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Source: *The American Economic Review*, Vol. 73, No. 2, Papers and Proceedings of the Ninety-Fifth Annual Meeting of the American Economic Association (May, 1983), pp. 89-95

Published by: American Economic Association

Stable URL: <https://www.jstor.org/stable/1816820>

Accessed: 01-02-2025 14:13 UTC

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# RECENT STRUCTURAL CHANGE IN THE CAPITAL MARKETS

## The Process of Financial Innovation

By WILLIAM L. SILBER\*

We often think of technological changes, such as the telegraph or xerography, as *de novo* events. That is no doubt true in some cases, but most evidence suggests that innovative activity responds to economic forces. In the financial sector, casual observation credits most new financial products to economic incentives, but there is a paucity of formal empirical evidence on the subject. For example, many agree that high interest rates and regulation stimulated new financial products, such as money market funds and NOW accounts, but we need both theoretical models and empirical observation to document the forces at work.

The objective of this paper is to survey recent financial innovations and to provide a framework for understanding why they arose. Models are designed to explain the process of financial innovation and are used to identify the variables that underlie new financial products and practices.

### I. Theories of Financial Innovation

Financial innovation is often viewed as a by-product of regulation. The argument is that most financial innovations try to circumvent regulatory constraints. There is little doubt that regulations play an important role, but that perspective is too narrow to explain the entire process. A more general model (see my 1975 article) has been developed emphasizing the microeconomic framework of financial innovation. I summarize

that approach because it helps pinpoint the sources of innovative pressure.

The main hypothesis (1975, pp. 64ff.) is quite straightforward: new financial instruments or practices are innovated to lessen the financial constraints imposed on firms. In fact, a simple linear programming model helps to articulate the process. Firms maximize utility subject to a number of constraints. These constraints are imposed both externally and internally. Among the most prominent external constraints are government regulations. But the marketplace also constrains the firm's optimization problem. For example, if market power exists, then the firm sets prices or yields and accepts whatever volume of funds are offered; alternatively if the firm is a price taker, it can buy precisely the quantity of funds that maximizes utility. Viewed more generally, the marketplace defines the parameters of demand and supply for different financial products and simultaneously identifies the policy tools available to the firm.

Constraints are often set internally by the firm, and these also influence the optimization problem. For example, a firm may establish a target rate of growth for assets. Self-imposed liquidity constraints are also frequently found within financial firms. Commercial banks, for example, usually manage discretionary funds so that all potential sources of funds are tapped on a regular basis (see my 1978 study, p. 15).

In the normal course of events, a firm maximizes its objective function subject to existing constraints. This simply says that a firm will sell securities or accept deposits and invest the proceeds, all within the framework of existing parameters and constraints. New sources and uses of funds are innovated when exogenous changes in the environment stimulate the search for new policy tools. As

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long as the development of new financial products is costly, normal financial decision making will be distinguished from new product innovation.

The programming framework suggests that the stimulus to innovation can be interpreted as an increase in the cost of adhering to existing constraints. For example, rising yields on assets in the objective function may raise the cost (shadow price) of the constrained volume of deposit funds. Alternatively, an increase in interest rate volatility may reduce funds from conventional fixed rate debt instruments, implying a higher shadow price for the proceeds of conventional securities flotations. In both cases, the rising costs of adhering to existing financing constraints stimulates the search for new financial products.

This constraint-induced innovation hypothesis acquires a time dimension once search and development costs are integrated with rising shadow prices. Although financial innovation is not considered as costly as new technology, there is considerable expense in designing new contracts, running a new secondary market or installing requisite computer equipment. These costs suggest that only a sustained increase in shadow prices over time will stimulate new product innovation. In addition, lower costs of developing new products will generate more innovations.

Before turning to the empirical evidence, two extensions of this view of financial innovation are useful. One explicit addendum is Richard Sylla (1982) and relates specifically to collective action and monetary innovation. The second observation is implicit in Albert Wojnilower's (1980) treatment of credit crunches and deals with the nature of new financial products.

Sylla's basic point is that new monetary standards (fiat currency, national bank notes) were introduced when crises in the monetary system forced the government to overhaul the payments mechanism. Sylla (especially fn. 6) follows my study and identifies the innovation of new monetary systems with the rising cost of adhering to existing constraints, where the rising costs are felt by individuals and firms simultaneously. Con-

sidering the congenital difficulty in both public and private collective action, it is not surprising that crises are needed to induce separate interest groups to innovate a product jointly.

Wojnilower's observations on new financial products stem from his interest in how financial responses to credit crunches set the stage for future cycles of recession and inflation (p. 227). From my standpoint, his most interesting observation (p. 295) is that floating rate debt transforms a lender's objective into simply maximizing total assets, rather than the normal constrained optimization. Wojnilower's perspective fits quite well within my framework, but emphasizes that new financial products are designed to *sustain* financing flexibility for the firm.

## II. Empirical Evidence on Sources of Innovation

The only formal empirical investigation of financial innovation appears in Moshe Ben-Horim's and my 1977 article. To test the constraint-induced model of innovation, that study specified a linear programming model of large money market banks designed to calculate shadow prices of deposits and capital between 1952 and 1970. The results were quite encouraging. Deposit shadow prices rose significantly in the years prior to 1961 and again before 1969. Both years experienced major financial innovations: in 1961, the negotiable certificate of deposit was born; and in 1969, bank-related commercial paper and loan repurchases were popularized. The shadow prices for capital jumped significantly between 1962 and 1964. In 1963, subordinated debentures were first introduced as part of bank capital, and in 1965, those debentures were issued in substantial volume. Thus the empirical results confirm that rising costs of adhering to constraints stimulate financial innovation.

Table 1 records new financial products and practices between 1970 and 1982. This provides a new data base on which to test the constraint-induced model of the innovative process. Most of the innovations listed in the table were cited in articles (available on request) from the *Wall Street Journal*, *Business Week*, *American Banker*, *Institu-*

TABLE 1—FINANCIAL INNOVATIONS: 1970–82

Types	Exogenous Causes <sup>a</sup>					
	I			2	3	4
	(a)	(b)	(c)			
A. Cash Management						
1. Money Market Mutual Funds	✓					
2. Cash Management/Sweep Accounts	✓				✓	
3. Money Market Certificates	✓					✓
4. Debit Card	✓				✓	
5. NOW Accounts	✓					
6. ATS Accounts	✓				✓	
7. Point of Sale Terminals					✓	
8. Automated Clearing Houses					✓	
9. CHIPS (Same Day Settlement)					✓	
10. Automated Teller Machines					✓	
B. Investment Contracts						
(i) Primary Market						
1. Floating Rate Notes				✓		
2. Deep Discount (Zero Coupon) Bonds	✓		✓	✓		
3. Stripped Bonds	✓		✓	✓		
4. Bonds with Put Options or Warrants	✓			✓		
5. Floating Prime Rate Loans				✓		
6. Variable Rate Mortgages				✓		
7. Commodity Linked (Silver) Bonds				✓		
8. Eurocurrency Bonds	✓					
9. Interest Rate Futures				✓		
10. Foreign Currency Futures						✓
11. Cash Settlement (Stock Index) Futures					✓	
12. Options on Futures				✓	✓	
13. Pass-Through Securities					✓	
(ii) Consumer-Type						
1. Universal Life Insurance				✓		
2. Variable Life Policies		✓				
3. IRA/Keogh Accounts			✓		✓	
4. Municipal Bonds Funds			✓		✓	
5. All-Saver Certificates	✓				✓	
6. Equity Access Account		✓		✓		
C. Market Structures						
1. Exchange-Traded Options						✓
2. Direct Public Sale of Securities						
Green Mountain Power Co.				✓		
Shelf Registration				✓		
3. Electronic Trading						✓
NASDAQ					✓	
GARBAN					✓	
4. Discount Brokerage						✓
5. Interstate Depository Institutions					✓	✓
D. Institutional Organization						
1. Investment Bankers/Commodity Dealers	✓			✓		
Salomon/Phibro, Goldman						
Sachs/J. Aron, DLJ/ACLI						
2. Brokers/General Finance						✓
Shearson/Amex, Bache/						
Prudential, Schwab/Bank of America						
3. Thrifts with Commercial Banks	✓			✓		✓
4. Financial Centers (Sears Roebuck)						✓

<sup>a</sup> Column headings: 1. Inflation: (a) Level of Interest Rates, (b) General Price Level, (c) Tax Effects; 2. Volatility of Interest Rates; 3. Technology; 4. Legislative Initiative; 5. Internationalization; 6. Other.

*tional Investor, Bank Marketing, Best's Review*, and other trade publications. My use of trade journals for compiling a list of innovations follows Edwin Mansfield (1968) who prefers that source to patent data (even when the latter are available).

The 38 individual entries in Table 1 are new financial products or practices that emerged during the 1970–82 period. There is little doubt that any single entry could be expanded into additional specific innovations. For example, interest rate futures (entry B(i),9) could be divided into numerous individual new futures contracts. Although such distinctions are quite important in certain contexts (see my 1981 article), my broad objectives required that these details be left to more specific analyses.

I cannot replicate the Ben-Horim-Silber experiments for the innovations recorded in Table 1. Considerable additional effort is needed to construct a time-series of shadow prices for each innovation. Instead, I take a less formal approach to evaluating the constraint-induced explanation of financial innovation. In particular, each of the columns in the table represents an exogenous force that influenced financial constraints during the 1970–82 period. I would like to see how many new financial products were stimulated by these forces and how well the constraint-induced model of innovation tells the story. Needless to say, this evidence on the innovative process is best viewed heuristically.

Each of the potential causes of innovation requires some elaboration. The first two items, inflation and volatility of interest rates, are self-explanatory, although I identify interest rate and tax burden effects of inflation in addition to the general increase in prices. Technology refers primarily to information processing and data transmission. Legislative initiatives are identified with agency regulations or congressional legislation. Internationalization includes the consequences of the expansion in foreign trade, floating exchange rates, and OPEC. Although I have labelled each of these items exogenous, some feedback effects will be noted as I discuss the individual new products and practices.

Cash management is the first broad category of innovation listed in the table. More particularly, the first six entries (A.1–A.6) are varieties of cash management accounts. The high level of interest rates is listed as a primary cause of each item. For three of these innovations, sweep accounts, debit cards, and ATS accounts, I also note the role of inexpensive computer technology (this might also be true of money market mutual funds). The money market certificate was also a by-product of interest rates levels, with an assist from favorable regulatory action (although this probably should not be labelled a legislative *initiative*).

All of these innovations were aimed at loosening constrained access to sources of funds created by rising interest rates. Even money market mutual funds might be viewed within this context because the industry responded to lagging equity fund sales caused, in part, by rising rates of interest. Note that the cost side of circumventing constraints enters via the role of inexpensive computer technology.

Items A.7 through A.10 are new products associated with the technology of the payments system. It is possible that interest rate levels played some role in stimulating the same day settlement procedure of CHIPS (Clearinghouse Interbank Payment System), but technology was the major force behind point of sale terminals, automated clearing houses and automated teller machines.

The next group of innovations is labelled (B) investment contracts. This category is divided into (i) primary market innovations and (ii) consumer-oriented products. While there are similarities in the subcategories, it is useful to consider them separately.

The first eight innovations under primary market investment contracts are modified debt instruments designed to help borrowers raise funds in an environment of high and volatile interest rates. In particular, 1) floating rate notes, 4) bonds with put options (bonds that can be sold back to the corporation at a fixed price), 5) the floating prime, 6) variable rate mortgages, and 7) commodity-linked bonds protect lenders from rising interest rates. Without such flexibility, bor-

lower access to funds would have been severely constrained. Similarly, 4) bonds with warrants (to buy additional debt from the corporation at a fixed yield), 2) deep discount bonds, and 3) stripped bonds (where the semiannual coupons and the final payment have been separated) also were designed because of interest rate volatility (in addition to offering certain tax benefits). In these cases, investors can lock in exceptionally high yields. Thus, the table indicates that both the volatility in yields and the high level of rates were important stimuli for these innovations. Eurocurrency bonds (item 8) are a product primarily of the increased internationalization of corporate balance sheets, but without high and volatile domestic interest rates, this market would probably not have grown significantly.

Four new products in futures markets are listed as items 9 through 12 under category B(i). Although these are not directly related to reducing the burden of financing constraints, they are complementary innovations that permit investors to hedge the risk of increased price volatility in financial markets. Note that both cash settlement (as opposed to physical delivery) futures contracts and options on futures required regulatory approval. But as with money market certificates, the initiative hardly came from the regulators.

Pass-through securities, listed as entry 13, is the first item in the table that emerged *primarily* through government initiative, via the GNMA pass-through program of the Department of HUD. Private pass-throughs subsequently joined them in the marketplace. The pass-through program was designed to increase the liquidity of mortgages and to direct the flow of credit to the mortgage market (see Rudolph Penner's and my 1973 article, and Deborah Black et al., 1981). It is unclear whether this is a constraint-induced innovation initiated by government collective action.

Under consumer-type innovations of subcategory B(ii), three items were initiated by legislation: 3) IRA/Keogh accounts; 4) municipal bond funds; and 5) all-saver certificates. But even these legislative

initiatives are not truly exogenous. With IRA/Keogh accounts and municipal bond funds, the rising tax burden associated with inflation probably stimulated legislative relief. For the all-saver certificate, the main thrust was to alleviate thrift institution funding constraints.

The remaining three innovations in the consumer-type category fit easily into the constraint-induced framework. Universal life insurance (item 1) combines insurance with a money market fund so that insurance companies can compete with short-term investments. Variable life policies (entry 2) keep insurance coverage constant in real terms, permitting insurance companies to increase nominal cash inflows during inflationary periods. The equity access account (item 5) was designed by Merrill Lynch & Co. to permit consumers to overcome liquidity constraints by borrowing through a line of credit against the built-up equity in their homes.

Approximately 75 percent of the new products listed under categories A and B fit into the constraint-induced framework. The model does not do nearly as well in the next two categories: (C) market structures and (D) institutional organization. Each requires some elaboration.

Among the new market structures listed under C, only item (2), the direct public sale of securities, explicitly promotes flexibility in financing constraints. The Green Mountain Power Co. of Vermont began the process back in 1970 by selling debt directly to its customers on a continuous basis. Sears Roebuck and AT&T announced similar plans but never consummated the arrangements. A ruling by the SEC now permits firms to register securities for sale over a two-year period and then to sell them "off the shelf" as market conditions dictate. This flexibility in the timing of new issues is crucial when interest rates are volatile.

The other developments in new market structures have little to do with relaxing constraints. Exchange traded options (entry 1) was an experiment of the Chicago Board of Trade through the Chicago Board Options Exchange. Electronic trading (item 3) in over the counter stocks (NASDAQ) and in the

government securities market (GARBAN) were technological breakthroughs. The SEC's end to fixed commission rates on May 1, 1975 initiated the era of discount brokerage (item 4). Finally, de facto interstate depository institutions (entry 5) stem from technological developments and implicit regulatory approval.

Constraints play a greater role in category D, institutional organization. The increased level and volatility of interest rates together with the development of financial futures markets encouraged the mergers between commodities dealers and investment bankers (entry D.1), thereby promoting institutional flexibility. A similar argument might apply to the merger between thrifts and commercial banks in item 3. But there is no constraint-induced story behind the takeover of brokerage houses by other financial institutions in entry 2 or financial centers in item 4. These developments rely on an anticipated synergism that has yet to emerge.

### III. Conclusions

I can summarize the empirical evidence on innovation with three points. First, the only formal test of the constraint-induced model of financial innovation appears in Ben-Horim's and my article. The model successfully explained new bank products during the 1952–70 observation period. Second, the constraint model underlies about 60 percent of the financial innovations during the 1970–82 period. Although formal work estimating the relevant shadow prices is necessary, the constraint-induced story seems appropriate in at least half of the cases. Third, the most important forces underlying the remaining innovations are technology and legislative initiatives. Both factors sometimes operate through constraints, but it is a mistake to ignore their independent role in financial innovations.

I began this paper by comparing financial innovation with technological change. I noted that both types of innovative activity respond to economic incentives. I conclude by mentioning that both processes also improve economic welfare. Technological change ex-

pands physical output, thereby increasing the standard of living. Financial innovation operates in somewhat different dimensions, as emphasized by Benjamin Friedman (1982, pp. 53–56). In particular, innovations in financial institutions and practices have improved the ability to bear risk (futures markets), lowered transactions costs (automated teller machines), and circumvented outmoded regulations (money market mutual funds and Regulation Q). Thus, the process of financial innovation described here yields economic benefits that are no less real in a welfare sense than improvements in physical technology.

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