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The Consequences of Financial Innovation: A Research Agenda

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Rev. 12/30/2009

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Financial innovation has been both praised as the engine of growth of society and castigated for being the source of the weakness of the economy. In this paper, we review the literature on financial innovation and highlight the similarities and differences between financial innovation and other forms of innovation. We also lay out a research agenda to systematically address the social welfare implications of financial innovation. This agenda has a few elements: Case studies of successful (widely adopted) innovations, in which we explicitly contemplate counterfactual histories had the innovations never been invented or adopted.

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The significance of financial innovation has widely touted. Many leading scholars, including Miller (1986) and Merton (1992), highlight the importance of new products and services in the financial arena, and characterized these innovations as an "engine of economic growth."

At several levels, these arguments are plausible. Financial innovations can be seen as playing a role akin to that of the "general purpose technologies" delineated by Helpman (1998): not only do these breakthroughs generate returns for the innovators, but they have the potential to affect the entire economic system and can lead to far-reaching changes. For instance, financial innovations enable firms to raise capital in larger amounts and at a lower cost than they could otherwise and in some cases (for instance, biotechnology start-ups) to obtaining financing that otherwise they would be unable to raise. Similarly, these innovations may have broad implications for households, enabling new choices for investment and consumption, and reducing the costs of raising and deploying funds.

Moreover, it appears that financial innovation is ubiquitous. Tufano (1995, 2003) shows that far from being confined to the last few decades, financial innovation has been part of the economic landscape for centuries. On a more systematic basis, Tufano (1989) shows that of all public offerings in 1987, 18% (on a dollar-weighted basis) consisted of securities that had not been in existence in 1974.

But at the same time, claims of the beneficial impacts of financial innovations must be approached with caution. One reason is that despite the acknowledged economic importance of financial innovation, the sources of such innovation remain poorly understood, particularly empirically. In a recent review article, Frame and White (2004) are able to identify only 39 empirical studies of financial innovation. Moreover, this literature concentrates largely on the "back end" of the innovation process, focusing on the diffusion of these innovations, the characteristics of adopters, and the consequences of innovation for firm profitability and social welfare. Frame and White identify only two papers on the origins of innovation, namely, Ben-Horim and Silber (1977) and Lerner (2002).

The paucity of research in this area contrasts sharply with the abundant literature on the sources of manufacturing innovation. This neglect is particularly puzzling given the special circumstances surrounding financial innovation. Several considerations—discussed in detail in Section III—suggest that the dynamics of financial innovation are quite different from those in manufacturing. Together, these considerations suggest the need to examine financial innovation as a phenomenon in its own right.

The second reason for caution has been the recent crisis in the global financial system, which has shaken many economists' faith in the positive effects of financial innovation. Certainly, in many *post mortems* of the crisis, financial innovation was seen as far from an "engine of economic growth." For instance, Levitin characterized recent changes in retail financial services as "negative innovations," such as "opaque pricing, including billing tricks and traps… that encourag[e] unsafe lending practices." A similar theme was sounded by Krugman (2007) in regards to securities regulation:

> (T)he innovations of recent years — the alphabet soup of C.D.O.'s and S.I.V.'s, R.M.B.S. and A.B.C.P. — were sold on false pretenses. They were promoted as ways to spread risk, making investment safer. What they did instead — aside from making their creators a lot of money, which they didn't have to repay when it all went bust — was to spread confusion, luring investors into taking on more risk than they realized.

Given this unsettled territory, it seems premature to provide definitive answers regarding the causes and consequences of financial innovations, and how they differ from the much better understood innovation process in the manufacturing sector. Rather, our goal is to lay out a *research agenda*, which we hope will encourage subsequent scholar. After we review the definition of financial innovation, we turn to three general observations about how financial innovation is (at least somewhat) different from other forms of innovation. We then consider two case studies of particular innovations, and highlight both what is known and unknown about their consequences. Finally, we suggest some avenues for future exploration.

I. Background on financial innovation

Much of the theoretical and empirical work in financial economics considers a highly stylized world in which there are few types of securities (e.g., debt and equity) and a handful of simple financial institution, such as banks or exchanges. In reality there is a vast range of different financial products, many different types of financial institutions, and a variety of processes that these institutions employ to do business. The literature on financial innovation must grapple with this real-world complexity.

Financial innovation is the act of creating and then popularizing new financial instruments as well as new financial technologies, institutions, and markets. The "innovations" are sometimes divided into *product* or *process* innovation, with product innovations exemplified by new derivative contracts, new corporate securities or new forms of pooled investment products, and process improvements typified by new means of distributing securities, processing transactions, or pricing transactions. In practice, even this innocuous differentiation is not clear, as process and product innovation is often linked. Innovation includes the acts of invention and diffusion of new products, services or ideas, though in point of fact these two are related as most financial innovations are evolutionary adaptations of prior products.

As noted above, one of the major challenges associated with the study of financial innovation is the lack of data. Studies of manufacturing innovation traditionally focus on R&D spending and patenting. Given the rarity with which financial service firms report R&D spending and the fact that financial patents were used only infrequently until recently, these measures are unlikely to be satisfactory in this context. Most alternatives are also troubling. Consider, for instance, the listings of new securities compiled by the Securities Data Company (SDC), which maintains the leading database of corporate new issues. First, much of the innovation in financial services has taken place outside the realm of publicly traded securities, such as new Automatic Teller Machines and insurance products. Second, as Tufano (2003) points out, many of the "novel" securities identified in the SDC database are minor variants of

existing securities, often promulgated by investment banks seeking to differentiate themselves from their peers.

Thus, saying much systematically about the variation in the rate of financial innovation across time and space is challenging. Lerner (2006) takes a first step towards addressing this gap by developing a measure of financial innovation based on news stories in the *Wall Street Journal*. The analysis finds that financial innovation is characterized by a disproportionate role of smaller firms. More specifically, a doubling in firm size is associated with less than a doubling in innovation generation. Moreover, firms that are less profitable in their respective sectors are disproportionately more innovative. These results are consistent with depictions by Silber (1975, 1983) that more marginal firms will contribute the bulk of the financial innovations. In addition, older, less leveraged firms located in regions with more financial innovation appear to be more innovative. Few patterns are seen over time, though this may reflect the fact that the analysis is confined to the years 1990 through 2002. Financial innovations seem to be disproportionately associated with U.S.-based firms, though this may reflect the use of a U.S.-based publication to identify the innovations.

A major focus of writings on financial innovations has been the attempt to catalog the inventions. There are almost as many schemes as authors, but many of these share the feature of looking through to the underlying functions performed by the innovations. Merton's (1992) scheme is illustrative. In particular, he divides financial innovation, as well as these products and institutions more generally, as playing six roles:

(1) Moving funds across time and space (e.g, savings accounts);
(2) The pooling of funds (for instance, mutual funds);
(3) Managing risk (insurance and many derivatives products);
(4) Extracting information to support decision-making (markets which provide price information, such as those for credit-default swaps);
(5) Addressing moral hazard and asymmetric information problems (venture capital firms); and
(6) Facilitating the sale of purchase of goods and services through a payment system (credit cards).

Not surprisingly, no classification scheme is perfect. As a result, many innovations seem to span multiple categories in this scheme and its alternatives.

In many respects, financial innovations resemble any other kind of invention. Among the points of commonality are:

- These innovations are not easy to develop. Investment banks frequently retain many highly-compensated Ph.D.s and MBAs to introduce and diffuse new products and services.
- These innovations are risky. Tufano (1989) documents that the vast majority of security discoveries do not lead to more than a handful of subsequence issuances.
- The success of these inventions is typically not automatic. Innovators must frequently expend consider resources developing a formal distribution channel.

- Innovation is frequently linked closely with the competitive dynamics between incumbents and entrants.
- Firms have struggled, at least until recently (and perhaps temporarily) to obtain intellectual property protection, akin to many emerging industries.

But in other respects, financial innovation is quite different. It is to these dissimilarities that we turn in the next section.

II. What is different—and challenging—about financial innovation?

In general, economists' thinking about financial innovation has been shaped by their experience with innovation in manufacturing industries. Assessments of the nature and consequences of innovation in the service sector are rarer. Financial innovation illustrates the limitations of our understanding of non-manufacturing innovation in particularly sharp relief.

In particular, in this section, we posit three sets of issues that make the assessment of financial innovation particularly challenging:

- The financial system is highly interconnected. As a result, a financial innovation is likely to generate a complex web of externalities, both positive and negative. As a result, assessing the social consequences of financial innovation can be very challenging.
- Financial innovations are highly dynamic. As an innovation diffuses from pioneering adopters to more general users, these products frequently change in their underlying structure and the way that they are marketing. These transformations mean that the consequences of an innovation may change over the diffusion process.
- While certainly many forms of innovation, such as pharmaceuticals, are subject to regulation, the regulation of new financial products and services is particularly complex and dynamic, and may increasingly impede innovation.

a) The challenge measuring social welfare

Since the pioneering work of Trajtenberg (1990), economists have understood that the benefits of innovation can be empirically quantified. These studies have focused on products whose features can be reduced to a relatively modest number of attributes and price. Each innovation can then be understood as offering a different combination of attributes. Often within the context of a discrete choice model, economists then use data on actual attributes, prices, and sales to estimate the underlying demand and utility functions of the representative consumer. The benefits from an innovation can then be quantified as the increase in social welfare associated with having the new set of choices compared to the ones available in the earlier period.[1] At least in theory, such a framework would allow one to assess whether innovations tend to significantly boost social welfare, or whether much of the spending on new product development is socially

[1] Other important papers in the literature on the quantification of the economic benefits of innovations and new goods more generally include Berry, Levinsohn, and Pakes (1995), Bresnahan (1986), Hausman (1997), and Petrin (2002).

wasteful, motivated instead by the rent-seeking behavior and the desire to steal market share from competitors and Dasgupta and Stiglitz (1980) suggest.

To be sure, many innovations give rise to externalities that would resist this type of straightforward analysis. For instance, the widespread diffusion of cellular telephones and text messaging has led by many accounts to an increase in automobile accidents caused by distracted drivers. Similarly, medical advances that prolong the life of cancer patients may have the consequence of putting greater financial pressures on Social Security and Medicare as the longevity (and associated medical bills) of senior citizens increase.

The particular challenge associated with assessing the social impact of financial innovation lies in the fact that so many of its consequences are in the form of externalities. On the positive side of the ledger, many financial innovations seek to solve broader social needs. The functional framework discussed above highlights the fact that innovations frequently address broader needs. Moreover, in many instances, the decisions of early adopters have important consequences for others. For instance, as the pool of mutual funds has proliferated, the upfront and annual fees associated with these intermediaries have dropped. As a result, the decision to partake of a financial innovation changes the attractiveness of the innovation for others.

But at the same time, in many instances these innovations have consequences to non-transacting parties which may be less desirable. To return to the subject of Krugman's quote earlier, it is indisputable that the collapse in the market for many of the complex securities based on mortgages contributed to a dramatic reduction in credit availability throughout the economy. Thus, these innovations led to numerous small businesses facing much higher interest rates or being unable to access credit at all, even though they had no involvement with the mortgage market. Even "well-meaning" innovations, such as process innovations that reduced the costs and effort of refinancing mortgages can lead to unintended consequences in the economy, a point emphasized by Khandani, Lo, and Merton (2009)

These detrimental effects are frequently referred to by the term "systemic risk." One immediate challenge is that systemic risk itself is a poorly defined notion. This confusion is captured by the following quote from Alan Greenspan (1995):

> It would be useful to central banks to be able to measure systemic risk accurately, but its very definition is still somewhat unsettled. It is generally agreed that systemic risk represents a propensity for some sort of significant financial system disruption, … (but) until we have a common theoretical paradigm for the causes of systemic stress, any consensus of how to measure systemic risk will be difficult to achieve.

Schwarcz (2008), after compiling the various definitions that have been used in policy circles, suggests the following definition:

> the risk that (i) an economic shock such as market or institutional failure triggers (through a panic or otherwise) either (X) the failure of a chain of markets or institutions or (Y) a chain of significant losses to financial institutions, (ii) resulting in increases in the cost of

capital or decreases in its availability, often evidenced by substantial financial-market price volatility.

Given the interconnected nature of the financial system, it would be surprising if the most widely adopted financial innovations did contribute to systematic risk as defined above, as well as "systemic benefits." When the bulk of the social impact is through positive and negative externalities, it is unclear how one should seek to assess welfare consequences of innovations.

b) The challenge of dynamic impacts

The word "innovation" is used by economists to indicate a change and financial innovation must be understood as part of a process of change. Financial innovations—especially systemically important ones—demonstrate two related dynamic features: the innovation spiral and a change in the "product" usage over time.

Merton (1992) coined the term "innovation spiral" to describe the process whereby one financial innovation begets the next. Sometimes this spiral has one successful innovation providing the raw material, or building blocks, for another. For example, the innovation of a futures market in a particular commodity can allow financial engineers to build specialized and more complex over-the-counter (OTC) products using dynamic trading strategies. An innovation need not be successful, however, to be part of the innovation spiral. Tufano (1995) and Mason, Merton, Perold and Tufano (1995) describes a sequence of financial innovations, most of which were unsuccessful, but nonetheless provided information that led to a subsequent wave of newer products. Persons and Warther (1997) formally model this spiral process. The innovation spiral is not unique to financial innovations; elsewhere one innovation can produce follow-on effects including lowering the barriers to subsequent innovation. For example, in electronics, semiconductor innovations have made possible host of products ranging from personal computers to industrial applications to handheld devices. Similarly, the technology developed for unsuccessful pioneering personal digital assistants, such as Go's Pen Operating System and Apple's Newton, ultimately led to the success of the BlackBerry and iPhone. Once one recognizes the existence of an innovation spiral, one must recognize that actions that might discourage a certain innovation could have implications for the development of subsequent innovations.

Much of the research on innovation deals with the dynamics of the adoption process, i.e., how a new product, process or service is taken up, first by innovators, then early adopters, early majority, late majority and laggards. This adoption process is typically characterized by an S-curve (or logistic function) which plots the number of adopters as a function of time. There is a substantial body of work on adoption rates, but Rogers (1962) is generally credited with codifying and advancing this literature. The sheer existence of an S-curve adoption pattern suggests that, almost by definition, an innovation is unlikely to have economy-wide or systemic implications until it has been adopted fairly widely.

Most of the work on the diffusion of innovations deals with the characteristics of the population and the various adopters. Generally, more knowledgeable, sophisticated and risk-

taking individuals adopt innovations earlier. Generalizing across the landscape of innovations in general (not just financial breakthrough), Rogers highlights five types of adopters:

- Innovators, the initial one to take up the innovation. These are typically younger, better educated, and have higher social status than later adopters.
- Early adopters, who often serve as opinion leaders in shaping others' decision to adopt the product.
- The early majority, who adopt an innovation after a varying time lag.
- The late majority, who approach innovations with skepticism and wait until most of society has adopted the innovation.
- The laggards, who are the last to adopt an innovation, and tend to be old and of low social status and with limited resources.

The mechanisms behind these broad patterns have attracted extensive research in subsequent years. For instance, Coleman, Katz and Menzel (1966) highlighted how these patterns are driven by direct social ties between potential adopters; Burt (1987) has emphasized more diffuse connections with third parties; and Granovetter (1978) explained many of the differences because of differing psychological thresholds.

Not only do the identities of adopters change over time, but sometimes the way in which products are used can evolves. Early adopters may not only be more aware of the features—and limitations—of new products, but use them differently. For example, it is typically difficult to get an issuer and set of investors to be the first to issue and buy a new security. These innovation partners are often informally part of the product development process, consulted by the bankers who are trying to bring the product to market. They would typically be much more informed about the strengths and weaknesses of a product than a late majority adopter, who might take a product's widespread usage to signal its lack of flaws. For example, in litigations involving "failed" financial products, it seems anecdotally that later adopters are more likely to sue, claiming that they were unaware of the potential flaws with the product, sometimes even claiming they never even read the security documents. (Consistent with these claims, Lerner (2010) show that those who litigate patented financial innovations are disproportionately smaller, more marginal firms, with less financial resources. Similarly, studies of litigation of new securities offerings suggest that much of the litigation is initiated by relatively unsophisticated individual investors (Alexander (1991).) Understanding the dynamics of adoption provides some insight into the potential for financial innovations to give rise to externalities and systemic risks. We may need to understand especially the processes whereby innovations become widely accepted—by whom and for what purpose—to understand systemic risks.

c) The interaction between regulation and innovation)

The relationship between financial innovation and regulation is complex. There has been much written about regulation (and taxes) as being an important stimuli for financial innovation. Miller (1986) expounds on this link at some length, and it is fairly easy to find financial products whose origins can be tied, at least in part, to regulations or taxes. For example, in the nineteenth century, the innovation of low-par stock was an outgrowth of state securities taxes (Tufano

(1995).) In the 1980s, the growth—and preferred stock form--of various adjustable rate products was stimulated by inter-corporate dividend deduction rules
Many innovations appear to be "functional" equivalents of earlier products. More recently, bank capital rules have encouraged the creation or adaptation of a variety of capital securities.

Not only does regulation give rise to some innovations, but then regulators need to "catch up" with the products, in a cat-and-mouse dynamic that Kane (1977) called the regulatory dialectic. Innovators look for opportunities that exploit regulatory gaps, regulators impose new regulations, and each new regulation gives rise to new opportunities for more innovation. In this back and forth, the regulatory system can be at a disadvantage for three reasons. First, many regulatory bodies have mandates that are defined by product or by institution, rather than by function. For example, consider just a few of the products that deliver equity-index exposure: baskets of stocks, index funds, exchange traded funds, futures contracts, index-linked annuities, indexed-linked Certificates of Deposit, and various structured notes. Suppose that one wanted to regulate equity exposures broadly. One would have to coordinate activities between the SEC, CFTC, banking regulators, and state insurance regulators for just a start. Without broad mandates or functional jurisdictions, opportunities for regulatory arbitrage through innovation will occur. Second, even a well-staffed, reasonably well paid, and highly talented regulatory agency is playing a game against an entire world of potential entrepreneurs and innovators. Inevitably, regulation will tend to react to innovations, typically with a lag. From the perspective of systemic risk, this responsive approach may be appropriate, as innovations early in their S-curve adoptions are unlikely to pose economy wide risks, and are probably being bought and sold by the most sophisticated set of adopters.

III. An Approach to Studying the Social Welfare Implications of Financial Innovation

In the wake of the events of the past few years, there have been numerous calls to limit or even ban financial innovation. For example, in a *Business Week* article entitled "Financial Innovation under Fire," the writer notes:

> [S]ome economists go further and argue that any financial innovation is guilty until proven innocent. Former International Monetary Fund chief economist Simon Johnson and James Kwak, authors of the popular Baseline Scenario blog, wrote in the summer issue of the journal *Democracy* that innovation often generates unproductive or even destructive transactions. "The presumption should be that innovation in financial products is costly…and should have to justify itself against those costs," they wrote. [2]

In April 2009, Fed Chairman Bernanke, while defending financial innovation, noted its precarious state in public debates:

> The concept of financial innovation, it seems, has fallen on hard times. Subprime mortgage loans, credit default swaps, structured investment vehicles, and other more-recently developed financial products have become emblematic of our present financial

[2] Coy (2009).

> crisis. Indeed, innovation, once held up as the solution, is now more often than not perceived as the problem.[3]

An interesting sign of the mood is the Security and Exchange Commission's creation of the first new division in 30 years, a Division of Risk, Strategy, and Financial Innovation, implicitly joining "financial innovation" and "risk."[4]

Against a populist chorus of anti-innovation rhetoric, it is important to carry out rigorous scholarly research to establish the social costs and benefits of financial innovation. Given the large number of financial innovations, it is important to come up with a research strategy that can address the important policy issues of the day. These debates seem to be of various forms: financial innovations' potential to give rise to systemic risks; financial innovations' potential to harm consumers; and "wasteful" use of private resource by financial innovators in rent-seeking behavior. Against this potential list of costs we must analyze innovation's benefits, both direct and indirect.

In this article, we focus on the *systemic* risks and benefits imposed by financial innovations. If an innovation is to have system-wide implications, by definition, it must be one that is broadly adopted. This research strategy permits us to focus on widely adopted innovations, rather than narrowly adopted ones or others which were never or barely adopted by users. To study wasteful rent-seeking or some aspects of consumer damage, one would need to include these latter innovations, but they strike us as not being the likely locus of systemic risks or benefits.

How do we define a "systemically important" or "broadly adopted" financial innovation? We use top-down data on the economy to identify these innovations. For example, if one studies the balance sheet of the US household over the past 60 years, a number of striking trends emerge, in particular the economic importance of money market mutual funds, mutual funds more generally, and retirement plans. Clearly, these are innovations that were adopted widely in the post-war period. Then, for a subset of these innovations, we detail the elements of their welfare implications. Using a technique sometimes adopted by historians, we not only detail the actual outcomes, but counterfactual histories: What would the economy have been like had this innovation not been invented or popularized? While this method is inherently judgmental, it frames a discussion or debate that attempts to tease out not only the direct costs and benefits, but also the externalities—both positive and negative—associated with each innovation. For example, cell phones have had a number of positive externalities with respect to auto travel: Individuals can call for help for emergencies and researchers can use cell phone records to better analyze traffic patterns. Yet cell phones can also have negative externalities associated with accidents caused by distracted drivers.

a) Criteria for selection of case studies.

We need a disciplined way to scan the economy to select our case studies. To do this, we consider the major changes in the way that financial functions are delivered to each of the

[3] http://www.federalreserve.gov/newsevents/speech/bernanke20090417a.htm
[4] http://www.sec.gov/news/press/2009/2009-199.htm

major non-governmental sectors in the economy. The sectors are (a) households, (b) non-financial corporations, (c) financial firms, and (d) public entities. As noted above, the functions include six activities: (a) pooling, (b) payments, (c) moving funds across time and space, (d) managing risk, (e) resolving information asymmetries, and (f) extracting information from markets. Our primary frame of reference for our exercise is the United States in the post-war period.

<table>
<tr><th></th><th>Households</th><th>Non-financial firms</th><th>Financial firms</th></tr>
<tr><td>Pooling</td><td rowspan="2">Mutual funds and exchange-traded funds</td><td rowspan="2">Venture capital and private equity</td><td rowspan="2">Securitization</td></tr>
<tr><td>Moving money across time and space</td></tr>
<tr><td>Payments</td><td>Card products</td><td></td><td></td></tr>
<tr><td>Managing risk</td><td>Retirement accounts</td><td colspan="2">Derivatives</td></tr>
<tr><td>Resolving information asymmetries</td><td></td><td>Venture capital and private equity</td><td></td></tr>
<tr><td>Extracting information from markets</td><td></td><td></td><td>Derivatives</td></tr>
</table>

In this draft, we focus on two case studies on venture capital and private equity on the one hand and mutual funds and exchange-traded funds on the other. This allows us to focus on three of the functions and two of the sectors. In the next version of the paper, we will add additional case studies, e.g., securitization.

b) Venture capital and private equity

i. A brief history

Long before the creation of the venture capital and private equity industry, fast-growing firms were able to raise financing.[5] Banks provided debt in the form of loans, and for more long-run, riskier investments, wealthy individuals provided equity. By the last decades of the nineteenth century and the first decades of the twentieth century, wealthy families had established offices to manage their investments. Families such as the Phippes, Rockefellers, Vanderbilts, and Whitneys invested in and advised a variety of business enterprises, including the predecessor entities to AT&T, Eastern Airlines, and McDonnell Douglas.

But by the time of the Great Depression of the 1930s, there was a widespread perception that the existing ways of financing fast-growing young firms were inadequate. Not only were many promising companies going unfunded, but investors with high net worth frequently did not have the time or skills to work with young firms to address glaring management deficiencies. Nor were the alternatives set up by the Roosevelt administration during the New Deal—such as

[5] Venture capital can be defined as professionally managed pools of capital making equity investments, typical in conjunction with an active oversight role, in new and growing firms; private equity as similar pools geared towards equity investments in older firms, often in conjunction with bank or publicly traded debt. This section is based on Lerner, Leamon, and Hardymon (2011).

the Reconstruction Finance Corporation—seen as satisfactory. The rigidity of the loan evaluation criteria, the extensive red-tape associated with the award process, and the fears of political interference and regulations all suggested a need for an alternative.

The first formal venture capital firm was established with both private and social returns in mind. American Research and Development (ARD) grew out of the concerns that the United States, having been pushed out of the depression by the stimulus of wartime spending by the federal government, would soon revert to economic lethargy when the war ended. In October 1945, Ralph Flanders, then head of the Federal Reserve Bank of Boston, argued that if this danger was to be addressed, a new enterprise was needed, with the goal of financing new businesses. He argued that the enterprise would not only need to be far more systematic in "selecting the most attractive possibilities and spreading the risk" than most individual investors had been, but would need to tap into the nation's "great accumulation of fiduciary funds" (i.e., pension funds and other institutional capital) if it was to be successful in the long term.

ARD was formed a year later to try to realize this vision. Flanders recruited a number of civic and business leaders to join in the effort, including MIT president Karl Compton. But the day-to-day management of the fund fell on the shoulders of Harvard Business School professor Georges F. Doriot. ARD in its communications emphasized that its goal was to fund and aid new companies in order to generate "an increased standard of living for the American people."

Flanders, Doriot and their contemporaries realized that the financing of young, growing, and restructuring companies was a risky business. These information problems made it difficult to assess these companies, and permitted opportunistic behavior by entrepreneurs after the financing is received. These risks had deterred investors from providing capital to these firms.

To illustrate these problems, if the firm raises equity from outside investors, the manager has an incentive to engage in wasteful expenditures (e.g., lavish offices) because he may benefit disproportionately from these but does not bear their entire cost. Similarly, if the firm raises debt, the manager may increase risk to undesirable levels. Because providers of capital recognize these problems, outside investors demand a higher rate of return than would be the case if the funds were internally generated. Additional problems may appear in the types of more mature companies in private equity firms invest. For instance, entrepreneurs might invest in strategies, or projects that have high personal returns but low expected monetary payoffs to shareholders.

Even if the manager wants to maximize firm value, information gaps may make raising external capital more expensive or even preclude it entirely. Equity offerings of companies may be associated with a "lemons" problem: that is, if the manager is better informed about the company's investment opportunities and acts in the interest of current shareholders, then he will only issue new shares when the company's stock is overvalued. Indeed, numerous studies have documented that stock prices decline upon the announcement of equity issues, largely because of the negative signal sent to the market. This "lemons" problem leads investors to be less willing to invest at attractive valuations in young or restructuring companies, or even to invest at all.

ARD established an approach to addressing these problems that venture capital and private equity groups have followed ever since. First, by intensively scrutinizing companies before providing capital, and only funding a small fraction of those seeking funds, they could alleviate some of the information gaps and reduce capital constraints. Second, they employed a variety of tools that allowed them to monitor and control firms after the transactions. These included the use of convertible securities with powerful control right, syndication and staging of investments, provision of oversight through formal board seats and information rights, structuring incentives of management through extensive equity holdings, and informal coaching of management. Finally, there was an effort to certify the funded entrepreneurs as being different from their peers, which facilitated their ability to enter into alliances, get access to investment bankers, and so forth. The tools that venture capital and private equity investors use in this difficult environment enable companies ultimately to receive the financing that they cannot raise from other sources.

The activity in the private equity industry increased dramatically in late 1970s and early 1980s. Industry observers attributed much of the shift to the U.S. Department of Labor's clarification of the Employee Retirement Income Security Act's "prudent man" rule in 1979. Prior to this year, the legislation limited the ability of pension funds to invest substantial amounts of money into venture capital or other high-risk asset classes. The Department of Labor's clarification of the rule explicitly allowed pension managers to invest in high-risk assets, including private equity. Numerous specialized funds—concentrating in areas such as leveraged buyouts, mezzanine transactions and such hybrids as venture leasing—sprang up during these years.

The subsequent years saw both very good and trying times for private equity investors. On the one hand, the 1980s saw venture capitalists back many of the most successful high-technology companies, including Cisco Systems, Genentech, Microsoft, and Sun Microsystems. Numerous successful buyouts—such as Avis, Beatrice, Dr. Pepper, Gibson Greetings, and McCall Pattern—garnered considerable public attention during that period. At the same time, commitments to the private equity industry during this decade were very uneven. The annual flow of money into venture capital funds increased by a factor of ten during the first half of the 1980s, but steadily declined from 1987 through 1991. Buyouts underwent an even more dramatic rise through the 1980s, followed by a precipitous fall at the end of the decade.

Much of this pattern was driven by the changing fortunes of private equity investments. Returns on venture capital funds had declined sharply in the mid-1980s after being exceedingly attractive in the 1970s. This fall was apparently triggered by overinvestment in a few industries, such as computer hardware, and the entry of many inexperienced venture capitalists. Buyout returns underwent a similar decline in the late 1980s, due in large part to the increased competition between groups for transactions" Kaplan and Stein (1993) documented that of the 66 largest buyouts completed during the market peak (between 1986 and 1988), 38% experienced financial distress, which they define as default or an actual or attempted restructuring of debt obligations due to difficulties in making payments, and 27% actually did default on debt repayments, often in conjunction with a Chapter 11 filing. Kaplan and Schoar (2006) and other papers provide indirect supporting evidence, showing that the performance of both venture and private equity funds is negatively correlated with inflows into these funds.

Funds raised during periods of high capital inflows—which are typically associated with market peaks—perform far worse than their peers.

The 1990s and 2000s saw these patterns repeated on an unprecedented scale. The second half of the 1990s saw dramatic growth and excellent returns in venture capital investments; the 2000s saw tremendous growth of private equity funds. This recovery was triggered by several factors. The exit of many inexperienced investors after the earlier collapse ensured that the remaining groups faced less competition for transactions. The healthy market for initial public offerings during much of 1990s meant that it was easier for venture funds to exit transactions, leading to high returns. Meanwhile, the extent of technological innovation—particularly in information technology-related industries—created extraordinary opportunities for venture capitalists. The mid-2000s saw unprecedented availability of debt on favorable terms, which enable buyout groups to highly leverage firms and make high returns likely. New capital commitments to both venture and buyout funds rose in response to these changing circumstances, increasing to record levels by the late 2000 and 2007. Once the enabling condition deteriorated, the level of fundraising and investment dropped sharply. Funds were left with large number of transactions which could not be exited, and investors faced the certainty of a sharp drop in returns.

ii. The broader social impact: Venture capital

Clearly, venture capital and private equity funds exert a major impact on the fates of individual companies. But does all this fundraising and investing influence the overall economic landscape as well? We will look at evidence regarding venture capital first, and then private equity funds.

To assess this question, we can look at studies of the experience of the market with the most developed and seasoned venture capital industry, the United States. Despite the fact that venture activity is particularly well developed in this nation, the reader might be skeptical as to whether this activity would noticeably impact innovation: for most of past three decades, investments made by the entire venture capital sector totaled less than the research-and-development and capital-expenditure budgets of large, individual companies such as IBM, General Motors, or Merck.

One way to explore this question is to examine the impact of venture investing on wealth, jobs, and other financial measures across a variety of industries. Though it would be useful to track the fate of *every* venture-capital-financed company and find out where the innovation or technology ended up, in reality only those companies that have gone public can be tracked. Consistent information on venture-backed firms that were acquired or went out of business simply doesn't exist. Moreover, investments in companies that eventually go public yield much higher returns than support given to firms that get acquired or remain privately held.

These firms have had an unmistakable effect on the U.S. economy. In late 2008, 895 firms were publicly traded on U.S. markets after receiving their private financing from venture capitalists (this does not include the firms that went public, but were subsequently acquired or delisted). One way to assess the overall impact of the venture-capital industry is to look at the

economic "weight" of venture-backed companies in the context of the larger economy.[6] By late 2008, venture-backed firms that had gone public made up over thirteen percent of the total number of public firms in existence in the United States at that time. And of the total market value of public firms ($28 trillion), venture-backed companies accounted for $2.4 trillion—8.4 percent.

Venture-funded firms also made up over 4 percent (nearly one trillion dollars) of total sales ($22 trillion) of all U.S. public firms at the time. Contrary to the general perception that venture-supported companies are not profitable, operating income margins for these companies averaged 6.8 percent—close to the average public-company profit margin of 7.1 percent. Finally, those public firms supported by venture funding employed 6 percent of the total public-company workforce—most of these jobs high-salaried, skilled positions in the technology sector. Clearly, venture investing fuels a substantial portion of the U.S. economy.

This impact is quite modest in industries dominated by mature companies—such as the manufacturing industries. But contrast those industries with highly innovative ones, and the picture looks completely different. For example, companies in the computer software and hardware industry that received venture backing during their gestation as private firms represented more than 75 percent of the software industry's value. Venture-financed firms also play a central role in the biotechnology, computer services, and semiconductor industries. In recent years, the scope of venture groups' activity has been expanding rapidly in the critical energy and environmental field, though the impact of these investments remains to be seen. Presumably, these are industries where the externalities generated by new activity are the greatest.

It might be thought that it would be not difficult to address the question of the impact of venture capital on innovation in a more rigorous manner. For instance, one could seek to explain across industries and time whether, controlling for R&D spending, venture capital funding has an impact on various measures of innovation. But even a simple model of the relationship between venture capital, R&D, and innovation suggests that this approach is likely to give misleading estimates.

This is because both venture funding and innovation could be positively related to a third unobserved factor, the arrival of technological opportunities. Thus, there could be more innovation at times that there was more venture capital, not because the venture capital caused the innovation, but rather because the venture capitalists reacted to some fundamental technological shock which was sure to lead to more innovation. To date, only a handful of papers have attempted to address these challenging issues.

The first of these papers, by Hellmann and Puri (2000), examines a sample of 170 recently-formed firms in Silicon Valley, including both venture-backed and non-venture firms. Using questionnaire responses, they find evidence that venture capital financing is related to product market strategies and outcomes of startups. They find that firms that are pursuing what

[6] This analysis is based on the author's tabulation of unpublished data from SDC Venture Economics, with supplemental information from Compustat and the Center for Research into Securities Prices (CRSP) databases.

they term an innovator strategy (a classification based on the content analysis of survey responses) are significantly more likely and faster to obtain venture capital. The presence of a venture capitalist is also associated with a significant reduction in the time taken to bring a product to market, especially for innovators (probably because these firms can focus more on innovating and less on raising money). Furthermore, firms are more likely to list obtaining venture capital as a significant milestone in the lifecycle of the company as compared to other financing events.

The results suggest significant interrelations between investor type and product market dimensions, and a role of venture capital in encouraging innovative companies. But this does not definitively answer the question of whether venture capitalists cause innovation. For instance, we might observe personal injury lawyers at accident sites, handing out business cards in the hopes of drumming up clients. But just because the lawyer is at the scene of the car crash does not mean that he caused the crash. In a similar vein, the possibility remains that more innovative firms choose to finance themselves with venture capital, rather than venture capital causing firms to be more innovative.

Kortum and Lerner (2000) visit the same question. Here, the study looks at the aggregate level: did the participation of venture capitalists in any given industry over the past few decades lead to more or less innovation? It might be thought that such an analysis would have the same problem as the personal injury lawyer story above. Put another way, even if we see an increase in venture funding and a boost in innovation, how can we be sure that one caused the other?

The authors address these concerns about causality by looking back over the industry's history. In particular, as we discussed above, a major discontinuity in the recent history of the venture capital industry was the U.S. Department of Labor's clarification of the Employee Retirement Income Security Act (ERISA) in the late 1970s, a policy shift that freed pensions to invest in venture capital. This shift led to a sharp increase in the funds committed to venture capital. This type of external change should allow one to figure out what the impact of venture capital was, because it is unlikely to be related to how many or how few entrepreneurial opportunities there were to be funded.

Even after addressing these causality concerns, the results suggest that venture funding does have a strong positive impact on innovation. The estimated coefficients vary according to the techniques employed, but on average a dollar of venture capital appears to be *three to four* times more potent in stimulating patenting than a dollar of traditional corporate R&D. The estimates therefore suggest that venture capital, even though it averaged less than three percent of corporate R&D in the United States from 1983 to 1992, is responsible for a much greater share—perhaps ten percent—of U.S. industrial innovations in this decade.

A natural worry with the above analysis is that it looks at the relationship between venture capital and patenting, not venture capital and innovation. One possible explanation is that such funding leads to entrepreneurs to protect their intellectual property with patents rather than other mechanisms such as trade secrets. For instance, it may be that the entrepreneurs can fool their venture investors by applying for large number of patents, even if the contributions of

many of them are very modest. If this is true, it might be inferred that the patents of venture-backed firms would be lower quality than non-venture-backed patent filings.

How could this question of patent quality be investigated? One possibility is to check the number of patents that cite a particular patent.[7] Higher-quality patents, it has been shown, are cited by other innovators more often than lower-quality ones. Similarly, if venture-backed patents are lower quality, then companies receiving venture funding would be less likely to initiate patent-infringement litigation. (It makes no sense to pay money to engage in the costly process of patent litigation to defend low-quality patents.)

So, what happens when patent quality is measured with these criteria? As it happens, the patents of venture-backed firms are more frequently cited by other patents and are more aggressively litigated—thus it can be concluded that they are high quality. Furthermore, the venture-backed firms more frequently litigate trade secrets, suggesting that they are not simply patenting frantically in lieu of relying on trade-secret protection. These findings reinforce the notion that venture-supported firms are simply more innovative than their non-venture-supported counterparts.

Mollica and Zingales (2007), by way of contrast, focus on regional patterns: as a regional unit, they use the 179 Bureau of Economic Analysis economic areas, which are composed by counties surrounding metropolitan areas. They exploit the regional, cross-industry, and time-series variability of venture investments in the United States to study the impact of venture capital activity on innovation and the creation of new businesses. Again, they grapple with causality issues by using an instrumental variable: as an instrument for the size of VC investments, they use the size of a state pension fund's assets. The idea is that state pension funds are subject to political pressure to invest some of their funds in new businesses in the states. Hence, the size of the state pension fund triggers a shift in the local supply of VC investment, which should help identify the effect of VC on patents.

Even with these controls, they find that VC investments have a significant positive effect both on the production of patents and on the creation of new businesses. A one standard deviation increase in the VC investment per capita generates an increase in the number of patents between 4 and 15%. An increase of 10% in the volume of VC investment increases the total number of new business by 2.5%.

iii. The broader social impact: Private equity

Turning to private equity, in the past decade, the growth of this industry has triggered anxiety about the impact of buyouts in markets as diverse as China, Germany, South Korea, the United Kingdom, and the United States. This anxiety is not unreasonable. While the leveraged buyout transactions of the 1980s were scrutinized in a number of important academic analyses, these studies had two important limitations. First, the bulk of the older research focused on a relatively small number of transactions involving previously publicly-traded firms based in the

[7] Patent applicants and examiners at the patent office include references to other relevant patents. These serve a legal role similar to that of property markers at the edge of a land holding.

United States. But these represent only a very modest fraction of all buyouts. The second limitation of the older research relates to the fact that the industry has grown and evolved tremendously since the 1980s.

A variety of recent research has sought to assess the consequences of private equity investments over a more comprehensive sample. Each study has looked at a particular consequence of the investment process.

First, Stromberg (2008) examined the nature and outcome of the 21,397 private equity transactions world-wide between 1970 and 2007. In the most straightforward possible outcome, the author simply sought to understand the consequences of these transactions. The key findings were:

- Of the exited buyout transactions, only 6% end in bankruptcy or financial restructuring. This translates into an annual rate of bankruptcy or major financial distress of 1.2% percent per year. This rate is lower default rate for U.S. corporate bond issuers, which has averaged 1.6% per year.
- Holding periods for private equity investments have increased, rather than decreased, over the years. 58% of the private equity funds' investments are exited more than five years after the initial transaction. So-called "quick flips" (i.e. exits within two years of investment by private equity fund) account for 12% of deals and have also decreased in the last few years.

This study, of course, only examines one small fraction of what would be the consequences of these transactions. It cannot answer the question of whether the bulk of the firms would be worse or better off because of these transactions.

Bloom, Sadrun, and van Reenen (2009) examine management practices across 4,000 PE-owned and other firms in a sample of medium-sized manufacturing firms in Asia, Europe and the US using a unique double-blind management survey to score firms across 18 dimensions. The main goal of the study is to determine whether private equity ownership, relative to other ownership firms, is a way to achieve improved management practices within firms through the introduction of new managers and better management practices

They find that private equity-owned firms are on average the best-managed ownership group. PE- owned firms are significantly better managed across a wide range of management practices than government, family and privately owned firms. This is true even controlling for a range of other firm characteristics such as country, industry, size and employee skills. PE owned firms are particularly strong at operations management practices, such as the adoption of modern lean manufacturing practices, using continuous improvements and a comprehensive performance documentation process. But because the survey is only a cross-sectional one, they cannot determine whether the private equity groups turned these firms into better managed ones, or simply purchases firms that were better managed in the first place.

Lerner, Sorenson and Stromberg (2008) examine long-run investments by firms. It was motivated by the lively debate about the impact of private equity investors on the time horizons

of the companies in their portfolios. The private status, according to some, enables managers to proceed with challenging restructurings without the pressure of catering to the market's demands for steadily growing quarterly profits, which can lead to firms focusing on short-run investments. Others have questioned whether private equity-backed firms take a longer-run perspective than their public peers, pointing to practices such as special dividends to equity investors.

In this study, one form of long-run investment was examined: investments in innovation. Innovation offers an attractive testing ground for the issues delineated above due to various factors. These factors include the long-run nature of R&D expenditures, their importance to the ultimate health of firms and the extensive body of work in the economics literature that has documented that the characteristics of patents can be used to assess the nature of both publicly and privately held firms' technological innovations.

The key finding was that patenting levels before and after buyouts are largely unchanged. But firms that undergo a buyout pursue more economically important innovations, as measured by patent citations, in the years after private equity investments. In a baseline analysis, the increase in the key proxy for economic importance is 25%. This results from firms focusing on and improving their research in their technologies where the firms have historically focused.

In a pair of studies, Davis and co-authors (2008, 2009) have examined the impact of these investment employment and productivity. The former question has aroused considerable controversy. Critics have claimed huge job losses, while private equity associations and other groups have released several recent studies that claim positive effects of private equity on employment. While efforts to bring data to the issue are highly welcome, many of the prior studies have significant limitations, such as the reliance on surveys with incomplete responses, an inability to control for employment changes in comparable firms, the failure to distinguish cleanly between employment changes at firms backed by venture capital and firms backed by other forms of private equity, and an inability to determine in which nation jobs are being created and destroyed.

The authors constructed and analyzed a dataset in order to overcome these limitations and, at the same time, encompass a much larger set of employers and private equity transactions from 1980 to 2005. The study utilizes the Longitudinal Business Database (LBD) at the U.S. Bureau of the Census to follow employment at virtually all private equity-backed companies, before and after private equity transactions.

Among the key results were:

:

- Employment grows more slowly at establishments that are bought out than at the control group in the year of the private equity transaction and in the two preceding years. The average cumulative employment difference in the two years before the transaction is about 4% in favor of controls.
- Employment declines more rapidly in bought-out establishments than in control establishments in the wake of private equity transactions. The average cumulative two-year employment difference is 7% in favor of controls. In the fourth and fifth years after

the transaction, employment at private equity-backed firms mirrors that of the control group.

- But firms backed by private equity have 6% more greenfield job creation, that is, at new facilities in the United States, than the peer group. It appears that the job losses at bought-out establishments in the wake of private equity transactions are largely offset by substantially larger job gains in the form of greenfield job creation by these firms.

In their follow-on study, the authors focus on whether and how labor productivity changes at U.S. manufacturing firms that were targets of private equity transactions in the United States from 1980 to 2005. The interpretation of the patterns regarding employment changes needed to be cautious, because we did not examine productivity changes at these establishments.

The authors find that while firms acquired by private equity groups had higher productivity than their peers at the time of the original acquisition, they experience in the two-year period after the transaction productivity growth on average that is two percentage points more than at controls. About 72% of this out performance differential reflects more effective management of existing facilities, rather than the shut-down and opening of firms. (It should be noted that private equity investors are much more likely to close underperforming establishments at the firms they back, as measured by labor productivity.)

iv. Taking stock

It should be noted, however, that all of these studies have important limitations. First, these studies consider venture capital and private equity in aggregate. As alluded to above, both industries have been characterized by highly "lumpy" fundraising, where a few years account for the peak of the fund-raising. These years are also characterized by poorer private returns and higher rates of bankruptcy, which might suggest that the social returns from these periods are modest as well.

These limitations are particularly acute in the case of the private equity studies. None of these studies can grapple with the consequences of the 2005-07 market peak, which accounted for fully __ of the private equity raised (in inflation-adjusted dollars) between 1980 and 2007.

Moreover, the findings that have been completed to date raise questions about what goes on during these boom periods. Axelson, et al. (2009) document the cyclical use of leverage in buyouts. Using a sample of 1157 transactions completed by major groups world-wide between 1985 through 2008, they show that the level of leverage is driven by the cost of debt, rather than the more industry- and firm-specific factors that affect leverage in publicly traded firms. The availability of leverage is also strongly associated with higher valuation levels in deals.

Similarly, Davis, et al. (2009) find that the positive productivity growth differential at target firms (relative to controls) is not even. Rather, it is larger in periods with an unusually high interest rate spread between AAA-rated and BB-rated corporate bonds, and virtually non-existent during periods with low spreads. One interpretation of this pattern is that private equity groups are committed to adding value to their portfolio only during periods when making money

through other means (e.g., through leverage and financial engineering) is not feasible, i.e., during periods when private equity activity is relative quiescent.

If firms completing buyouts at market peaks employ leverage excessively and are less likely to focus on adding value, as their finding suggest, we may expect industries with heavy buyout activity to experience more intense subsequent downturns. Moreover, the effects of this overinvestment would be exacerbated if private equity investments drive rivals, not backed by private equity, to aggressively invest and leverage themselves. (Chevalier (1995) shows that in regions with supermarkets receiving private equity investments, rivals responded by entering and expanding stores.)

But this claim remains unproven. A counter-argument, originally proposed by Jensen (1989), is that the high levels of debt in private equity transactions force firms to respond earlier and more forcefully to negative shocks to their business. As a result, private equity-backed firms may be forced to adjust their operations earlier at the beginning of an industry downturn, enabling them to better weather a recession. Even if some private equity-backed firms eventually end up in financial distress, their underlying operations may thus be in better shape than their peers, which facilitates an efficient restructuring of their capital structure and lowers the deadweight costs on the economy. Consistent with this argument, Andrade and Kaplan (1998) study thirty-one distressed leveraged buyouts from the 1980's that became financially distressed, and found that the value of the firms post-distress was slightly higher than the value before the buyout, suggesting that even the leveraged buyouts that were hit most severely by adverse shocks added some economic value.

Thus, the extent to which the steady-state findings are weakened and undone by the intense cyclicality in these markets remains an open question.

c) Mutual funds and exchange-traded funds

Just as venture capital and private equity have become important parts of the modern US economy, mutual funds (including exchange traded funds) have become a dominant force in the investment management arena. While there has been substantial work on mutual funds, little of it directly addresses the social welfare consequences of this innovation. To lay out the approach for studying its implications, we (a) provide a brief history of the US mutual fund industry; (b) demonstrate its economic importance; (c) highlight the areas in which funds may have positively and negatively influenced social welfare, and (d) sketched out a counterfactual history to draw out these consequences.

i. A Brief History of the Innovations in US Mutual Fund Industry.

While mutual funds have antecedents in nineteenth century British Unit Investment Trusts (comparable to closed end funds today), the "modern" open-end mutual fund was created in 192.[8] The Massachusetts Investment Trust, launched in March 1924, was be followed in quick succession by the State Street Investment Corporation in July and the Investment Corporation the following November 1925. Like the investment trusts that preceded them, these new funds were pooled investment vehicles offering professional active investment management

[8] For a history of the fund industry, see Fink (2008) and the references therein.

services. The key innovations were the structure of the funds, as well as the manner in which redemptions were handled. Open-ended mutual funds, as they would come to be known, had a single class of investor claims in the form of equity, rather than a levered structure (still common in closed end funds). More importantly, they allowed investors to buy or redeem shares on a daily basis at Net Asset Value, unlike the prior investment trusts which traded on exchanges and were (and are) typically sold at discounts or premia to net asset value. The offer of shares and redemptions was daily and continuous, as opposed to the infrequent issuance of new shares by prior investment trusts.

The next major wave of innovation in mutual funds took place in the early 1970s. Up until this time, funds had held portfolios of stocks, and, to a far lesser degree, bonds. No fund had primarily held short-term money market instruments and designed itself to maintain a stable net asset value. In September 1972, the Reserve Fund was launched, followed a few weeks later by a competing fund, the Capital Preservation Fund, and in 1974 by offerings by Dreyfus and Fidelity. The latter allowed shareholders to redeem shares through a check-writing feature. The innovation of money market funds was not the holding of short-term instruments *per se*, but their mechanisms to maintain stable net asset values through either rounding their NAVs to the nearest penny (penny rounding funds), by valuing their portfolio at amortized cost (versus market value), or by adding or subtracting realized gains and losses from accrued income on a daily basis. (See Fink (2008), p. 84). These practices would eventually be memorialized into regulation through section 2a7 of the 1940 Act, which would permit amortized cost accounting and penny rounding methods for money market funds.

At about the same time, in the early 1970s, the first municipal bond funds, by Kemper and Fidelity, were offered, expanding the asset classes in which fund shareholders could invest. The next major innovation would take place in 1976, with the creation of the first indexed mutual fund, Jack Bogle's Vanguard First Index Investment Trust. The early investment trusts had both actively managed and fixed portfolios, with the latter being unmanaged and not rebalanced portfolios of securities. In the early 1970s, institutional index funds were first offered. Rather than use active management or a completely unmanaged fixed portfolio, these investments offered investors the return of a stock index (including the occasional rebalancing due to additions/deletions by the index.) The First Index Investment Trust brought the indexing concept to retail investors in a mutual fund structure, wrapped around a low cost, high service business model that was informed Bogle's experiences beginning with his 1951 Princeton college thesis on "The Economic Role of Investment Companies." (See Slater (1997).)

A more recent innovation, similar in spirit to index funds but with a different institutional structure, was created in 1992 by Leland O'Brien Rubinstein in the form of SuperTrust and rapidly followed by a similar offering by the American Stock Exchange in the form of SPDRs. (See Tufano and Kyrillos (1994).) The products, which would later morph into exchange traded funds, had features of the old fixed-portfolio investment trusts and closed end funds, in that they passively managed funds that were bought and sold on exchanges. The key innovation was to find a way to keep these funds trading at fundamental value or net asset value, rather than at fluctuating discounts and premia. The traditional open-end fund did so by contract form, allowing shareholders to buy and redeem shares at the NAV. The ETF innovation kept the link to NAV by allowing institutions to assemble the portfolio of underlying securities and create new

ETFs (and disassemble the ETF portfolio into its underlying components.) By creating a direct link between the security and its underlying components, ETFs minimize discounts or premia to NAVs.

ii. The economic importance of the US Mutual Fund Industry.

As we write, policymakers are debating whether mutual funds, or at least money market mutual funds, are "systemically important" and be regulated by others beyond the SEC. Regardless of the outcome of this regulatory debate, there is little question that mutual funds are one of the most successful financial innovations of the twentieth century. Whether measured by growth rates, adoption rates, fraction of capital intermediated in the economy, or importance to household balance sheets, mutual funds are critical to the economy. Furthermore, evidencing the innovation spiral, the original actively managed stock and bond mutual fund structure has been the chassis on which we have seen innovations such as index funds, exchange traded funds, sector funds, and money market funds.

On an absolute level, the US mutual fund industry is simply enormous. As of October 2009, industry assets (excluding ETFs) exceeded $10 trillion, as shown below from the Investment Company Institute's data of the 7762 funds in operation:

Total Net Assets of US domiciled Mutual Funds, October 2009
Billions of dollars

	Oct 09
Stock Funds	4,596.2
Hybrid Funds	604.5
Taxable Bond Funds	1,682.5
Municipal Bond Funds	443.9
Taxable Money Market Funds	2,951.3
Tax-Free Money Market Funds	409.9
Total	**10,688.3**

Source: http://www.ici.org/research/stats/trends/trends_10_09. This total excludes exchange traded funds, with $738 billion in assets.

These absolute numbers, while staggering in size, do not put the economic importance of the fund industry into context. One way to do so is to examine their adoption, in aggregate, by an important sector of the economy: households. The chart below shows the breakdown of

aggregate financial assets held by the US household (and nonprofit) sector in 1950 and 2008, as calculated by the Federal Reserve's Flow of Funds accounts.[9]

Composition of US Household Financial Market Assets 1950 and 2008			
	1950	**2008**	**Gain/Loss**
Bank-System Deposits	28.1	18.2	-9.9
Money Market Mutual Funds	0.0	4.5	4.5
Direct Holdings of Stocks and Bonds	51.1	29.0	-22.1
Mutual Funds (Stock, Bond, Balanced)	0.7	10.0	9.3
Pension Reserves (incl. DB and DC plans)	5.2	30.4	25.2
Other	14.9	7.9	-7.0
Total Financial Market Assets	100	100	
Total Mutual Fund Share	*0.7*	*14.5*	*13.8*

The pervasive impact of mutual funds can be seen in three elements. First, from 1950 through 2008, households held far fewer "deposits," defined broadly with the deposit-like share going from 28.1% of financial assets to 22.7%. Of this 22.7%, money market funds accounted for 4.5%, or nearly one-fifth. Secondly, in 1950, slightly over half of all household financial assets were in direct holdings of stocks and bonds. By 2008, this figure had dropped to 29.0%, but 10% were held in long-term stock and bond mutual funds, which increased from 0.7% to 10.0% over 58 years. Finally, the decline in direct holdings of stocks and bonds was more than offset by an increase in holdings in pension reserves, which rose from 5.2% to 30.4% of all household financial assets. A large fraction of these pension assets are in defined contribution plans, which in turn are invested in mutual funds. Putting these three elements together, mutual funds have had a profound impact on the household balance sheet.

iii. The social welfare implications of Mutual Funds

While there is little question that mutual funds have not only been a financial innovation, but a successful one in terms of adoption, how can we gauge the social welfare implications of this sector? Unlike the venture capital and private equity innovations, where researchers have documented employment, business formation and productivity impacts, there is far less done at a macro level on the social welfare impacts of fund industry. In part, this may reflect the fact that funds are not typically involved with portfolio firms in the same direct way as private equity or venture capital firms. Their impact on social welfare would come from benefits to shareholders as providers of low-cost diversified portfolios, or to markets, as new motivated information-processors and as deep pools of capital. We are therefore not able to make as direct a link between the innovation and social welfare.

[9] http://www.federalreserve.gov/releases/z1/ for the various data series. These numbers include financial assets excluding equity in unincorporated businesses, to reflect financial market claims.

Nevertheless, we can use the industry as a case study to lay out a research agenda that would more carefully document the social costs and benefits. We begin by listing the possible areas of inquiry and then discuss an approach drawn from historiography.

It is clear from the past six decades history that households' revealed preference is to hold funds more so than individual securities—and to hold securities more than bank deposits. If one were to assume that these choices are the direct result of the existence of mutual funds, one could provide a crude estimate of the return differential earned by investors as a result of the mutual fund innovation, one portion of the social welfare gains from innovation. For the purpose of this thought exercise, suppose that households allocated their assets between cash (earning the risk free rate) and the market (stocks and bonds) which earns a premium over the risk free rate.

Define

r_f = the risk free rate, a proxy for the return on deposits and money market funds.
RP = the equity risk premium on an unmanaged portfolio of assets
M = the fraction of assets held in deposits (pre mutual funds)
ΔM = the incremental fraction of assets held in the market as a result of mutual fund introduction
f = the weighted average incremental fee charged by funds in excess of the embedded fees in direct holdings of equities, where the weight is given by the mix of mutual fund holdings as a fraction of all market holdings.

Pre and post the introduction of mutual funds, the household sectors' return would be

$$E(R_{pre}) = (1-M)r_f + (M)(r_f+ERP)$$
$$E(R_{post}) = (1-M-\Delta M)r_f + (M+\Delta M)(r_f+ERP-f)$$

Taking the difference between these two and combining terms, we could calculate a net increase in return equal to

$$- Mf + \Delta M(ERP-f),$$

where the first term is the decrease in private return due to incremental weighted average fees on the pre-fund level of market holdings and the second term is the net increase in return due to the increased holdings of risky market assets.

Even a quick inspection of this formula makes clear some of the challenges with estimating this differential. First, it assumes that the introduction of funds does not affect the risk-free rate or the market risk premium. However, if in aggregate funds help direct more funds into the market and away from banks and risk free investing, these returns, and other market-wide elements, could easily be affected. The increased demand for riskier assets from the deeper pool of potential market investors could have lowered costs of capital for firms. The more intensive alpha-seeking behavior of funds could have make prices more reflective of efficient market levels. Second, it attributes the change in deposit holdings entirely to funds. For

example, the increase in household wealth over this period could have impacts on aggregate risk aversion, leading to willingness to hold greater market-risk assets. Third, while mutual funds clearly charge fees, and ample research demonstrates that funds cannot persistently beat the market, we need to calculate the *incremental* fees incurred by household investors. While the absolute level of mutual fund expenses is greater than zero, and while turnover is far higher than a passively managed portfolio, the relevant comparison for our purposes would be the incremental fees and turnover relative to a *directly-held portfolio*. This directly-held portfolio would have individual investors (or a bank trust department) managing her own investments, paying retail commissions, and implementing her own trading strategy.

This simple specification makes clear some of the elements left out of this analysis. On the positive side, how would we capture:

(a) Greater development of capital and debt markets as a result of new institutions. There is an extensive literature on financial development and economic development. While there are ongoing debates about causality and magnitude of the relationships, to the extent that financial development supports economic development, one would have to acknowledge that mutual funds have been a substantial element of financial development.

(b) Greater holding of foreign securities to counteract home bias; French (2008) documents a substantial increase in US holdings of foreign securities, which partially can be attributed directly or indirectly to mutual fund holdings.

(c) Greater savings overall. While it is purely speculative, one wonders what the savings rates of individuals would have been in the absence of mutual funds.

(d) Institutional competition for the fragmented and regulated banking industry. On this latter point, the development of money market funds was an explicit reaction to the interest rate caps imposed by regulation Q. The co-development of mutual fund and investor protection regulation, documented by Khorana, Servaes and Tufano (2005, 2009) might be yet another side-benefit of having an active fund industry.

On the negative side, this specification would not capture (a) Excessive rent seeking by mutual fund companies; (b) Excessive or insufficient savings by individuals; (c) Excessive risk taking by individuals; (d) Costly disintermediation of the banking sector, including the relative loss of regulatory control over the money supply that bank regulators had traditionally enjoyed.

Trying to untangle any of these issues is difficult enough, but the specification also makes clear that one cannot analyze the social welfare consequences of the fund industry except in context. Most of the time, economists apply "incremental" approaches; *ceteris paribus* approaches are commonplace. We seek identification strategies that isolate certain innovations to study their impact. Sometimes these identification strategies employ differences between two populations; pre- and post- analyses; new data that covaries with some factors and not others; or even randomized experiments designed to experimentally strip out extraneous factors. All of these seek to identify a "but-for" world.

This approach runs into a substantial problem when analyzing large systemic innovations like mutual funds. Their adoption is over such a long period of time that pre- and post-approaches, traditional control and treatment, and randomized experiments are not feasible. By virtue of their systemic nature, ceteris paribus assumptions tend to be heroic at best. We are left

with positing an alternative or counterfactual world. Historians sometimes use the method of hypothetical counterfactuals to shed light on questions of this sort. Against the realized history, they ask "What would the outcome had been, if event X had not happened?" This relatively new form of historiography was most famously used by Fogel in his 1964 book *Railroads and American Economic Growth: Essays in Econometric History*. Fogel compares the actual development of the economy to its development were railroads not to have been invented. More recent examples can be found in *Virtual History: Alternatives and Counterfactuals* (1997), edited by Niall Ferguson.

Had mutual funds not been invented (or adopted), what counterfactual history might have played out? One possibility is that 1950s era investing practices would have continued. Closed end funds would have remained a minor player in the economy. Fink (2008) argues that closed end funds became marginalized in the wake of the events of 1929, and direct holdings of securities—sold by brokers—were preferred as the means by which households acquired exposure to the "market." In this counterfactual world, households would have held poorly diversified, rarely rebalanced portfolios of a small number of securities. They would have been advised by bank trust departments (for the very wealthy), securities brokers, and popular periodicals. One could not assume index funds or ETFs in this counterfactual, as they were part of the innovative process we are analyzing. One may not even be able to assume low-cost brokerage models, as they too, were a relatively recent financial innovation.

While the actively-managed mutual fund industry is often criticized for failing to produce reliably positive excess returns or alpha, it is less likely that investors would have performed better on their own employing this direct-ownership counterfactual. Perhaps the most complete analysis of the social welfare impacts of mutual funds, in the context of active investing, can be found in French's (2008) AFA Presidential Address. In it, he documents that perpetual, and costly, search for alpha, estimating the deadweight loss to be about 67 basis points per year relative to passive investing. French convincingly documents that actively traded mutual funds are considerably more expensive than passive portfolios, but assumes virtually zero costs for direct-held portfolios: "I assume the only expenses individuals incur when they hold shares directly are trading costs, which are included in the aggregate estimates below. I ignore, for example, the time they spend managing their portfolios and the cost of subscriptions to Value Line and Morningstar." It is unclear if he includes non-commission payments to financial advisors, bank trust departments, or others who would facilitate the direct investing activities of investors. In our counterfactual, we would need to include these costs, which were likely sizeable. Furthermore, it is not so clear that the direct buyers of securities would receive excellent investing advice. Recent evidence by Bergstresser, Chalmers and Tufano (2009) for example, shows that broker-sold mutual funds consistently underperform direct-sold funds. If this is any indication, replacing thousands of fund managers with millions of even less well-informed brokers is not likely to increase household wealth. One might imagine that household portfolios might show even greater home bias and would virtually certainly not contain index-like fund holdings.

Another possibility is that an alternative functional substitute for funds would have emerged, providing low-cost pooling and investment management, small lot sizes for diversified portfolios, and liquidity in the form of daily trading. By 2000 or so, this alternative history might

not have seemed far-fetched. A number of startups offered products of this sort, allowing investors to directly buy pools of securities, including fractional shares, and provided a high level of liquidity. For example, one of the first of these innovators, folioFN permitted investors to buy folios (portfolios) of stocks (as well as mutual funds) in fractional shares. However, it would take the development of the internet, and the adoption of internet-based transacting, to make this counterfactual a reality. Even so, one wonders about the ultimate returns earned by direct investors. Recent behavioral finance work, by Odean (1999), Barber and Odean (2000, 2001a, 2001b, 2002, 2003) and others would call into question the investing acumen of individual investors.

While this discussion of mutual funds is less definitive about their social welfare consequences, it should make clear that the research agenda would need to consider a wide range of outcomes (versus a single metric of welfare), and would need to frame the marginal contribution relative to a hypothetical counterfactual.

IV. Additional research directions

As we have highlighted here, while existing empirical evidence and conceptual frameworks can tell us much about financial innovation, there are substantial unanswered questions. In this final section, we discuss some of the avenues for future research that we believe are the most promising. In particular, we highlight four approaches.

The first is to examine settings where there are constraints on financial innovation. The exploitation of exogenous constraints is by now a well-accepted technique in empirical economic research. In particular, a classic example of such constraints that might present an opportunity for careful study is Islamic finance, particularly as practiced in Saudi Arabia and the Persian Gulf. As commonly interpreted, sharia-compliant financial structures exclude the use of debt and multiple classes of equity. Such a setting may provide ca "natural experiment" for gauging impact of financial innovation or its absence.

A second avenue may be the greater exploitation of experimental techniques. A number of efforts have attempted to gauge the consequences of new securities, with an almost exclusive focus on those geared toward the developing country poor. Examples of such experimental studies have included assessments of new products such as rainfall insurance (Giné, Townsend, and Vickery (2007) and Cole, et al. (2009)), novel rules for institutions (such as Giné and Karlan's (2009) analysis of microcredit lending rules), and new institutions (for instance, Bhattamishra's (2008) study of rain banks). The focus on such innovations is easy to understand: one can gain statistically meaningful results for a very modest investment. But the methodology could be more generally applied, particularly if researchers were to work in conjunction with financial institutions. One problem with such methodologies, however, is that small-scale experiments are almost surely unable to measure the systemic costs or benefits that we highlighted above.

The same concern—an inability to assess broader externalities--is likely to be a barrier to our third suggested avenue as well: to apply the tools of structural estimation of the social impact of new products to financial innovations. While these models have assessed many classes of

product innovations, financial innovations have been largely neglected. But complex dynamics outlined above may make such empirical assessments challenging.

Finally, a more careful look at the consequences of diffusion of financial innovations for social welfare seems very worthwhile. As noted above, often there are changes in users and even in the nature of the products as new financial products and services diffuse. Even getting a better understanding of "stylized facts" about diffusion would be an important first step, including the speed with which financial innovations are adopted, the nature of different classes of adopters, and the transformation of products over the diffusion cycle. Seeking to develop and test theoretical perspectives, such as how these features will vary with innovation types, is an important next step.

We are left, then, with the approach of detailed case studies of financial innovation as the model for uncovering the social welfare implications of systemically important new products. By judicious selection of case studies, we can put appropriate attention on innovations that had major impacts on society. The case study approach, while somewhat ad hoc, will force us to examine each innovation in its entirety, both in terms of the full time span of its adoption and the many ripples in the economy. The use of counterfactuals will force us to be explicit about our implicit assumptions. While less "scientific" than other approaches, it stands the best chance to inform our understanding.

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