Effect of the Internet on Financial Markets

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I review some academic work on electronic markets in an effort to provide some guidance about future evolution of "cybermarkets" in the real world.

1 Retail transactions in financial services

Financial services, especially stock market trading, have been one of the killer apps of the Internet. In 1996 there were about 1.5 million online brokerage accounts; by the end of 1998 that number is expected to be 5.3 million. Online accounts now are used for about 25% of all retail trades and Forester Research forecasts 14.4 million online accounts by 2002. (Dwyer et al. [1998])

These customers behave differently than traditional stockholders. The online broker E-Trade[1] claims its customers average 25 trades a year, which is much more than customers of full-service brokerages (1-2 times per year) or discount brokerages (4-6 times per year). (Harmon [1998]) There are now 74 online brokers, whose intense competition has pushed commissions down to only $16 a trade, compared to $53 in 1996.

Mortgage refinancing has also benefited from advances in information technology and the Internet in particular. Refinancing in Q1 1998 made up about 57% of conventional mortgage applications, close to the record of 58% set in 1993. According to Byrt [1998], this boom is due in large part

[1] http://www.etrade.com

to reduced transactions costs to refinance: borrowers can complete forms online and the processing is highly automated. Closing points and fees averaged 1.1% in July 1998, compared to 1.5% in 1993. The old rule of thumb that a two-percentage-point drop in rates was required to generate refinancing boom has now dropped to less than 0.75 percentage points due to the reduction in transactions costs. (Byrt [1998])

Home banking, on the other hand, has been something of a disappointment. Currently, about 6 percent of customers use home banking, significantly less than was forecast a few years ago. The slow adoption of home banking has been attributed to 1) bank mergers (more than $200 billion in 1998), 2) Year 2000 problems, 3) lack of interoperability standards, and 4) poor user interfaces. The latter two problems may be dealt with by the Internet, and, in particular, by the Web. However, progress has been slow, and as of July 1998 only about 30 of the top 100 banks had a transactions-capable Web site. (Wallace [1998])

Similarly, online insurance sales have been less than forecast. According to a study of households with Internet access by Opinion Research Corporation International, 50 percent said they were interested in online banking, 44 percent were interested in consumer goods, but only 27 percent were interested in home or auto insurance, and only 6 percent were "seriously interested." (Mullins [1998])

2 Transactions by financial services providers

The picture is similar on the provider side of the industry. Financial services have always been heavy users of IT, and this will likely continue to be the case for many years. However, the most innovative uses of IT are likely to take place in securities markets. As indicated above, online brokerages have been quick to take advantage of the Internet's potential, offering quotes, trades, and even IPOs.

The next wave of innovation is likely to be actual online trading, via cybermarkets. The first significant example of such a cybermarket is OptiMark[2], which will start electronic trading of NYSE stocks on the Pacific Stock exchange in October. Next year, it will offer NASDAQ trades, which, itself is planning to put its trading network on the Internet.

[2]http://www.optimark.com

This is just the tip of the iceberg. The Paris futures exchange is now using exclusively online trading, the London exchange has offered some contracts online, and Cantor Fitzgerald & Company is currently seeking SEC approval to trade U.S. Treasury bond futures electronically. NASD President Richard G. Ketchum says "I have no doubt that investors will trade NASDAQ stocks over the Internet in a few years."

The Paris futures exchange, MATIF, offers an illustrative example. It offered both electronic and floor trading, assuming that the market would eventually decide which was superior. "Eventually" came a lot sooner than anyone had expected: within 2 weeks, nearly everyone was trading electronically, and within 8 weeks, MATIF had to close floor trading entirely due to lack of demand. (Dwyer et al. [1998])

This lesson is not lost on floor traders. New York Stock Exchange seats are down 32% from their February high of $2 million. Chicago Board of Trade seats are down 52% from their high of $857,000 in 1997, and the Chicago Mercantile Exchange seats are down 64% from their $925,000 high in 1994. (Dwyer et al. [1998],Barboza [1998])

3 Where will it all lead?

My goal in this paper is to speculate a bit about what will happen to financial markets as they evolve into cybermarkets. I will draw on the economics literature in making these prognostications, since there is a surprisingly old literature on Internet-based markets. The Internet, after all, was once available only to universities, and some economists were quick to realize its potential for studying market behavior.

As the Internet developed, more adventuresome users began to experiment with exotic markets of one form or another, offering some interesting lessons for future deployment of "real" markets.

According to Keynes [1935]:

> "[T]he ideas of economists and political philosophers, both when they are right and when they are wrong, are more powerful than is commonly understood. Indeed, the world is ruled by little else. Practical men, who believe themselves to be quite exempt from any intellectual influences, are usually the slaves of some defunct economist. Madmen in authority, who hear

> voices in the air, are distilling their frenzy from some academic scribbler of a few years back."

This is as true for the cybermarkets of the 90s as it was for Keynes's world of the 30s.

4 The Iowa Electronic Markets

One of the first "serious" markets on the Internet was the Iowa Presidential Market, which was initiated in April 1988 and opened for trade on June 1. (See Forsythe et al. [1992] for a description and analysis of the Iowa market.) The market sold traded shares in the candidates for the 1988 Presidential election, including George Bush, Michael Dukakis, and Jesse Jackson. The dollar value of a share in a particular candidate after the election was defined to be the fraction of the popular vote which the candidate received.[3] Since Dukakis received 45.4 percent of the popular vote, Dukakis shares ended up being worth 45.4 cents. Prior to the election the market value of a Dukakis share could be expected to be a predictor of the likely vote share that Dukakis would receive.

The Iowa market was remarkably accurate. On the eve of the election , it forecast a vote share for Bush of 53.2 percent, which was exactly right, and a share for Dukakis of 45.2 percent, which was only .2 percent less that the share he actually received. This is substantially better performance than any of the opinion polls. Furthermore, over the entire history of the campaign the market forecasts were substantially less volatile than those of the polls.[4]

One reason for the poor predictive power of polls is that the pool participants exhibit various biases in their responses. For example, individuals' preferences tend to bias their forecasts; i.e., voters favoring Bush tended to overestimate the fraction of the popular vote Bush would receive. Using conventional political surveys Forsythe et al. [1992] found that the participants in their experiment exhibited exactly the same biases as the population at large.

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[3] Times a constant of $2.50, which we will ignore.

[4] This finding offers an interesting rebuttal to the claim that markets are "excessively volatile." Perhaps it is the case that peoples' opinions are excessively volatile, and market prices fluctuate less than opinons.

This finding poses a problem: how can it be that the market forecast is so much more accurate than the polls, even though the market participants are no more objective, rational, or farsighted than the population at large?

Forsythe et al. [1992] offer a convincing explanation of this seeming paradox using the notion of "marginal traders." A marginal trader, in their context, is one who submits limit orders at prices close to the market price. Such traders tended to have about twice as high an investment as the other traders, and realized a much larger rate of return on their investment. They also participated in the market much more frequently. In other words, the "marginal traders" were the "professionals:" people who traded frequently, methodically and profitably.

The most remarkable characteristic of the marginal traders was that their trading responses showed no evidence of judgment biases. Some traders liked Bush, some liked Dukakis. But if their candidate's price got to high, they would sell him in a minute! This behavior is quite different from that of non-marginal traders, whose trading patterns appear to be strongly influenced by their preferences.

This finding has tended to be confirmed by other political stock markets run by the Iowa team, including some that were open to participation by the entire `edu` domain.

The presidential stock market has evolved into the Iowa Electronic Markets[5] which currently runs markets on a number of political events, as well as on derivative securities related to technology stocks. See Robert Forsythe's home page[6] for a recent list of articles about the Iowa markets.

5 The Santa Fe Double Auction

The Santa Fe Double Auction was conceived by John Rust, John Miller, and Richard Palmer in 1989. They created a computerized environment for "double auctions," which was essentially a bid-ask market using as simplified version of the AURORA rules used at the Chicago Board of Trade, and invited researchers to contribute computer programs that would "compete" against each other in this market. The outcome of this experiment is described in Rust and Friedman [1993], Rust et al. [1993] from which the following summary is drawn.

[5] http://www.biz.uiowa.edu/iem/index.html

[6] http://www.biz.uiowa.edu/econ/faculty/rforsyth.html

Rust et. al. developed a program known as the Santa Fe Token Exchange, which opened each hour for trading over the Internet. The purpose of this exchange was to offer an environment in which participants in the double auction experiment could try out their trading agents. IBM offered a $10,000 prize for the winner, and the tournament was held in March, 1990. There were 30 programs submitted, 15 from economists, 9 from computer scientists, 3 from mathematicians, and the remainder from an investment broker, a marketing professor, and a pair of cognitive scientists.

The winner of the tournament was submitted by a graduate student in economics, Todd Kaplan. When I asked Todd why he thought his program did so well, he responded that all the other contestants wanted to show their theory was correct. As a poor graduate student, he really wanted to win the $10,000!

The Kaplan program was remarkable in its simplicity: in the words of Rust et al. [1993], it was "simple, non-adaptive, non-predictive, non-stochastic, and non-optimizing." The strategy used can be succinctly summarized as follows: "wait in the background and let the others do the negotiating, but when the bid and ask get sufficiently close, jump in and steal the deal." (Rust et al. [1993]) The program accomplished this by waiting until the bid and ask came within 10% of each other and then bidding an amount slightly larger than the previous ask.

The Kaplan program's winnings were highly statistically significant and subsequent rounds of trading, some using programs designed to optimize against the Kaplan algorithm, did not succeed in unseating it from first place.

The researchers also conducted an "evolutionary tournament," in which successful strategies were allowed to "reproduce" themselves. After 28,000 plays, Kaplan's strategy achieved almost total domination of the market. However, at this point, the market essentially crashed. The reason is that a "wait-in-the-background strategy" only works if there are many other active traders. When Kaplan's strategy took over the entire market, it could no longer free-ride on price-discovery by other bidders.[7] However, a small fraction of active bidders (only 5 or 10 percent) is sufficient to prevent such crashes, as long as they continue to be replenished.

[7] The Kaplan program did have a default rule when no one was willing to trade, but it was not particularly sophisticated.

Rust et al. [1993] conclude:

> "By remaining in the background, Kaplan's program is able to capitalize on the mistakes of the active bidders, lifting its efficiency well above 100% and ensuring its growth while pushing the active bidders' efficiency well below 100% and ensuring their decline. The biological analogy is a parasite that invades and eventually destroys its host."

To me, the Santa Fe Double Auction serves as a cyber-metaphor of real financial markets. It has long been known that a passive buy-and-hold-the-market strategy is extraordinarily efficient. Passive index funds tend to outperform active investment strategies in virtually every market. Indeed, index funds are essentially the Kaplan strategy: let others do the price discovery, and make your own transactions at the price that emerges.

Such passive strategies are, of course, vulnerable to the evolutionary collapse exhibited in the Santa Fe market: if everyone buys an index fund, who is left to set prices? The answer offered by Grossman and Stiglitz [1980] is that informed traders, which I interpret as professional traders in this context, must realize a higher return to trading, which, on the margin, just compensates them for the extra cost of becoming informed. However, the existence of equilibrium in such a model depends critically on the presence of "noise traders," like those in the Santa Fe Double Auction that serve to both obscure the information content of the professionals (so as to prevent total free-riding by passive traders) and add liquidity.

6 Electronic trading and the Crash of 1987

Another example of the possibly "destabilizing" activity of trading agents is described in Gennotte and Leland [1990], which examines the role of portfolio insurance in the stock market crash of October 1987.

Portfolio insurance is a type of "dynamic hedging" strategy that is designed to provide a floor on portfolio value by sacrificing upside gains. It is important to recognize that portfolio insurance is not "strategic." It is simply a fixed rule that says to buy or sell stocks, depending on their recent behavior.

As it happens, portfolio insurance involves a form of positive feedback: buy when the market is going up, sell when it is going down. Hence they

are potentially destabilizing. Gennotte and Leland [1990] argue that this positive feedback played a critical role in the October 1987 stock market crash. They suggest that other traders mistakenly thought that there was information content in the mechanistic sell orders placed by the portfolio insurance programs. Assuming that these sell orders were based on "bad news," the other traders sold as well.

The problem, according to Gennotte and Leland [1990], was a lack of information about what fraction of trading was mechanistic. They argue that

> To the extent that stock-exchange specialists have privileged access to information on the nature of order flows, they play a key role in providing stability . . . Electronic "open books" should be a seriously considered reform.

7 Exotic markets

In addition to the developments in online markets described above, there have been many more exotic speculative markets created on the Internet. A good source for the rationale and description of such markets is Robin Hanson's Idea Futures page[8]. Hanson's work in this area dates back to 1988; he was one of the first to think seriously about the concept.

Suppose that one has a question that will be resolved time in the future, such as "Who will win the 2000 election?" According to Hanson:

> One can subsidize a market on a question, offering extra rewards to those who bet right on this question. This subsidy is an "information prize," offered to those who first provide information on a question, in contrast to an "accomplishment prize," given to those who first accomplish some task. Instead of patronizing academic basic research via proposal peer-review, we should use prizes more.

This is essentially the idea behind the Iowa Electronic Markets. However, it has also been applied to other questions:

[8] http://hanson.berkeley.edu/ideafutures.html

- The Foresight Exchange[9] allows participants to bet on a number of different events that are proposed by the participants. In the first week in September the 10 most active questions were:

  1. DJIA below 7,000 by 11/30/99
  2. UNIX is irrelevant by 2000
  3. Bill Clinton President in 2001
  4. Nuke capable Terrorists
  5. DJIA hits 10,000 by 12/31/99

- The Invisible Hand[10] is similar to the Foresight Exchange. In the first week of September, the 5 most active securities were:

  1. Mark McGwire hits less than 62 home runs
  2. Mark McGwire hits more than 61 home runs
  3. PGA top money winner is not Tiger Woods
  4. Cigarette smoking man is not Mulder's father
  5. PGA top money winner is Tiger Woods

- Fantasy Futures[11] is yet another variation on the same idea.

- Hollywood Stock Exchange[12] allows participants to bet on the box office gross during the first four weekends after release (along with various derivatives).

- Wahl$treet[13] (in German) allows real money betting on various political events, similar to the contracts offered on the Iowa Stock Exchange.

- Chen and Plott [1998] describes an electronic market deployed over the Internet to do sales forecasting for Hewlett-Packard. The market, which was internal to HP, involved Arrow-Debreu type securities

[9] http://www.ideosphere.com/
[10] http://myhand.com
[11] http://198.199.206.221/cgi-bin/start.cgi/betexchange/welcome.html
[12] http://www.hsx.com
[13] http://www.wahlstreet.de/

> contingent on states defined in terms of various levels of sales of HP printers. The forecasts implicit in the market prices of these securities was consistently better than the HP official forecasts.

8 Securitization

There has been a substantial amount of experimentation with securitization of various "exotic" cash flows in recent years. After the huge success with mortgage bonds in the 1980s, Wall Street has looked to other forms of cash flows to package as securities.

> Wall Street is securitizing virtually everything that produces a predictable stream of cash. Typhoon insurance. Tax liens. Loans for used cars and fraternity houses. Fax machine leases. Mutual-fund fees. Unused airline tickets. Movies yet to be made. Even defunct power plants. (Eaton [1998])

Several firms on Wall Street are securitizing electricity bills, and the rock star David Bowie recently sold $55 million worth of bonds backed by the anticipated royalties on his recordings.

A closely related form of exotic security is "catastrophe bonds," which offer a way for insurance companies to lay off risk on the market. The first such bond was issued in December of 1996. Subsequently, in July 1997 the United Services Automobile Association, issued $477 million of the bonds tied to an East Coast hurricane disaster. If a single East Coast hurricane caused enough damage within one year of the issue date to cost the insurer at least $1.5 billion in damage claims, the investors would lose their entire principal. If the loss was between $1 billion and $1.5 billion, they would lose a portion of their principal. If there was no hurricane, the investors would receive their entire principal plus about 11.8 percent. The bonds were immensely popular, with the initial offer being oversubscribed by more than $500 million. (Treaster [1997])

A few weeks later the Swiss Reinsurance Company issued a $137 million bond linked to the potential of a California earthquake.

Currently these bonds are limited to large investors, but it is only a matter of time before such bonds, or variants thereof, are available to everyone.

9 Conclusion

What conclusions can we draw from these trends in financial markets? I will offer the following observations:

- Electronic trading is here to stay; the Paris MATIF experience is likely to be repeated.
- Exotic markets, such as the markets in political events, can play a significant role in forecasting public and private events.
- Electronic agents for trading will likely be widely used. This is unlikely to cause a problem unless there is significant specialization on one type of trading agent.
- Electronic markets should aim for transparency in transactions, which is one of the best defenses against instability.
- We will see a continuation of the trend towards securitization. Electronic markets will allow for retail participation in such markets, helping to share risk more efficiently.

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