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Program Report

Productivity, Innovation, and Entrepreneurship Program

Nicholas Bloom and Josh Lerner*

The Productivity, Innovation and Entrepreneurship Program was founded as the Productivity Program, with Zvi Griliches as the inaugural program director, in 1978. It has more recently expanded to incorporate the vibrant and growing body of research in the affiliated fields of innovation and entrepreneurship. The program benefited tremendously from Griliches’ inspirational leadership, continued by Ernst Berndt after Zvi’s untimely death in 1999. We have had the privilege of co-directing the program since 2011.

The program has generated a remarkable volume of research activity. It currently has 90 active members, and the program’s cumulative output includes more than 1,350 affiliated working papers on a wide range of topics. The activities of the program are organized into four large project areas. These are: economic research on the measurement and drivers of productivity growth; entrepreneurship, which focuses on the measurement, causes, and effects of new business creation; innovation, which examines R and D, patenting, and creative activities; and digitization, a recently-launched project area, which focuses on the creation, use, and impact of digital information. This review summarizes the research in each of these four areas.

Economic Research on Productivity

As Paul Krugman famously quipped, “Productivity isn’t everything, but in the long run it is almost everything. A country’s ability to improve its standard of living over time depends almost entirely on its

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ability to raise its output per worker.” Rising productivity has been the key to American growth over the last two centuries and will be the key to improving the lives of many millions in the developing world. Even in the recent recession, there has been an active and ongoing debate about the long-term potential growth rate of US output. Understanding productivity growth is a central topic in economics, and one that naturally overlaps with many other NBER programs.

The research by program affiliates displays a strong emphasis on the roles of research and development, patents, incentive systems, regulations, technological progress, and organizational form in influencing the extent and nature of productivity growth. In addition, the PRIE Program has long had a sharp focus on economic measurement, including inputs, outputs, prices, quality change, and multifactor productivity, that has been led in particular by the Conference on Research in Income and Wealth (CRIW). Activities on the broad subject of productivity center on spring and summer research meetings. These meetings allow program members to present work in progress on a variety of productivity topics. The summer meetings are split into sessions that focus on macroeconomic aspects of productivity, and on productivity issues in developing countries. Given the breadth of the program’s research, we can highlight only a few examples of the research issues that program members explore.

One strand of research revolves around the productivity and performance of health care. For example, one recent study examines the traditional wisdom that market forces are weak in the health care sector, leading to a massive dispersion of performance across hospitals. If poorly performing hospitals rarely close, there should exist a huge dispersion of performance. The paper finds that indeed while there is a large spread of performance across hospitals, surprisingly it is comparable to the extent of dispersion in other sectors like manufacturing and retail. Moreover, much like manufacturing, the health care sector shows a strong link between market share and productivity — high performing hospitals grow faster than low performing hospitals, so that performance and size are strongly linked. The paper concludes that health care is far less of
an exceptional industry than is commonly believed, looking in fact rather similar to sectors like manufacturing on certain market dimensions.

Another strand of the program focuses on the importance of micro and macro forces in driving aggregate productivity. Researchers often highlight two ways aggregate productivity can rise: firstly there is the reallocation “batting average” effect, whereby if more productive firms expand and less productive firms contract, then average productivity rises. The second is the macro “rising tide” effect, whereby if innovation and development increase the productivity of every firm, aggregate productivity also rises.

One recent paper on this topic investigated the role of adjustment costs and volatility in explaining the dispersion and average of productivity across over 30 developing countries. The authors found that low productivity in developing countries may be the result of extremely volatile micro-productivity of firms, making it hard for market forces to reallocate output appropriately. This highlights how removing distortions and adjustment costs, as well as reducing market turbulence and uncertainty, can aid the promotion of successful firms.

A third strand of work centers around management and managers. For example, one recent paper shows how the structure of top management in US firms has radically changed since the 1980s. CEOs have doubled the number of managers reporting to them, with a large rise in the number of “product” managers (R and D, marketing) as firms have focused their businesses, and in “functional” managers (finance, law, human resources) as firms invest more heavily in information technology. General managerial positions have shrunk as a share of the total, and the pay of such managers has fallen as more specialized product and functional managers have joined. Another study on a related topic detailed the collection of extensive data on the daily activities of Indian CEOs. It revealed that there is a massive variation in their activities, with CEOs who adopt a more structured routine involving internal cross-functional meetings tending to be more successful compared to those with more “free” time focused on outsiders. It also reported that CEO hours are strongly linked with performance, and that non-family CEOs tend to be much harder working and dedicated — in particular, showing they battle to work even during monsoons and Indian international cricket matches. This highlights how CEO types, hours, and management styles are important drivers of firm productivity, and the importance of starting to explore what these are and how to measure them.

The CRIW is also an important component of the program’s research activities on productivity issues. One of its goals is to support the development of the national accounts and associated statistics. It represents an ongoing collaboration between the statistical agencies, policy community, and academia to advance the field of economic measurement. As such, the membership of the CRIW is split between academic and non-academic members. The CRIW is funded by the statistical agencies and the organization has a sixteen person executive committee, chaired by Charles Hulten, that elects the membership and arranges for individual conferences.

The CRIW organizes a workshop at the NBER Summer Institute which tackles a range of data-related topics. In 2012, for example, one focus was on the emerging value of “big data,” including both administrative records from government agencies and transaction and customer data from private firms. The CRIW also sponsors an annual conference. In 2013 the topic will be “Measuring and Modeling Health Care Costs”, and in 2014, “Measuring Entrepreneurial Businesses: Current Knowledge and Challenges.” These conferences usually result in a conference volume published under the auspices of the NBER.

Entrepreneurship

The PRIE Program’s activities in the entrepreneurship area, and the NBER’s efforts more broadly, are directed by Antoinette Schoar, an NBER Research Associate at MIT’s Sloan School of Management. Activities in this area were launched at a 2003 meeting that included many of the leading researchers from various fields of economics that touched on entrepreneurship. This meeting led to a broad consensus that by many measures, the years since 1980 had seen a dramatic increase in the importance of entrepreneurial activity in the United States. While the overall growth in the number of entrepreneurial firms and business starts was relatively modest, the role of new enterprises in fomenting innovation, stimulating employment, and creating value for investors increased dramatically. Yet surprisingly, academic research — particularly in economics — had not kept pace. The number of articles on entrepreneurship issues in the major economics journals actually declined in the 1990s from the levels seen in the 1980s.

A number of factors might explain this pattern. While data on public firms are readily available in machine-readable databases such as those maintained by the Center for Research in Security Prices, and Compustat, information on young private firms is much harder to come by. Datasets on entrepreneurial firms are in many cases only available through the time-consuming cultivation of personal contacts, and even then are often of widely variable quality.

In an effort to encourage research on entrepreneurship and to build a network of researchers who could share data and other insights, and with the ongoing support of the Ewing Marion Kauffman Foundation, the NBER launched an entrepreneurship initiative, which has carried out three broad types of research activity. First, the group convenes a semi-annual meeting of researchers interested in entrepreneurship research. During the 2013 Summer Institute, for example, more
than 100 scholars participated, ranging from Ph.D. candidates to some of the most senior scholars in the field. This meeting has brought together researchers working on a wide range of topics and presentations have included papers ranging from the financing of entrepreneurs and venture capital funding to macro implications of entrepreneurship and self-employment. At many universities, to young scholars interested in entrepreneurship. At many universities, entrepreneurship in developing countries.

Second, the entrepreneurship initiative has sponsored a number of meetings on specialized topics. The first was on academic entrepreneurship. The idea that academic science is an engine of growth, creating technological opportunities for industrial innovation as well as future scientific research, is well known and studied. Little is known, however, about the role of academic entrepreneurship — faculty participation in commercialization of their inventions and new firm creation — in the innovation process. The project offered a range of new insights on the nature of the entrepreneurship process that emerges from colleges and universities. The second meeting focused on the strategy and structure of entrepreneurial firms. It provided a forum for rigorous research on the microeconomic and institutional foundations of entrepreneurship, and the strategic and market consequences of entrepreneurial activity. The third meeting focused on international differences in entrepreneurship. It was motivated by the concern that far too much of the research into entrepreneurship was focused on the United States. This project sought to encourage a range of studies by a global team of scholars. A fourth conference was motivated by the unprecedented activity in private equity, despite which most of the academic research on private equity markets was undertaken as a result of the previous leveraged buyout (LBO) wave of the 1980s.

The third major activity of the entrepreneurship initiative is outreach to young scholars interested in entrepreneurship. At many universities, graduate students interested in entrepreneurship have few knowledgeable scholars with whom to discuss their research. The consequences in many cases are either the abandonment of the research agenda or the production of inferior research. Since the summer of 2008, the NBER has brought together graduate students in doctoral programs in the United States and Europe for a four-day “boot camp” on entrepreneurship research. The Entrepreneurship Research Boot Camp (ERBC), which is organized by Thomas Hellmann, is typically held immediately following the NBER Entrepreneurship summer meeting. ERBC participants are Ph.D. students who have completed at least one year (and ideally two or three) of their Ph.D. program, and are committed to doing research on entrepreneurship.

**Innovation Policy**

The PRIE program’s activities on innovation policy, and those of the NBER more generally, are directed by Scott Stern, an NBER Research Associate at the MIT Sloan School of Management. This effort, including the Innovation Policy and the Economy (IPE) meeting which is held in Washington each year, was launched in 1999 to provide first-class researchers with frequent and repeated interaction with other researchers interested in innovation, and with those who deal with specific policy questions. Early support was provided by the Alfred P. Sloan Foundation. More recently, the Kauffman Foundation provided partial support for the IPE program as well, focusing specifically on the relationship between entrepreneurship and public policy.

This effort examines a wide range of issues, including any policy that affects the ability of an economy to produce scientific and technological progress or that mediates the impact that science and technology has on the process of economic growth. Thus the area of attention is broader than “science and technology policy,” which typically connotes a focus on issues such as federal R and D policy and fiscal incentives for private R and D.

Recent research discussed at meetings of the innovation group has touched on the role of intellectual property rights in affecting innovation, the impact of incentives for innovation on the production of new ideas, and the role of innovation in the health care sector. The NBER’s innovation policy initiative has four primary activities, the first of which is the IPE meeting. For more than ten years, the NBER has hosted this meeting in Washington geared to an audience of congressional and administration staff and other policymakers and policy analysts. The organizers solicit the papers for this meeting, identifying particular individuals who have been active researchers in areas of policy interest, and who have the skills and inclination to interact with a broader audience. These meetings are not organized around a single theme, but rather include about six papers on topics of current policy interest. The meeting concludes with a luncheon address by an academic economist currently involved in public service such as the Chairman of the Council of Economic Advisers. In recent years, these meetings have traditionally attracted between 125 and 150 people from the executive and legislative branches, as well as from other Washington organizations, as well as members of the press. Each of these meetings results in an annual edited volume.

The second activity is a meeting at the NBER Summer Institute featuring the presentation of early-stage research. One day of this meeting has typically focused on the economics of intellectual property. Collectively, these meetings have highlighted research on a wide range of issues in innovation policy, such as the Orphan Drug Act, the drivers of regional entrepreneurship, R and D manpower policy, a range of issues related to the patent system, and the evaluation of various innovation.
policy programs. These sessions have been organized in recent years by Pierre Azoulay, Jeff Furman, Ben Jones, and Scott Stern.

Third, the innovation policy initiative convenes occasional research conferences. One particularly notable meeting, held in 2010, was organized to mark the 50th anniversary of The Rate and Direction of Inventive Activity, a volume published by the NBER in 1962. This historical volume contains several landmark papers in the economics of technological change, including Kenneth Arrow’s essay on “Economic Welfare and the Allocation of Resources for Invention.” The 2010 conference and subsequent volume, The Rate and Direction of Inventive Activity Revisited, sought to commemorate the achievements of the original volume, and to sponsor new theoretical and empirical contributions on fundamental questions in the economics of innovation and technological change. In 2013, the group convened for another meeting titled “The Changing Frontier: Rethinking Science and Innovation Policy.” The proceedings of this meeting, which focused on the impact of the changing nature of scientific research and innovation, for example, the rise of scientific teams, increased internationalization, and rising specialization, will be published as an NBER volume.

Finally, the innovation policy initiative administers an annual series of modest research grants, and appoints an Innovation Policy and the Economy Fellow. The IPE Fellow is a junior scholar who has the opportunity to spend a year in residence at the NBER and to participate in the activities of the IPE group and those of the NBER more generally.

The Economics of Digitization

The fourth distinct project within the PRIE program focuses on the economics of digitization. This project is led by NBER researchers Shane Greenstein, of Northwestern University, and Scott Stern. The starting point for this project is the recognition that the creation, support, use, and consumption of digital representation of information has touched a wide breadth of economic activities. In less than a generation the costs of storage, computation, and transmission of information have declined by several orders of magnitude, lowering the costs of many final products and enabling the creation of an enormous range of new applications. Digitization has transformed social interactions, facilitated entirely new industries and undermined others, and reshaped the ability of people—consumers, job seekers, managers, government officials, and citizens—to access and leverage information. This project is supported by the Alfred P. Sloan Foundation.

The digitization project examines the causes and consequences of digitization for market actors—for their choices over strategic organization, market conduct, and public policies. This project seeks to identify and stress unaddressed research areas, and to tackle questions about business strategy and economics touched by legal forms for governing property rights in information, in particular copyright and open source. Of the various technology drivers enabling the rise of digital technology, growth in digital communication—particularly the internet—has played a central role. Not surprisingly, therefore, this project emphasizes research on internet technology and its economics.

The digitization project has focused on several core themes. One concerns the analysis of supply and demand in internet-mediated markets. These studies help to explain how internet technology came to be widespread, and they explore how the benefits and costs of moving information to a digital format determined internet diffusion. A second theme explores how internet technology changes market behavior and outcomes. These studies explore, in particular, how digitization altered economic frictions such as search costs and distribution costs over a wide range of economic activity. Research on this theme also emphasizes the constraints on the ability of digital technology to overcome such frictions. A third theme explores the impact of the changes associated with digitization on policy and vice versa. If search and distribution costs are lower and information sharing is easy, how does that affect local sales taxes, local restrictions on information, and the demand for privacy? What issues can government policy address, and what consequences—anticipated and unanticipated—result from different types of intervention? The economics of digitization project has hosted two meetings, each of which has included not only economists but also lawyers and business leaders.

This project has convened two meetings as part of the NBER Summer Institute. These have been organized by Susan Athey, Erik Brynjolfsson, Shane Greenstein, and Hal Varian. The papers presented at these meetings have touched on a range of issues, including the role of copyright protection in the music industry,15 the microeconomics of digitization (online content, market structures, impacts on the economy and society), and the macroeconomics of digitization (the role of IT in driving US growth, inequality, and innovation). The project also sponsored a recent conference that included sixteen papers, organized by Shane Greenstein, Catherine Tucker, and Avi Goldfarb: the published proceedings will represent an important reference on this emerging topic area.16 This project also offers fellowship support for a Ph.D. student who is completing a dissertation on some topic related to the economics of digitization, and it offers small grants to more senior researchers who are working on this topic.

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2. A. Chandra, A. Finkelstein,


The proceedings were published in the Fall 2009 issue of the Journal of Economics and Management Strategy.
Banking Crises and the Federal Reserve as a Lender of Last Resort during the Great Depression

Gary Richardson*

My research focuses on banking crises in the Great Depression, the structural flaws in the financial system that propagated the crises, the Federal Reserve’s efforts to act as a lender of last resort, and the factors that shaped how policymakers responded to the crisis. Research on these issues involves gathering documents from the archives of the Federal Reserve System as well as collecting information from state regulators and private firms.

My emphasis on institutions and data stems from a desire to identify the causes of the crises and the effects of a lender of last resort. These events and policies were, obviously, endogenous, making it difficult and at times impossible to clearly identify cause and effect. Identification is complicated because the factors that facilitate identification in financial theory consist of information—that is difficult (and often impossible) to observe in practice and that exists in few of the records remaining from the 1930s.

Structural Weakness in the Commercial Banking System before the Great Depression

The NBER dates the onset of the Great Depression to August 1929. In the fall of 1930, 15 months after the onset of the contraction, the economy appeared poised for recovery. The previous three contractions, in 1920, 1923, and 1926, had lasted an average of 15 months. In November 1930, however, a series of crises among commercial banks turned what up to that time had been a typical recession into the longest and deepest contraction of the twentieth century.

When the crises began, over 8,000 commercial banks belonged to the Federal Reserve System, but nearly 16,000 did not. Those non-member banks operated in an environment similar to that which existed before the Federal Reserve was established in 1914. That environment harbored the causes of the banking crises.

One cause was the practice of counting checks in the process of collection as part of banks’ cash reserves. These “floating” checks were counted in the reserves of two banks, the one in which the check was deposited and the one on which the check was drawn, and in many cases additional banks through which the check flowed while clearing. In reality, however, the cash resided in only one bank. Bankers at the time referred to the reserves comprised of float as fictitious reserves. The quantity of fictitious reserves rose throughout the 1920s and peaked just before the financial crisis in 1930. Estimates vary, but in the fall of 1930, fictitious reserves probably accounted for more than half and possibly up to four-fifths of all reserves in non-member banks. This meant that the banking system as a whole had a limited amount of cash reserves available for emergencies.1

Another challenge was the inability to mobilize bank reserves in times of crisis. Non-member banks kept a portion of their reserves as cash in their vaults and the bulk of their reserves as deposits in correspondent banks in designated cities. Many, but not all, of the ultimate correspondents belonged to the Federal Reserve System. This reserve pyramid limited country banks’ access to reserves during times of crisis. When a bank needed cash, because its customers were panicking and withdrawing funds en masse, the bank had to turn to its correspondent, which might be faced with requests from many banks simultaneously, or might be beset by depositor runs itself. The correspondent bank also might not have the funds on hand because its reserves consisted of checks in the mail, rather than cash in its vault. If so, the correspondent would, in turn, have to request reserves from another correspondent bank. That bank, in turn, might not have reserves available or might not respond to the request.2

It should be noted that these flaws had been apparent to the founders of the Federal Reserve. Paul Warburg wrote about them even before the financial crisis in 1907. The National Monetary Commission described them in its series of reports. The initial leaders of the Federal Reserve System discussed them in their writings and explained how the structure of the Federal Reserve and the actions of its leaders solved these problems for member banks. But—here is a key part of the story—the Federal Reserve solved these problems only for member banks. For this reason, Warburg urged all commercial banks to join the Federal Reserve System. At the start of the depression, what the Federal Reserve could and should do for non-member banks remained an open question.
The Initial Banking Crisis and a Policy Experiment

These flaws in the financial system engendered the initial banking crisis of the Great Depression. This crisis began with the collapse of Caldwell and Company. Caldwell was a rapidly expanding conglomerate and the largest financial holding company in the South. It provided its clients with an array of services—including banking, brokerage, and insurance—through an expanding chain and a series of overlapping directorates controlled by its parent corporation headquartered in Nashville, Tennessee. The parent got into trouble when its leaders invested too heavily in securities markets and lost substantial sums when stock prices declined. In order to cover their own losses, the leaders drained cash from the corporations that they controlled.

On November 7, one of Caldwell’s principal subsidiaries, the Bank of Tennessee (Nashville) closed its doors. On November 12 and 17, Caldwell affiliates in Knoxville, Tennessee, and Louisville, Kentucky, also failed. The failures of these institutions triggered a correspondent cascade that forced scores of commercial banks to suspend operations. In communities where these banks closed, depositors panicked and withdrew funds from other banks. Panic spread from town to town. Within a few weeks, hundreds of banks suspended operations. About a third of these banks reopened within a few months, but the majority liquidated.

Panic began to subside in early December. But on December 11, the fourth largest bank in New York City, Bank of United States, ceased operations. The bank had been negotiating to merge with another institution. The New York Fed had helped with the search for a merger partner. When negotiations broke down, depositors rushed to withdraw funds, and New York’s Superintendent of Banking closed the institution. This event, like the collapse of Caldwell, generated newspaper headlines throughout the United States, stoking fears of financial Armageddon and inducing jittery depositors to withdraw funds from other banks.

The Federal Reserve’s reaction to this crisis varied across districts. The crisis began in the Sixth District, headquartered in Atlanta. The leaders of the Federal Reserve Bank of Atlanta believed that their responsibility as a lender of last resort extended to the broader banking system. The Atlanta Fed expedited discount lending to member banks, encouraged member banks to extend loans to their non-member correspondents, and rushed funds to cities and towns beset by banking panics.

The crisis also hit the Eighth District, headquartered in St. Louis. The leaders of the Federal Reserve Bank of St. Louis had a narrower view of their responsibilities and refused to rediscount loans for the purpose of accommodating non-member banks. During the crisis, the St. Louis Fed limited discount lending and refused to assist non-member institutions.

Outcomes differed between the districts. After the crisis, in the Sixth District, the economic contraction slowed and recovery began. In the Eighth District, the banking system lay in shambles. Lending declined. Business faltered and unemployment rose.

I examine these events in a paper that estimates the effect of the intervention by the Federal Reserve Bank of Atlanta relative to the inaction of the Federal Reserve Bank of St. Louis. To control for the factors that typically impede inference in such situations, we restrict our analysis to the state of Mississippi. The southern half of Mississippi belonged to the Atlanta District. The northern half belonged to the St. Louis District. None of the banks in Mississippi had connections to the Caldwell conglomerate, so the banking crisis in the state stemmed almost entirely from the panic and runs that spread throughout the region in the wake of Caldwell’s collapse. An array of statistical tests (including non-parametric survival analysis and more common parametric regressions) demonstrate that during the panic in the Atlanta District, banks failed at much lower rates, and after the crisis, banks loaned larger amounts of funds, and output and employment were higher than in the St. Louis District. A variety of robustness checks corroborate this claim.

To further examine the impact of Atlanta’s lender-of-last resort policies, two co-authors and I exploit exogenous variation in banking conditions across Florida in 1929 to assess the effect of the Atlanta Fed’s policies during the last banking crisis before the onset of the contraction. This crisis involved an infestation of Mediterranean fruit flies in the spring and summer of 1929. In the summer of 1929, the state and federal government began eradicating infested groves and embargoing shipments of crops from infested regions. Congress recessed without determining whether to compensate farmers for their losses. Within two weeks, runs began on the correspondent banks in Tampa which served as a hub of the financial network in central Florida. The Atlanta Fed intervened by rushing large quantities of cash to the afflicted institutions, stopping the panic in its tracks, and resuscitating the financial system.

Banking Crises in 1931 through 1933

Much of my research focuses on the initial banking crises of the Great Depression, because the structure of institutions and events enables plausible identification of cause and effect at that time. The banking crises continued, however, for two and a half years, and my research examines that period as well.

From 1931 to 1933, the US banking system experienced a series of regional crises as well as two national crises. The first national crisis coincided with the financial crisis in Europe and peaked after Britain’s departure from the gold standard in the fall of 1931. The second national crisis began in the winter of 1933 and ended when Roosevelt declared a national banking holiday.

In one paper, I reassess a perennial debate concerning the causes of the banking crises during the Great Depression. One school argues that illiquidity forced most banks out of business, and therefore, an aggressive lender of last resort may have mitigated the crisis. Another
school argues that insolvency forced most banks out of business. These failures occurred, in other words, because the banks invested funds in assets that failed to pay back. Returns to investments fell because the industrial economy contracted. "Fundamental" investment losses drove banks out of business. In this case, a lender of last resort could not have ameliorated the crisis. Government assistance of financial institutions might have worsened the problem by enabling zombie banks to remain in operation and shifting losses from private investors to the public sector.

To address this debate, I examine a database on the causes of bank suspensions compiled by the Federal Reserve Board. It indicates bank examiners' conclusions concerning the causes of failure for almost all commercial banks operating in the United States at that time. The data demonstrate that both illiquidity and insolvency were substantial sources of bank distress. Periods when large numbers of banks failed were periods of intense illiquidity. Illiquidity and contagion via correspondent networks was particularly intense during the initial banking panic in the fall of 1930 and the last banking panic in the winter of 1933. As the depression deepened, asset values declined, and the Reconstruction Finance Corporation increasingly served as a lender of last resort, insolvency loomed as the principal threat to depository institutions.

In a series of three papers, I examine the transmission of the financial crisis from Europe to the United States in the summer and fall of 1931. The transmission might have occurred by directly affecting financial institutions in the United States, particularly the banks in New York, which had sizeable investments in and deposits from Europe. To determine the magnitude of this channel, my co-authors and I compare the performance of banks with substantial exposure to European deposits and debts with those with little or no exposure to European risks. We demonstrate that the banks with European exposure—which tended to be the largest money-center banks in the United States—performed significantly better by almost all measures than banks without European exposure.

Why? New York's money-center banks predicted financial turmoil in Europe at least two years prior to the event. Recognizing their vulnerability to a trans-Atlantic crisis and realizing that they had to rely on their own efforts to survive the shock, these banks accumulated reserves and capital in preparation for the event. When the crisis came, they wrote down their reserves and both deliberately and collectively continued lending as usual.

Another paper examines a related question: why did bank failures in New York City, at the center of the U.S. money market, peak in July and August 1931, when the banking crisis peaked in Germany and before Britain abandoned the gold standard? The chronological correlation suggests that a connection existed between events in New York and on the continent. Our research initially sought this connection. Instead, we found the correlation to be coincidental. Rather than the exposure to events overseas, bank distress rose in New York because of intensified regulatory scrutiny, which was a delayed reaction to the failure of the Bank of United States. In the summer of 1931, New York's legislature held hearings regarding the performance of the Superintendent of Banking, whom they accused of lack of vigilance. Before and during the hearings, the bank superintendent directed a wave of examinations of banks in New York City and shut down a series of institutions that failed to pass muster.

A final essay examines the transmission of financial shocks from the periphery to the center of the financial system in the United States. In 1929, nearly all interbank deposits held by Federal Reserve member banks belonged to "shadowy" non-member banks which were outside the regulatory reach of federal regulators. Regional banking panics in the early 1930s drained these interbank deposits from central reserve city banks of Chicago and New York. Money-center banks responded to the increasing volatility and declining quantity of interbank deposits by changing the composition of their balance sheets. They reduced lending to businesses and individuals, and increased their holdings of cash and government bonds. This interbank channel accounted for a substantial share of the decline in lending during the contraction of the 1930s.

**What Have We Learned?**

The financial crisis of 2008 and its aftermath highlight the importance of studying infrequent economic catalysts. These events seldom occur, but when they do, economic agents and policymakers need to be prepared, because in a short span of time, they must make decisions that have tremendous impact on the lives of ordinary men and women and on the future of the world economy.

By studying the late 1920s and early 1930s, we learn that prosperous economies can have healthy financial systems that harbor hidden flaws. The depth of the structural problems may not be apparent during the boom years. Detecting them may be difficult even for scholars studying events after the fact. The structural flaws that I study are a case in point. Scholars studying the Depression after World War II attributed the weakness of the financial system to an institutional change that they believed had occurred around the time of the Federal Reserve Act. In the nineteenth and early twentieth centuries, the principal defense mechanism for banks beset by runs was the suspension of the conversion of deposits to currency. Suspension of convertibility enabled banks to preserve their assets by strictly enforcing the contracts that depositors signed when they opened accounts. While the suspension of convertibility during crises before the founding of the Federal Reserve is widely recognized, leading scholars asserted that because of regulations associated with the founding of the Federal Reserve, banks could not suspend payments during the Great Depression. My research
drawing on records of the Division of Bank Operations of the Federal Reserve Board finds that during the early 1930s, banks could and frequently did suspend payments to depositors.\textsuperscript{10} In the 1920s, the Division of Bank Operations established a nationwide reporting network that gathered information—including examiners’ reports—in all bank suspensions, liquidations, and mergers.\textsuperscript{11} This data clearly illuminates problems relating to reserves (which I described earlier) as the principal propagators of the commercial banking crises in 1930 and 1933 and a contributor to the financial crises that occurred in the interim.

We also learn that policymakers can take actions to mitigate a financial crisis. When a correspondent cascade knocks banks down like dominoes, rushing liquidity to nodes in the network can stop the chain reaction. The Atlanta Fed took this approach during crises in Florida in 1929 and Tennessee and Mississippi in 1930. Their efforts mitigated the panic and encouraged economic recovery.


\textsuperscript{7} G. Richardson and P. Van Horn, “Intensified Regulatory Scrutiny and Bank Distress in New York City during the Great Depression,” Journal of Economic History 69 (2009), pp. 446–65 (also NBER Working Paper No. 14120, June 2008.)

\textsuperscript{8} K. Mitchener and G. Richardson, 2013, op cit.


\textsuperscript{11} G. Richardson, “Bank Distress during the Great Contraction, 1929 to 1933, New Data from the Archives of the Board of Governors,” NBER Working Paper No. 12590, October 2006. I found this data in the National Archives. Milton Friedman read the draft of this paper and told me that he and Anna Schwartz had looked for this data long ago, but could not find it, and then listed the questions that I should try to answer with the information.
The Economics of Variations in Health and Health Care

Jonathan Skinner*

When my Dartmouth colleague Dr. John Wennberg drove through Vermont in the late 1960s collecting data on hospital admissions, surgical procedures, and doctor visits, he found something unexpected—enormous variability in rates of medical care use across seemingly similar Vermont towns. In some school districts, nearly every school child still retained his tonsils, while in other districts, nearly every school child’s tonsils had been removed.

Since 1996, the Dartmouth Atlas of Healthcare has used national Medicare claims data to document regional variations in health care patterns, now across 306 “hospital referral regions” in the United States. The most recent data from 2010 shows per capita age-sex-race-price-adjusted Medicare expenditures ranging from $6,176 in LaCrosse, Wisconsin to $13,824 in McAllen, Texas. These variations have captured the attention of a now-expanding group of economists, physicians, and other social scientists. Both NBER and Dartmouth have been centers for this research, much of which has been supported with funding through the National Institute on Aging. My work, with various collaborators, has focused on three general questions:

What are the Causes of Regional Variations in Health Care Utilization?

Health status is one leading candidate for the observed variations; after all, regions in Louisiana or West Virginia should spend more, given the greater burden of disease and poverty in those states. One study drew on rich survey data of elderly Medicare enrollees with information about income, poverty status, health behaviors such as smoking and drinking, and self-reported health, and found that health and income explained one-third of overall regional variations, leaving two-thirds unexplained. A different approach compared treatment patterns for specific diseases such as heart attacks with highly detailed chart-review information; even this “apples-to-apples” approach finds considerable differences in risk-adjusted spending between the highest and lowest quintile of Medicare patients.

Another explanation for the regional variations is patient preferences and demand more generally—people in high-spending regions may demand, and get, more health care. We have tested this hypothesis using a national survey of Medicare enrollees, where enrollees were asked about their preferences for more intensive diagnoses and treatments. However, we did not find that patient preferences in a region could explain more than a small fraction (generally less than 10 percent) of the overall regional variations in Medicare spending across regions.

If not health or demand, then perhaps these variations are the consequence of “supplier-induced demand”: physicians prescribing more than medically necessary to augment their income. One problem with this explanation is that Medicare is a federally administered program that pays just about the same for procedures (adjusted for local prices) in LaCrosse, Wisconsin as in McAllen, Texas. If McAllen physicians are engaging in classic supply-induced demand behavior, then why aren’t LaCrosse physicians?

If not the standard supplier-induced demand story, then perhaps a more subtle version applies: that physicians perform clinically unnecessary procedures in response to peer pressure from referring physicians, or because patients insisted on them. We found that physicians were surprisingly disposed to reporting such effects, but these factors didn’t explain regional differences in Medicare expenditures. Instead, physician beliefs in the effectiveness of intensive treatments for chronically ill patients (for example those with serious Class IV heart failure) were the best explanation for why some regions spent so much more than others. That many of these beliefs were inconsistent with guidelines set by the American College of Cardiology, and the American Heart Association, at least points to the possibility that some treatments are being provided with very little benefit to patients.

What are the Consequences of Regional Health Care Variations?

What are the welfare consequences of these variations in spending, in terms of improved health and longevity? If more spending leads to better health, then perhaps some regions are spending too little. There is some controversy about the association between spending and health outcomes, with some studies showing zero or even negative associations between spending and survival or quality of life. Still others, using instrumental variables approaches, have shown that higher spending is associated with better health outcomes, for example Joseph Doyle and colleagues’ research showing greater health returns to tourists with acute emergency room admissions admitted to higher cost hospitals, or for those patients who happen to be picked up by an ambulance loyal to higher-spending hospitals. Some sense of this ambiguity can be seen in an earlier study by Elliott Fisher and colleagues; using a variety of datasets and measures of both intensity and health

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outcomes, they tested this hypothesis in 42 different ways, and found 23 showed a negative association, 14 a zero association, and five a positive association—in other words, no consistent pattern.\(^9\)

How can this empirical puzzle be explained? One approach is to recognize that health care offers a mind-boggling variety of different treatments, ranging from aspirin for heart attacks (highly effective, nearly costless), to antiretrovirals for HIV and AIDS patients (highly effective, even if costly), to proton beam therapy for prostate cancer (no known medical benefits over alternatives, very expensive). Thus $1,000 in extra spending could go for valuable treatments that save lives, or it could be devoted to useless (or even harmful) treatments or diagnostic tests. Without knowing more about how the money is spent, it’s nearly impossible to discern how some measure of average health care spending should be associated with health outcomes, so it is probably not surprising to find confusion as well in the empirical evidence. As it turns out, the productivity literature in economics provides a valuable conceptual and empirical framework for addressing this question of how spending relates to health.

**Why are Productivity Differences so important in explaining Regional Variations?**

Nearly every study of spending and outcomes shows a similar pattern—wide variability in both health outcomes and health spending, as shown in the figure. Each dot in the accompanying Figure could represent (for example) outcomes for a specific hospital, or it could be for a region or even a country.\(^9\) Empirically, the correlation between these dots could be positive, negative, or zero; the slope of the line is less important than the scatter-shot nature of the data. The key point is that, relative to the most productive hospital or country in the upper left hand corner of the graph (denoted A), the other hospitals either cost more, get worse health outcomes, or both, as is the case for Hospital B.

Amitabh Chandra and I, following earlier work by Wennberg and colleagues, have tried to capture these productivity issues in the context of a simple model that characterizes medical treatments from most cost-effective to least cost-effective.\(^10\) The most cost-effective treatments, like antiretrovirals for AIDS and HIV patients, are deemed “Category I,” while treatments with heterogeneous benefits—helpful for some, but not all patients, such as stents for cardiovascular disease—are “Category II.” Finally, treatments like proton beam therapy with little known value but very high costs are viewed as “Category III” treatments.

As Douglas Staiger and I found for the treatment of heart attacks, hospitals that adopted Category I treatments like aspirin and beta blockers—pennies per pill—showed consistently better health outcomes with identical costs; in other words, they were the hospitals with the open dots, characterized by the production function \(F_1\) in the Figure below, rather than on \(F_2\) which characterized the slower adopters marked by the green dots.\(^11\) Similarly, the lower production function \(F_2\) can represent health care systems that are investing more heavily in Category III treatments, leading to the same outcomes but at higher costs. This Figure also illustrates why simple correlations between health care spending and health outcomes could be either positive or negative (or zero), even when the “true” return to spending is still positive, as shown by the generally positive slopes of the production functions.

Thinking about health care as an industry that is far from the production possibility frontier immediately raises the question of why — is there something specific about health care’s lack of market incentives and dominance of third-party payers that might lead to such inefficiencies? One study suggests no, that in fact these differences in productivity in health care are little different from the degree of inefficiency in some other industries, and that the more productive hospitals actually gain market share over time.\(^12\)

There are also several unresolved questions. For example, why do some regions appear to do so much better in adopting “Category I” treatments (such as beta blockers for heart attack patients), and why were these same regions so rapid to adopt other innovations in non-health sectors as well (such as hybrid corn in the 1930s and 1940s)?\(^13\) Second, why are regional variations for private health insurance often so different from patterns for Medicare patients?\(^14\) Finally, will financial reforms such as those being implemented under the Affordable Care Act of 2010 lead existing health care providers to improve their productivity so that they figure out how to offer better quality care at lower cost?
Conclusion

Productivity in US health care is a central issue to the economic health of the United States. My work and that of others suggests that between 10 and 20 percent of US health care spending may have very little effect on health outcomes. These efficiency estimates are staggering—20 percent inefficiency in an industry comprising 18 percent of GDP is nearly 4 percent of GDP—and underestimate the additional efficiency costs of raising tax revenue to pay for the inefficient care.15

More importantly, there is likely to be enormous inefficiency because hospitals and providers are so far from the production frontier in health, whether because of the slow diffusion of new technologies, poor use of existing technologies, or a lack of knowledge about the value of commonly used treatments for different types of patients. Understanding better how to target and reward productivity improvements in health care can ultimately provide the basis for real productivity growth in health care: both saving money and saving lives.

International Mobility of Research Scientists

Paula Stephan*

In the United States, approximately half of all Ph.D.s awarded in science and engineering go to the foreign born. More than two-thirds of temporary residents who receive Ph.D.s in science and engineering work in a research capacity while in graduate school. The proportion is over 80 percent in engineering. Approximately 60 percent of postdoctoral fellows are in the United States on a temporary visa and approximately 42 percent of those with a doctoral degree working in a science and engineering occupation in the United States were born outside the United States. There is evidence that the foreign born contribute disproportionally to exceptional contributions in science and engineering and that highly productive scientists are even more mobile than the underlying scientific population. Despite the importance of the foreign born, it is difficult to make cross-country comparisons regarding their presence and role because of the absence of consistent data across countries. Most OECD countries, for example, collect data on recipients of tertiary degrees by immigration status, but the data do not distinguish between those with Ph.D.s versus other tertiary degrees, nor do they distinguish field of study. Moreover, most countries have an incomplete picture of the migration patterns of scientists born in their country because it is difficult to track individuals working outside their country of origin.

To provide consistent cross-country data on active researchers, my co-authors and I fielded the GlobSci survey of corresponding authors of articles published in 2009 in four fields of science: biology, chemistry, earth and environmental sciences, and materials. The fields were chosen in part because 95 percent or more of all articles published in these disciplines contain the corresponding author’s email. We focused on researchers who were studying or working in one of 16 “core” countries: Australia, Belgium, Brazil, Canada, Denmark, France, Germany, India, Italy, Japan, Netherlands, Spain, Sweden, Switzerland, United Kingdom, and United States. China was initially included in the survey. However, a low response rate of less than 5 percent for a test sample of Chinese addresses suggested that respondents were either not receiving the invitation or had problems responding to the invitation. The response rate to the web-based survey, which was administered during the spring of 2011, was 40.6 percent. Country of origin was determined by asking the respondents to report country of residence at age 18.

**Mobility Patterns of the Foreign Born**

We find widely varying patterns of immigration and emigration for the more than 17,000 scientists for whom country of origin and country of residence in 2011 could be determined. The country with the largest percentage of Ph.D. scientists who are immigrants was Switzerland (56.7), followed distantly by Canada (46.9), Australia (44.5) and then by the United States (38.4). Virtually no foreign-born scientists reported working in India; only 3 percent of the research-active scientists in Italy and 5 percent in Japan are foreign. Immigrant scientists were asked to evaluate the importance of 14 possible reasons for coming to work or study in their country of residence. Virtually no variation exists across country in response. The “opportunity to improve my future career prospects” and the presence of “outstanding faculty, colleagues or research team” trump all other reasons. Regardless of country, respondents list family reasons or fringe benefits last among reasons for coming to work or study in a foreign country.

Our approach provides information on emigration flows among core countries. We find Indians to be the most likely to emigrate—almost 40 percent of scientists living in India at age 18 were working outside the country at the time of the survey. Approximately one-third of Swiss scientists are outside their home country; the Netherlands and the United Kingdom have the next highest rate of emigration. The country with the lowest percentage of emigrants is Japan (3 percent) but the United States is a close second (5 percent). In all cases, save Belgium, the United States is the most likely destination country. The data also permit us to determine that half or more of the respondents who lived in 13 of the 16 countries at age 18 have an international experience. The three exceptions are the United States, Japan, and Italy. Return rates also vary among emigrants. The country with the highest return rate is Japan (nine out of ten), followed by Spain and Brazil (seven out of eight). Less than one out of two Indian emigrants has returned. The most likely reason that scientists give for return to their country of origin is for “personal or family reasons.” Taken together our results suggest that policy levers are extremely important in attracting scientists to work or study abroad, but that they appear to play little role in drawing emigrants to return to their home country.

**Graduate School and Postdoctoral training**

In companion research we explore factors related to the probability that students who leave their country of origin for Ph.D. or postdoctoral training come to the United States rather than to another country. We find that those who place

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a higher weight on the prestige/research excellence of the institution as a reason for their choice are significantly more likely to train in the United States than to go elsewhere, as are those who report that opportunities for career advancement played a strong role in their decision to go abroad for study. Individuals who report that the appeal of lifestyle or international experience played an important role in their decision of where to pursue Ph.D. study are significantly less likely to attend graduate school in the United States than go elsewhere.

With regard to postdoctoral study, we find that individuals who place a higher weight on the quality of faculty, the excellence/prestige of the country’s institutions, and the career prospects associated with where they train are significantly more likely to come to the United States. The U.S. lifestyle discourages individuals from coming to do postdoctoral study, as does the relative unattractiveness of benefits and working conditions provided to postdoctoral researchers. The current discussion on immigration reform focuses on the importance of visa reform for retaining researchers who complete their studies in the United States. Our research suggests that maintaining the level of research funding and the quality of university research infrastructure are likely to be important if the United States hopes to continue to attract foreign-born students and postdoctoral researchers.

Networks

Innovation policies, particularly in Europe, have strongly supported international mobility of the highly skilled workforce as a means for enhancing the overall scientific performance of both source and destination countries. Despite the importance attributed to such ties, little empirical research has systematically investigated mobility, in part because of the lack of international comparable data. We draw on the GlobSci survey to explore the link between mobility and the presence of international research networks. We classify researchers into three mobility states: foreign-born (24.3 percent); returned after one or more periods abroad for a Ph.D., postdoc or employment (29.7 percent); and non-mobile (46.0 percent). We create two measures of the individual’s propensity to co-author with those from a different country: the first counts the number of distinct international co-authors on the paper that was included in the GlobSci survey and the second draws on the respondents’ answer to a question regarding the number of countries in which the scientist reported having one or more collaborations in the past two years. We find the incidence of international collaboration on the survey paper to be lowest for non-mobile researchers. It is generally highest for the foreign born. We also find non-mobile researchers to report the highest incidence of having had no international scientific collaboration in the past two years. The distribution of the number of countries with which the foreign born and returnees report having had a collaborator is almost the same. Approximately one out of three have collaborated with scientists in four or more countries; slightly more than one out of two has collaborated with scientists in one to three countries.

We examine the presence of significant correlation at the individual level between international mobility and the presence of international co-authors, controlling for the researcher’s demographic characteristics, field of research, country of residence, number of co-authors, and whether the scientist is independent or works in a support role, such as a staff scientist. We find the marginal effect of being foreign born on the likelihood of having an international collaboration to be 13.8 percentage points. The marginal effect of being a returnee is 7.4 percent. We also examine the correlates of working with co-authors in four or more countries and find that the foreign born and returnees are significantly more likely to collaborate with scientists in a large number of countries than are the non-mobile. This effect is slightly larger for the foreign born than for those who have returned.

Performance

Mobility policies, such as visa reform, are predicated on the assumption that the foreign born perform at the same or a higher level than the non-mobile workforce. Likewise, countries that implement policies to encourage emigrants to return do so on the assumption that the mobility experience enhances the productivity of the emigrant and that the country will benefit from the emigrant’s return. Empirical evidence on the correlation of mobility and performance in science, however, is inconclusive and often limited to the foreign born in the United States and focused on those who make exceptional contributions. The GlobSci survey allows us to explore the correlation between mobility and performance within our 16 country sample. We are not able to infer causality given the cross-sectional nature of the data, but the results suggest that mobility is a plus for destination countries and that promoting international experience can have positive returns for a country.

We use two measures of performance: two-year citations to the author’s article and the Impact Factor of the journal in which the article was published. We limit the analysis to individuals working in universities, medical schools, and government research agencies, and control for article and individual characteristics. We find that holding all else equal, the average foreign-born scientist outperforms a homegrown scientist by 0.84 in terms of Impact Factor of the journal in which the article appeared and by 2.29 in terms of two-year citations to the paper. We also find that scientists who have studied or worked abroad and subsequently returned to work and live in their country of origin outperform the non-mobile by 0.63 in terms of Impact Factor and by 1.69 in terms of total citations.