Community Outreach Program. Center for Regional Research, George Mason University.

University of Cincinnati. 2000. University of Cincinnati Economic Impact Study (http://medcenter.uc.edu/impact.cfm)

This study looks at the impact of the medical center on the economy. The medical center is an area that is primarily involved in teaching and research. The information presented on the website contains information on how the center increases economic well-being in the tri-state region of Indiana, Ohio and Kentucky through the generation of jobs, increase in funding and through the generation of revenues.

General Health Related Impacts

Aaron, Henry J. (Ed.) 1996. The Problem That Won't Go Away: Reforming U.S. Health Care Financing. Washington DC: The Brookings Institution.

This text offers a compilation of articles that evaluate past initiatives for health care reform. The selected articles present a clear picture that public debate on health care reform will not go away in the near future. Reasons submitted for this argument are: (1) Pressure to constrain government budgets at all levels holds this topic in the public's view; (2) Demographic changes caused by the baby boom and lowered birth rates after the 1960s will increase medical demands on budgets contrasted with a shrinking workforce to pay for these demands; and (3) The continuing supply of new and expensive technology will continue to drive higher demand. The articles provide varying opinions regarding the future of health care reform.

Aaron, Henry J. and Barry P. Bosworth, "Economic Issues in Reform of Health Care Financing," Brookings papers on Economic Activity, Microeconomics, (1994): p. 249-286.

This article was written during the legislative debate regarding the Clinton health care plan. The authors support universal health and do not discuss the Clinton plan directly. Instead they approach the topic as a primer on issues that policy makers should consider when developing public policy to reform health care. They indicate that the technical switch to universal health coverage is relatively easy, but that it requires careful considerations of the nuances involve with a complex weave of health care, labor compensation packages, and prices. In transition, national and international competitive advantages and disadvantages could result. This could effect inflation, the balance of trade, aggregate supply and demand, and employment; however, they project this impact to be negligible. Finally, they point out what they believe to be the most complex issue--how to rate the risk of using either an experience rating or a community rating. In their view, current risk adjustment formulas are inadequate and long-term solutions would be inefficient to deal with the enormity of the population covered under universal health care.

Abramson, J. H. and Z. H. Abramson. 2001 Making Sense of Data: A Self-Instruction Manual on the Interpretation of Epidemiological Data. Third ed., London, UK: Oxford University Press, 2001.

Although somewhat technical, this text provides a good overview on how to interpret and use epidemiological data in analysis. Of particular value is the section on meta-analysis. This text expands upon econometric methodology. This could be useful when distilling key economic factors from reports regarding the efficacy of technological advancements in disease management.

Anderson, Gerard F. and Jean-Pierre Poullier, 1999. "Health Spending, Access, and Outcomes: Trends in Industrialized Countries," Health Affairs, 18, no. 3 (1999): p178-192.

Using Organization for Economic Cooperation and Development (OECD) on health spending among member nations, the authors report that in 1997 the United States spent $3,925 per capita on health or 13.5 percent of gross domestic product (GDP), while the median country spent $1,728 or 7.5 percent. From 1990 to 1997 U.S. health spending per capita increased 4.3 percent per year, compared with the OECD median of 3.8 percent.

Despite this expenditure, the U. S. has the lowest percentage of the population with government-assured health insurance, the fewest hospital days per capita. On the other hand, the U.S. has the highest hospital expenditure per day and significantly higher physician salaries than the other OECD countries. On the available outcome measures, the United States is generally in the bottom half, with a declining relative ranking since 1960. The authors note that outcome measures are problematic and present only rough outcome estimates.

Anderson, Gerard. 1998. Multinational Comparisons of Health Care: Expenditures, Coverage, and Outcomes, Baltimore, MD: The Commonwealth Fund, 1998.

Although the data are four years old, the country comparisons (Australia, Canada, France, Germany, Japan, New Zealand, the United Kingdom, and America) provides an excellent reference for comparing how well each country is doing with their health policy. The four performance areas presented include: health expenditures, insurance coverage, financing and delivery, and outcomes.

Implications are that the U.S. spends more than twice as much on per capita health spending than any other nation compared. This leaves fewer resources for other goods or services. The data indicate that hospital costs per day and physician incomes bear most responsibility for these expenditures. Despite financial expenditures, the U.S. falls significantly short of the other countries in terms of longevity and infant mortality--and has the only uninsured population (16 percent of the U.S. population was uninsured).

Bazzoli, Gloria J. Benjamin Chan, Stephen M. Shortell, and Thomas D'Annuno 2000. "The Financial Performance of Hospitals Belonging to Health Networks and Systems," *Inquiry*, 37 (2000): p. 234-252.

This paper develops and tests four hypothesis related to hospital financial performance. The study found that hospitals in health systems with unified ownership generally had better financial performance than with contractually based ownership. Network hospitals with highly centralized systems performed better than decentralized systems. These results are consistent with resource dependence, transaction cost economics, and institutional theories of organizational behavior.

Berwick, Donald, "A User's Manual for the Institute of Medicine's (IOM's) "Quality Chasm" Report," Health Affairs, 21, no. 3 (2002): p. 80-90.

This article addresses the key issues in the Institute of Medicine's (IOM's) Crossing the Quality Chasm. Doctor Berwick advises that the Quality Chasm report is more comprehensive than previous work on patient safety and, in the long run, more important. It calls for improvements in six dimensions of health care performance: safety, effectiveness, patient-centeredness, timeliness, efficiency, and equity; and asserts that those improvements cannot be achieved within the constraints of the existing system of care. It provides a rationale and a framework for the redesign of the U.S. health care system at four levels: patient's experiences; the "microsystems" that actually give care; the organizations that house and support microsystems; and the environment of laws, rules, payment, accreditation, and professional training that shape organizational action. This paper is relates to Dr Berwick's work on health care reform and is relevant regarding the need to enhance quality, control costs, and improve access.

Coddington, Dean C., Elizabeth A. Fischer, Keith D. Moore, and Richard L. Clarke. 2000. Beyond Managed Care: How Consumers and Technology Are Changing the Future of Health Care, First ed., San Francisco, CA: Jossey-Bass Publishers, 2000.

This book presents an excellent synopsis of the history of managed care and the issues that helped frame the health care delivery system in existence today. The authors then present a view of the predicted future of health care in a tightly connected link to 1980 to 2025. This link develops a clear picture of a developmental process, offering several alternatives for the future of health care policy.

Key to their predictions is the influence of the Internet on health care delivery as a means to empower the consumer with knowledge based decisions. The authors provide insightful analysis on the health care industry's need to grasp technology available to control costs, increase access, and improve quality. The authors propose and assess four factors that will influence the future of health care delivery and policy: continued incremental changes, constrained resources, technology, and consumerism.

Cutler, David M. and Mark V. Pauly. 1994. "Economic Issues in Reform of Health Care Financing, Comments, and Discussion," Brookings papers on Economic Activity, *Microeconomics*, (1994): p. 287-299.

This article provides counterpoints to a previous article by Henry Aaron and Barry Bosworth that promoted changes via universal health coverage under the Clinton health care plan. The authors make some excellent points about the economics of health care. Four predominant unintended consequences resulting from universal health care coverage are predicted. They include: (1) universal coverage encourages early retirement by removing health insurance as an employment incentive; (2) it increases spending overall rather than decreasing costs; (3) it decreases incentives for the unemployed to return to work; and (4) long-term costs of another social program. The

last issue is the most significant for public policy should if costs are greater than expected--or savings less than expected.

The authors believe that if health care remains in the public sector that the market will correct itself through consumer choice. Cost overruns in the public sector entitlement program results in five options to balance the budget: (1) reduce the benefit; increase the deficit; lower subsidies to the poor; raise taxes; or impose price ceilings. Overall, this is an excellent overview of the arguments against universal health.

Cutler, David M. and Elizabeth Richardson. 1999. "The Value of Health: 1970-1990," *The* American Economic Review, 88, no. 2 (1999): p. 97-100.

The authors attempt to develop a method to measure health and its value. The value of a life-year is set at $75,000-$150,000 with an annual 3 percent discount rate. Disease prevalence, adjusted for age and gender, is used to proxy "quality of life." Quality of life improved as measured by survey respondents reports that they were "in less worse health" over this time period. Using their econometric model, the authors determined that health improved by a value of $100,000 to $200,000 between 1970 and 1990. This is reportedly greater than health expenditures for this population.

Danzon, Patricia 2002. "Health Care Industry," The Concise Encyclopedia of Economics, [Library of Economics, 2002], available from www.econlib.org/library/.

The article provides a synopsis of how health care differs from other goods and services, the role of risk and insurance, and the government's role in health care. The article also explains why health care costs have increased in terms of per capita expenditures as a percent of GDP and attempts to address the value added from these increased costs. Finally, the article concludes with current public policy regarding health care (typically addressing quality and equity) and briefly discusses the future of public policy to provide a minimum safety net for all citizens

Dranove, David. 2000. The Economic Evolution of American Health Care, First ed., Princeton, NJ: Princeton University Press, 2000.

This book presents an excellent review of changes in healthcare delivery over the past several decades. Professor Dranove provides an excellent conceptual evaluation of the key issues surrounding largely unsuccessful attempts to reform American healthcare delivery. Emphasis is placed on prior attempts to affect marketplace forces and how these efforts failed because of unforeseen variables. In general this is a very good over view of important American health care economic issues. Most importantly, however, is the author's insight into the core reasons for "deviations" in healthcare delivery, such as the economic incentives for offering healthcare services (or rationing of care) within

managed care institutions, physicians and hospitals. Such understanding is critical to proposing any sort of rational solution to current problems in the health care system.

Drummond, Michael and Alistair McGuire (Eds.). 2001. Economic Evaluation in Health Care, First ed., London UK: Oxford University Press, 2001.

This in-depth text offers quantitative techniques to evaluate economic effects of health care evaluation. Although very technical, it does effectively merge theory with practical aspects of health policy formulation.

Dubois, Robert W., Anita J. Chawla, Cheryl A. Neslusan, Mark W. Smith, and Sally Wade 2000. "Explaining Drug Spending Trends: Does Perception Match Reality?," Health Affairs, 19, no. 2 (2000): p. 231-239.

A number of recent studies indicate that drug expenditures are rising more rapidly than other health care spending. Using claims databases from managed care and employer-sponsored health benefit plans, this article evaluates the factors and drivers of drug spending for seven selected disease groups. In both types of health care plans, the authors found that it is volume, not price, to be the largest driver of drug spending for the diseases studied. This implies that utilization is at issue as much as pharmaceutical prices.

Feldstein, Paul J., Health Care Economics, Fifth ed., Albany NY: Delmar Publishers, 1999.

This book is intended to be an introductory text that provides an analytical approach to understanding the economics and public policy issues affecting health care. Professor Feldstein focuses on financing and personal medical service delivery and only touches on the broad issue of health and health services. This text provides a comprehensive discussion of supply, demand, market, and public policy considerations as they apply to health care.

Friend, David B. 2000 Healthcare.Com: Rx for Reform, First ed., Boca Raton, FL: St. Lucie Press, 2000.

Dr. Friend presents the argument that the current system not only results in escalating costs, but results in questionable quality of care. He urges increased use of available technology and disease management to harness costs and promote quality. The author also promotes changing roles and empowering the consumer to take an active role in their care, while diminishing the influence exerted by managed care organizations as decision makers.

Ginsburg, Paul B. 1997. "The Dynamics of Market Level Change," Journal of Health Politics, Policy and Law, 22, no. 2 (1997): p. 363-382.

In this article the author states that the health care industry is displaying a competitiveness mirroring other service industries. Organizations are becoming larger to achieve scale economies and to increase market power. Vertical integration, whether through ownership or complex contracts, is also being pursued both to seek efficiencies and to improve the bargaining position of the organization. External forces that are driving these changes include more aggressive activities on the part of purchasers to contain their costs, developments in information technology, management innovation in other service industries, and advances in medical technology.

Within the heath care industry, there is a pattern of organizations taking the initiative to respond to these external forces and other organizations then responding to the pressures in turn placed on them. Although information on strategies is communicated rapidly throughout the country, what is attempted and what succeeds differs a great deal across communities. The nature of current health care institutions in the community, including the presence of large entities with extensive capital and strong management in a particular segment of the health system and the community's experience with managed care are important factors in future trends.

Ginsburg, Paul B. 1999. "Health Spending: Questioning the Assumptions," Health Affairs, 18, no. 1 (1999): p. 272-274.

This article questions the Health Care Financing Administration's (HCFA's) 1998 projections of national health spending. HCFA's projection was based on the assumption that slow premium growth in the 1990s was due to a shift from fee-for-service (high cost) to managed care (low cost). Under this premise, they project that most people are enrolled in managed care plans and that growth of aggregate premiums will increase. Professor Ginsberg asserts that the slowing of premium growth in the 1990s was due to increased competition and incentives of managed care organizations to contain costs. However, he also projected changes in the underwriting cycle that would increase costs. On balance he projected that growth in aggregate Medicare and private insurance premiums would be about 8 percent per year.

Ginsburg Paul B., Peter Kemper, Raymond J. Baxter, and Linda T. Kohn, "Monitoring Market Change: Findings from the Community Tracking Study: The Community Tracking Study Analyses of Market Change: Introduction," Health Services Research, 35, no. 1 (2000): p. 7-16.

This article reports on findings from the Community Tracking Study. This study encompasses 12 metropolitan statistical areas with populations over 200,000. Researcher conducted interviews with leaders of organizations involved in the financing and delivery of health care in the time period of 1996 to 1997. Interview modules were designed to obtain multiple perspectives on a question, and the communities were compared to identify common patterns of change and differences across communities. Researchers found that a fundamental change in the way care is actually delivered is likely to lag behind the extensive changes in organizational relationships that are taking place.

Griffith, John R 1999. The Well-Managed Healthcare Organization, Chicago, IL: Health Administration Press, 1999.

Although this text was written for to assist managers at the local delivery point for health care, select chapters provide interesting background into health care financing, policy, and resource management.

Henderson, James W., Health Economics and Policy. Second ed., (Cincinnati, OH: South-Western, 2002.

This comprehensive text addresses the microeconomics of health care and policy formulation. The text provides an excellent background and discussion on how economic principles apply to health-related issues and explains the social, political, and economic contexts of health care delivery. In addition to exploring the dynamic nature of health care, Professor Henderson addresses the impact of reliance on the private sector to finance health care in the U. S

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The in-depth discussion of the cost and structure of health care in the U.S, such as the market for health insurance, the market for health care practitioners, the aging population, the legal system, technology, and public policies provides an enlightening comparison of the health care industry to other markets. Professor Henderson provides an up-to-date view of the current evolution regarding fee-for-service care, consolidation in the hospital industry, and the economics of state-level health insurance mandates.

Hackey, Robert B. 1999. <u>Rethinking Health Care Policy: The New Politics of State Regulation,</u> First ed. American Governance and Public Policy`, ed. Barry and John Tierney Rabe, Washington, DC: Georgetown University Press, 1999.

This book provides an analytical model to compare differences in the policy choices, implementation, and outcomes of state initiatives to control hospital costs in New Hampshire, Massachusetts, New York, and Rhode Island. The author presents three regulatory regime types, each of which takes a different approach to controlling health care costs. They are: (1) imposed regimes, which use "coercive state authority," to impose public solutions, rather than using private institutions and programs; (2) negotiated regimes, in which cost control policies emerge through a process of consensus building among public and private decisions makers; (3) market regimes, which rely on market forces (i.e., competition) to help control costs, and in which policy is largely in the hands of private, not public, decision makers. Hackey's model is a dynamic, not a static, one. He explains policy regime change in terms of a two stage process involving, first, "a catalyzing event or series of events" (e.g., a fiscal crisis, state judicial decisions, federal policy changes), and then "precipitating" factors involving changes in the following: regime ideology, party control of policy-making institutions, interest groups coalitions, administrative capacity, and court decisions).

Hackey applies his analytical framework to the study of the policy regimes and regime transformations in the four Northeastern states. He shows how the different regime types—e.g., New York's "imposed" policy regime; Massachusetts and Rhode Island's "negotiated" regimes; and, New Hampshire's market regime - produce different politics, policy solutions (e.g., managed care, certificate-of-need legislation, hospital spending caps, etc.), and outcomes in face of the universal need to control health care costs. Space does not allow the reviewer to do justice to the richness of Hackey's analysis, but the book provides some fascinating insights into, for example, the differences in the politics and policy outcomes of cost control under the imposed regime in New York (prior to the Pataki administration) and the market-oriented regimes in New Hampshire. Thus, for example, he contrasts the fiscal condition of New York's hospital system with that of New Hampshire. He concludes that while, "The fiscal condition of the state's hospitals . . . was among the weakest in the United States during the 1980s and 1990s" (72), "the hospital industry in New Hampshire is in strong fiscal health. . . "(176). Indeed, one of the disappointments of the book for me was that Hackey did not extract enough "lessons to be learned" from the apparent cost-containment successes of New Hampshire's market competition approach. The reader is left with the impression that the market does, in fact, help control costs better than the government, but it is not clear if the author is willing to endorse this policy stratagem.

There are some other, fairly minor, criticisms I have of this book. First, Hackey does not make it clear if his three regime types are exhaustive and mutually exclusive. Are these, in fact, the only regime types? Are there any hybrid types? If the model presented here is to guide future research--which one hopes it will--researchers are going to need more guidance on this point. Second, although Hackey refers to the impact of morbidity and mortality variables throughout the book, he does not include them in his inventory of the factors that catalyze and precipitate regime change Clearly such factors as HIV/AIDS, changes in the treatment of people with mental illnesses, and the aging of our population have influenced both the growing costs of health care and the range of policy options for controlling those costs.

Finally, although containing health care costs is a major public policy concern, one question that remains unasked and unanswered is: What impact do various cost control mechanisms have on health outcomes and the health status of a state's population? Presumably a set of policies that successfully contains costs but jeopardizes the health of people would be unacceptable. One suspects that there are not very many, if any, differences in the aggregate health indicators among the people of these four states, regardless of regime type and policy approach. But does a particular cost control mechanism, say managed care, disadvantage certain groups? There is, for example, some evidence that managed care improves the health of urban, educated populations but may not improve that of rural, poor, minority populations. If the ultimate purpose of health care policy is not to save money but to prevent and treat illness, it would have been nice to have some discussion about this.

Herzlinger, Regina E. 1997. Market-Driven Health Care: Who Wins, Who Loses in the Transformation of America's Largest Service Industry, First ed., Cambridge, MA: Perseus Books.

Professor Herzlinger offers an argument for empowering the consumer and promoting free market principles in the health care industry. Solutions reside in providing adequate information to allow the consumer to take control of their health care decisions. Promoting consumerism and public choice economic theories, she addresses demand side economics. Her solutions to the health care crisis are wrapped in the premise that market imperfections will be primarily resolved by enhanced ability of the consumer to make choices. Missing from her argument is what to do with the consumer who does not have the means to purchase care in a free market--i.e. the poor or near poor.

Institute of Medicine. 2001 Crossing the Quality Chasm: A New Health System for the 21st Century, Washington DC: National Academy Press, 2001.

The report envisions a revamped system that not only is centered on the needs, preferences, and values of patients, but also encourages teamwork among health care workers and makes much greater use of information technology. Health care organizations are only beginning to apply technological advances. For example, patient information typically is dispersed in a collection of paper records, which often are poorly organized, illegible, and not easy to retrieve, making it nearly impossible to manage various chronic illnesses that require frequent monitoring and ongoing patient support. Many patients also could have their needs met more quickly and at a lower cost if they had the option of communicating with health care professionals through e-mail. The use of automated medication order entry systems can reduce errors in prescribing and dosing drugs, and computerized reminders can help both patients and clinicians identify needed services. However, the report recognizes that many policy, payment, and legal issues would have to be resolved before much headway could be made.

Petitti, Diana B. 2000. Meta-Analysis, Decision Analysis, and Cost-Effectiveness Analysis: Methods of Quantitative Synthesis in Medicine, Second ed., London, UK: Oxford University Press, 2000.

Very technical, but a comprehensive text on preparing for and conducting quantitative analysis regarding health policy. The text is most useful in understanding quantitative methodology and research findings.

Posner, Richard A. 1999. Natural Monopoly and Its Regulation, Washington DC: Cato Institute.

Imperfections in the health care market could lead to false assumptions regarding health care's status as a natural monopoly. This book is added to the bibliography as a reference to provide a legal, as well as economic, discussion on monopolies. The author defines natural monopolies as those that "exist in those markets in which demand can be

satisfied at lowest cost by the output of only one rather than several competing firms. Under such conditions, conventional wisdom suggests that government regulation must substitute for competition to discipline the behavior of firms." Following up on this definition, the author provides numerous examples of monopolies and debates the need for regulations to prevent monopolies. No examples of medical monopolies are provided in this book.

From a financial reform perspective, this report offers a number of recommendations to optimize resources that will improve quality of care and constrain, or reduce costs. Professor Mary Wakefield, from George Mason University's Center for Health Policy Research and Ethics, was one of the notable health care analysts contributing to this volume.

Skocpol, Theda 1997. Boomerang: Health Care Reform and the Turn Against Government, New York, NY: W. W. Norton & Company, 1997.

This book provides a well-documented explanation for the failure of the Clinton health care plan. The author does an excellent job of presenting the political realities of how flaws in Clinton's "selling" of the program along with the disunity of sympathetic interest groups could not match the unity and purpose of Republican opponents. Following this book, it is easy to apply the principles provided in Kingdon's Agendas, Alternatives and Public Choices. It answers questions regarding why this program appeared to be sacrificed by the Clinton administration and sheds new light on how agendas are set and then altered.

Skocpol, Theda. 1994. Social Policy in the United States: Future Possibilities in Historical Perspective, Princeton, NJ: Princeton University Press, 1994.

This book is a collection of Professor Skocpol's essays on the topics of U.S. social programs and policies, including health care, welfare, and Social Security. Providing an important historical background, these essays, focusing on governmental institutions and political alliances, sheds valuable light on U.S. social policy. Professor Skocpol clearly dispels the myth that Americans are inherently hostile to social spending and suggests. Including a brief assessment of why the Clinton health care plan did not succeed, this is an excellent corallary to her book on that topic, *Boomerang*. Well-written and based on sound facts or observations, this book was positively endorsed by Professor Lipsett of George Mason University.

The Institute for the Future. 2000. Health and Health Care 2010: The Forecast, the Challenge, First ed., San Francisco, CA: Jossey-Bass Publishers, 2000.

This book provides a comprehensive review of the various dimensions of the U.S. health care system to include: changing demographics, demand for health care services, insurance, providers, consumers, medical technology, information technology, workforce, public health services, and behavioral health. The Institute for the Future uses

a panel of experts to analyze and summarize data into a comprehensive resource, complete with exhibits to illustrate the key data points surrounding each area.

VandeHei, Jim and Juliet Eilperin. 2001 "Drug Firms among Big Donors at GOP Event," Washington Post, June 19 2002, p. A01.

Pharmaceutical companies and financial service firms are reportedly among the biggest contributors to the GOP fund-raising events. Both are lobbying to fend off new and costly regulations. Using a senior House GOP leadership aide as a source, the reporter advises that Republicans are working hard to ensure that the party's prescription drug plan for the elderly meets the needs of Pharmaceutical Research and Manufacturers of America (PhRMA), a trade group funded by the pharmaceutical industry. Republicans favored a private sector approach to lowering drug costs that requires seniors to by insurance for drug coverage; Democrats want pharmacy coverage added as a Medicare benefit. The pharmacy industry fears the Democrat plan will require ceilings on profit margins.

Weimer, David L. and Aidan R. Vining. 1998 Policy Analysis: Concepts and Practice, Third ed., Upper Saddle River, NJ: Prentice Hall, 1998.

Although not directly related to health care, this text provides excellent case studies and analysis of policy analysis, concepts, and rationales for development of public policy. Particularly useful are the discussions of when it is appropriate for the government to intervene in a free market system with a focus on government failures and market failures. The overarching concept on both quantitative and qualitative methods to address public policy concerns makes this a very good reference for developing a research framework.