Conference Summary
PAYMENT CARDS CENTER

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Innovation in Financial Services and Payments

A conference organized by

The Research Department and the

Payment Cards Center of the
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May 16-17, 2002

Summary: *Rapid innovation is changing the array of financial services and payment options available to customers. To examine the driving forces behind the surge of innovation and the adoption of new technology, the Payment Cards Center and the Research Department of the Federal Reserve Bank of Philadelphia hosted a conference on "Innovation in Financial Services and Payments" on May 16-17 of this year.*

This document provides a summary of the presentations and discussions during the two day conference event. Special thanks to the conference organizer, Robert Hunt of the Philadelphia Fed's Research Department and Gabriela Guibourg of the Riksbank and a visitor to the Payment Cards Center for their work in preparing this summary.

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INNOVATION IN FINANCIAL SERVICES & PAYMENTS

Conference Summary

Rapid innovation is changing the array of financial services and payment options available to customers. To examine the driving forces behind the surge of innovation and the adoption of new technology, the Payment Cards Center and the Research Department of the Federal Reserve Bank of Philadelphia hosted a conference on "Innovation in Financial Services and Payments" on May 16 -17 of this year.

Perspectives on Research Issues in Consumer Behavior

In his introduction to the conference **Dr. Anthony M. Santomero**, president of the Federal Reserve Bank of Philadelphia, reviewed a series of fundamental changes taking place in the payment system — changes, he noted, that "are affecting all aspects of the payment process: how payments are made, by whom, and through what services."

The share of retail transactions paid for by credit cards, debit cards, and Automated Clearinghouse (ACH) and other emerging payment vehicles is rising rapidly as cash and check payments continue to lose market share to more efficient electronic alternatives. At the same time, technological advances affecting check processing, such as electronic presentment, imaging, digital transfer, and electronic archiving, are blurring the lines between electronic and check-based payments while improving efficiencies in the payment system. New nonbank providers have extended the market for consumer payments. Joint ventures between banks and technology firms have become commonplace.

Dr. Santomero noted that at the wholesale level the pace of change continues to accelerate as well. While Fedwire continues to be the industry choice for large dollar payments, the Fed is moving into an era of unprecedented cooperation with alternative providers. Fedwire's interoperability with other systems is increasing, and discussions are taking place to consider the expansion of operating hours to overlap with foreign payment systems.

As Dr. Santomero emphasized, "All of these changes have dramatic implications for the structure of payments." The Fed's responsibility is to foster continued advances in the efficiency and effectiveness of payments and ensure system stability and integrity. The Philadelphia Fed has a particular interest in these issues because not only is it the single largest check-processing center in the System but also the home of its Payment Cards Center. The focus on payments is a natural outgrowth of the geographic concentration in our District of credit-card-issuing banks, EFT network providers, payment processors, and a host of emerging payment innovators.

This conference, co-sponsored by the Bank's Research Department and Payments Card Center, is one example of the Bank's commitment to informing the debate on the ongoing payments evolution. In closing, Dr. Santomero urged the academic researchers in the audience to join in this commitment and continue their important contributions to the literature.

Innovation and Network Structure

David A. Balto, a partner with White & Case LLP and a former policy director for the Bureau of Competition of the Federal Trade Commission (FTC), presented the opening address of the conference. He spoke about innovation as it is perceived from the perspective of antitrust enforcement. Balto used the recent decision in the antitrust suit involving Visa and MasterCard to illustrate issues surrounding innovation and competition in a network industry.

Balto began by pointing out Washington's renewed interest in the relationship between competition and innovation in markets, on the one hand, and the government's role in the areas of antitrust and intellectual property on the other. Determining what the optimal government policies should be is a complicated question that is made more difficult when evaluating the conduct of joint ventures. A joint venture structure is a common business model in the financial services industry and especially so in the payment cards arena. As a result, a number of the leading antitrust cases addressing these issues have involved the bankcard associations Visa and MasterCard.

In the most recent case, the Antitrust Division of the U.S. Department of Justice (DOJ) argued that two of the associations' rules were anti-competitive: *governance duality* — the policy permitting members of one network to belong to the other — and *exclusivity* — the policy that prevents member banks from issuing the cards of certain rival networks such as Discover or American Express. The DOJ alleged that these rules stifled competition between the networks and dampened product development and innovation. DOJ filed its suit in 1998, and a trial verdict was reached in 2001. The trial court ruled against the DOJ on the governance rule. But it ruled in favor of the DOJ on the exclusivity rule, ordering the associations to allow their members to issue Discover or American Express cards if they wish. The case is currently under appeal.

Balto noted that this decision was not about competition at the level of individual issuers (banks), but rather about competition at the network level. The significance of network competition in the payment cards industry has been the subject of several antitrust cases over the last quarter century. In the most recent case, the court concluded that the exclusivity rule could impair the number and quite possibly the functionality of cards being offered. This was a somewhat surprising conclusion given that Discover and American Express have millions of cardholders and payment card features have proliferated over time. Balto suggested the court was looking ahead, recognizing that payment cards offering both credit and debit features were likely to become the dominant payment instrument. In that case, the ability to access consumers' bank accounts would be crucial, and this would be feasible only with banks' participation.

This case illustrates the legal and economic complexities that arise when considering the factors likely to influence the degree of innovation and competition in financial services. This is particularly true in markets, such as payment cards, where network effects are important and much innovation occurs at the network level. Balto concluded by noting that much of this debate arises at the intersection of antitrust and intellectual property law. In spurring innovation in network industries, size does matter but so does competition.

Empirical Studies of Financial Innovation

Lawrence J. White of New York University summarized the results of a literature review he prepared for this conference with his co-author, **W. Scott Frame** of the Federal Reserve Bank of Atlanta, entitled "Empirical Studies of Financial Innovation: Lots of Talk, Little Action?" While there are hundreds of studies of innovation in the economics literature, White and Frame could find only 27 empirical studies that pertain to financial services (a number of these were presented at the conference and are described below). They offer some explanation for the relative scarcity of these studies and made suggestions that might increase the quantity and quality of such research.

In their study, a financial innovation is defined as a new product or service, a novel organizational form, or new processes that reduce costs or risks or that improve quality. Rapid innovation, they emphasize, contributes to the dynamic efficiency of the financial sector, which ultimately affects the overall growth of the economy. They identify a number of important research questions, which were just beginning to be explored in the 1990s: What are the environmental conditions that encourage or discourage financial innovation? Who are the customers and users of such innovations? What factors determine whether financial innovations are developed within or outside the financial services sector? What characteristics distinguish financial institutions — or their customers — that adopt these innovations and those that don't? Which firms adopt first? What factors determine the rate of adoption across the industry? What are the social consequences of financial innovation? Do innovators and early adopters earn more profits? Are the benefits of innovation more than offset by the cost of duplicative R&D programs across the industry? Their paper summarizes some of the tentative answers so far reported in the financial economics literature.

White and Frame suggest a number of reasons for the scarcity of empirical studies of financial innovation. Much of the empirical testing on innovation in general attempts to explain the level of R&D, the rate of invention, or the rate of productivity growth in a given sector. That linkage is typically not observable for financial innovations. While many firms in the manufacturing sector report spending on research and development, hardly any financial institutions do. Until recently, the official surveys of industrial R&D did not cover firms in the service sector, and it is only in the last few years that any data were reported for firms in finance, insurance, or real estate. Patents are a commonly used indicator of inventive activity among manufacturers but, until recently, were extremely rare among financial institutions. Finally, measuring productivity growth in the financial services sector is very complicated. To redress these data limitations, the authors urge financial regulators to conduct and publish studies and surveys and, within the boundaries of confidentiality, to make the raw material as widely available as possible.

Demand Side: Choice of Payment Instruments

The first panel began with a presentation by **David B. Humphrey** of Florida State University and a Visiting Scholar with the Federal Reserve Bank of Philadelphia's Payment Cards Center. In his paper "U.S. Cash and Card Payments Over 25 Years," Humphrey uses two approaches to estimate changes in the share of cash expenditures – at least for reported transactions - in U.S. consumer payments between 1974 and 2000. These approaches were developed in earlier papers, co-authored with colleagues at the Bank of Finland and the Bank of Norway, and applied to European data.[1]

For the U.S., there are relatively good data on consumer payments made via cards and checks. But there is no comparable data on the use of cash. Cash usage might be inferred from the ratio of currency outstanding to GDP, but this requires some assumption about the share of currency held abroad and any movements in that share over time. Alternatively, one can derive an estimate of cash usage via comparisons to other economies, but this does not account for differences in currency turnover or the margin of competition from card payments, which has presumably changed over time.

Humphrey's first approach is a direct calculation, where the share of cash in consumer expenditures is calculated as a residual. From the total of consumer expenditures, the value of card transactions – both credit and debit – and the total value of check transactions are subtracted. This should provide an estimate of the value of cash used in legal transactions. But even this is not a simple calculation. Data on the value and volumes for checks exist only for those check transactions processed by the Federal Reserve System. Estimates for the total volume of check transactions must be derived from information about the Fed's share of the check-processing business. The estimates of the total value of

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[1] See J. Snellman, J. Vesala, and D. Humphrey, "Substitution of Non-cash Payment Instruments for Cash in Europe," *Journal of Financial Services Research* 19 (2001): 131-145, and D. Humphrey, A. Kaloudis, and G. Owre, "Forecasting Cash Use in Legal and Illegal Activities," Working Paper, Research Department, Central Bank of Norway, Oslo (November 2000).

check transactions assume the average check is written for the same amount as an average credit card transaction. This approach was chosen because the available data on the value of check transactions do not separate the many billions of consumer checks, written for relatively small amounts, from the relatively few business checks that are written for very large amounts.

The second approach relies on regression analysis based on a two-equation model. The first equation estimates the total change in consumer payments as a function of personal consumption expenditures. The second equation estimates changes in cash payments as a function of currency outstanding (excluding $50 and $100 bills) and interest rates. The regressions control for the diffusion of ATMs and EFTPOS terminals on the use of cash, checks, and cards over time.

Both methods show that the share of consumer expenditures paid via cash decreased about 20 percentage points during the 25-year period 1975-2000.[2] In 2000 the cash share of consumer transactions was 16 percent to 19 percent. During the 1974 to 1990 period, checks gradually replaced a portion of consumer cash transactions. Thereafter, card transactions began to replace both cash and check transactions. Humphrey expects this trend to continue in the future, but he points out a few factors that might affect the rate of change: (1) widespread adoption of check truncation, which would reduce check-processing costs; (2) reduced merchant costs for accepting debit cards if the Wal-Mart antitrust suit is successful; and (3) the possibility that merchants will be permitted to add surcharges for credit card transactions.[3]

Supply Side: Cost Structure in the ACH Market

In their paper "Post Consolidation Estimates of ACH Scale Economies, Technical Change and Cost Efficiency," **Paul W. Bauer** and **Patrick Higgins**, both of the Federal Reserve Bank of Cleveland, provide a quantitative study of the ACH market in the U.S. This payment technology has existed for about a quarter of a century, with the Fed playing a leading role in its development. In 2000, the Fed processed nearly 7 billion ACH transactions with a total value of $20 trillion.

Previous studies of the ACH market have found strong evidence of both economies of scale – i.e., falling unit costs as volume transacted increases — and rapid technical change — i.e., falling unit costs as better technology is implemented over time. Although the Federal Reserve System is the largest provider, it competes with the private sector in the provision of ACH services. Thus, the authors point out, pricing in order to meet competition may be crucially important for this service. The evidence of economies of scale shows that the loss of volumes, albeit small, may lead to significantly higher unit costs.

To determine whether rapid technical change and scale economies continue to hold, Bauer and Higgins examine quarterly data from 1990 to 2000 on production costs, ACH, processing volumes, and input prices for 12 Federal Reserve Districts. Their measure of output is the number of ACH payments originated and received, divided by two. Owing to changes in the information reported in the Fed's cost accounting systems, the authors were forced to make certain assumptions in order to construct a consistent output measure over the entire period. By estimating their models over various sub-periods, the authors verified that their results were not sensitive to these assumptions.

Bauer and Higgins consider two functional forms for the production cost function — a translog and a hybrid translog. They estimate the cost functions and input shares jointly, using the technique of seemingly unrelated regressions. They estimate facility level cost inefficiencies using generalized least squares on the residuals of the first regression. They generate a second estimate of cost inefficiencies

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[2] This is also consistent with the trend of cash use shown by the CURRENCY/GDP proxy.

[3] In 1996 Wal-Mart and other retailers sued Visa and MasterCard, alleging the associations had imposed an illegal tying arrangement — if stores wanted to accept these brands of credit cards, they were required to also accept similarly branded debit cards. The trial is scheduled for the spring of 2003.

using site-specific dummy variables (within estimation), which allows for the possibility that cost inefficiencies are correlated with other variables in the regression equation.

Bauer and Higgins find that unit costs for ACH processing declined from about $0.04 in 1990 to $0.01 in 2000. Depending on the regression technique used, they find that technical change appears to account for about 50 percent to 70 percent of this cost reduction, with economies of scale explaining the remainder. They also found that cost reductions driven by technical change were smaller in the later years (1998-2000), potentially evidence that the technology is maturing. They interpret their regression results to imply that there remain significant economies of scale beyond the range of current output.

The discussant, **Elizabeth Klee**, from the Board of Governors, agreed with the general conclusions of the two papers. The demand-side analysis (Humphrey) shows that electronic payments have gained considerable market share. The supply-side analysis (Bauer and Higgins) shows that while ACH technology may be maturing, the remaining economies of scale suggest that additional growth and the resulting cost reductions could have a significant impact on composition of consumer payments.

Klee made a number of suggestions for improving each paper. Newly released data on check-processing trends could be used to refine Humphrey's estimates of the share of consumer payments accounted for by paper and electronic methods. Taking into account the explicit timing of the Fed's reorganization of individual ACH facilities during the 1990s could refine Bauer and Higgin's estimates of scale economies. Finally, Klee predicted that further rapid growth in ACH volume is likely to occur if electronic checks are widely adopted.

Network Effects: A Theory of Credit Cards

The next session examined the significance of network externalities in payment systems. **Sujit Chakravorti**, from the Federal Reserve Bank of Chicago, presented the first paper, "A Theory of Credit Cards," which was co-authored with **Ted To** of the Bureau of Labor Statistics. They ask, and attempt to answer, several important questions: Why do merchants accept credit cards when they are more expensive than other payment instruments and may reduce their profits? How does a merchant's decision to accept credit cards affect other merchants? Do network externalities in the credit card market explain a sub-optimal acceptance decision on the part of merchants?

Chakravorti and To present a two-period model of consumers, merchants, and a monopolistic credit card issuer. There is imperfect competition among merchants, which allows them to earn strictly positive profits. Merchants cannot determine prices or costs, so the only way they can raise their profits is by increasing sales. But individual merchants are small, so they have no bargaining power in their negotiations with the card issuer.

There is always a chance that a customer will need to borrow funds in the first period in order to finance purchases, but merchants do not have long-term relationships with their customers (which rules out the possibility of offering them store credit). In that case, the only way to make a sale to these customers is to accept the credit card offered to consumers by the monopoly issuer. The card issuer decides whether to offer a consumer a card on the basis of her income in the first period. If the consumer uses the card, the resulting debt is repaid, where possible, in the second period. Opportunistic defaults are ruled out because the authors assume the card issuer can confiscate whatever income the card user has earned.

 What happens in such a model? First, merchants accept credit cards so long as they earn at least as much profit as they would earn if they accepted just cash. Accepting credit cards has two effects on the merchant. First, it increases sales whenever credit cards are given to consumers who could not otherwise afford to purchase goods in the first period. Second, merchants pay a price for credit card transactions — the merchant discount charged by the card issuer (the authors assume there is a *no-surcharge rule,* which prevents merchants from passing this cost on to card users via higher prices). The

merchant incurs this cost on every card transaction, even those by consumers who would otherwise pay with cash but choose not to in order to benefit from float (paying later on purchases today).

The credit card issuer understands all of this and charges a merchant discount that makes the merchant just indifferent between accepting or rejecting credit cards. In other words, the card issuer extracts all of the additional profits the merchant would have earned on customers who needed to borrow in the first period. But this makes merchants worse off because, in the second period, those borrowers must pay off their balances before they can make additional purchases. By accepting credit cards in the first period, merchants borrow sales from the future and earn less profit because they pay the merchant discount on those sales. It is only rational for any single merchant to do this when most (or all) merchants are going to do it anyway.

The card issuer earns more profits when there are more card transactions. So if it can charge a higher merchant discount, it will also give credit cards to a larger share of the population even if doing so increases the likelihood of default. And the more willing merchants are to accept credit cards (and pay for them), the more cards will be issued. More generally, the nature of the equilibrium in this model depends on the income distribution of consumers (relative to merchant prices) and the relative bargaining power of merchants and the credit card network.

Network Effects: Lessons from Electronic Payments

Gautam Gowrisankaran, from the Federal Reserve Bank of San Francisco, presented the paper "Network Effects In Financial Services: Lessons from Electronic Payments," co-authored with **Joanna Stavins** of the Federal Reserve Bank of Boston. The paper begins by presenting a theoretical model of ACH adoption. If network externalities are present, each customer's usage is an increasing function of other customers' usage — a network effect at the customer level. A bank's profits from adopting ACH should also increase in the adoption rate by other banks — a network effect at the bank level.[4]

But do these network effects actually exist? Gowrisankaran and Stavins argue that they can be identified via a careful statistical analysis. They study banks' ACH adoption decisions, using a panel data set of bank characteristics and data on ACH transactions processed on behalf of those banks by the Federal Reserve System during 1995-97. Banks headquartered within 30 kilometers of each other are said to be part of the same network. A bank is said to adopt ACH in a given quarter of a year if it initiates at least one ACH transaction. A variety of regression techniques are used, but they share a common feature: They allow for the possibility that the likelihood a given bank has adopted ACH may depend on the proportion of other banks in the same network that have adopted ACH.

Any statistical analysis of this sort must contend with the fact that one bank's behavior can, in principle, affect the behavior of other banks. Unless properly controlled for, these relationships can result in biased statistical results and possibly false inferences. This is particularly true when testing for network effects because the authors are proceeding from the assumption that these relationships are economically important and look for evidence of this in the data. The authors are very much aware of the problem and present three different approaches to identify significant network effects in the market for ACH services.

Gowrisankaran and Stavins first show that the adoption decisions of network members are indeed positively correlated with a given network member's adoption choice, even after controlling for bank characteristics (size) and changes over time. They point out that while the regression coefficients may be biased, under certain assumptions, the fact that they are statistically significant is indeed evidence of a network effect.[5]

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[4] There is more than one equilibrium of the model; the one with the highest adoption of ACH produces the most welfare for all participants.

[5] This is a valid inference if, within a given network, unobserved bank characteristics are uncorrelated across banks after one has controlled for observable bank characteristics.

In their second approach, they instrument for the adoption choices of other member banks using their size and market concentration to explain those decisions.[6] Using this approach, a 10 percent increase in the share of other banks using ACH in a given market is associated with about a 9 percent increase in a bank's likelihood of adopting ACH. They also rule out an alternative explanation — that higher ACH adoption is explained by market power — because ACH volume rises with concentration. If market power was a causal explanation, they argue, banks would reduce rather than increase output.

In a final approach, the authors focus only on a set of markets where a given small bank is competing with branches of a much larger bank. The idea here is that the ACH adoption decision of a larger bank will be made on a company-wide basis and is unlikely to depend on the adoption decision of a small bank in one of its markets. While this approach greatly reduces the sample size, Gowrisankaran and Stavins show that a 10 percent increase in the ACH adoption rate of other banks in a network is associated with about a 4 percent increase in the likelihood of the small bank's adopting ACH.

The discussant, **James J. McAndrews** of the Federal Reserve Bank of New York, emphasized the importance of network effects in the economics of payments. He said that the dynamic prisoner's dilemma facing merchants in Chakravorti and To's model is a contribution to the theoretical literature seeking to explain the adoption of new forms of payment. McAndrews recommended that the model be modified to incorporate a more realistic assumption about the issuer's losses that result when a consumer defaults on an unsecured debt. He also suggested that the authors consider generalizing the model to allow merchants to adjust their prices when they have an incentive to do so.

McAndrews argues that the empirical methodology employed in the paper by Gowrisankaran and Stavins is a major advance over the previous literature. Still, he believes the network effects identified by Gowrisankaran and Stavins may actually be underestimated. The reason, McAndrews argues, is that they have probably identified the indirect network effects in ACH rather than the direct network effects, which are likely to be of larger economic significance. An example of an indirect network effect is the benefit of having more users of a technology that results from people learning how to use it and communicating this knowledge to others. This would explain the paper's results on the clustering of ACH adoption. An example of a direct network effect would be the benefit to a debit card user of having more stores that accept the card. McAndrews also suggests an alternative explanation of the results that cannot be ruled out by Gowrisankaran and Stavins' empirical approach — the initiation of bank or nonbank competition to provide a complimentary service (say payroll processing) that relies on ACH for transactions.

Adoption of Financial Innovation: Credit Scoring

There is some empirical evidence that the adoption of credit scoring for small business loans may increase the volume of those loans or their share in a bank's loan portfolio.[7] But until recently, there was no empirical research that could explain the timing of banks' decisions to adopt this technology. **W. Scott Frame** of the Federal Reserve Bank of Atlanta addresses this question in the paper entitled "The Diffusion of Financial Innovations: An Examination of the Adoption of Small Business Credit Scoring by Large Banking Organizations." The paper was co-authored with **Jalal Akhavein** of Moody's Risk Management Services and **Lawrence J. White** of New York University.

The authors consider a variety of factors identified in previous (mostly theoretical) studies of the technology adoption decision. For example, according to the Schumpeterian hypothesis, large firms and firms with market power are more innovative because they can exploit economies of scale in innovation, can spread risks by engaging in many R&D projects, and are better equipped to capture the gains from

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[6] This is a valid approach so long as a bank's size may be important to its own decision to adopt ACH, but not to the adoption choices of other banks in the same network.

[7] Credit scoring assigns a single quantitative measure or score representing an estimate of the borrower's future loan performance.

innovation. Other factors mentioned in the literature include management style, organizational structure, access to capital, and information spillovers.

These hypotheses are tested using the results of a survey conducted by the Atlanta Fed. Ninety-nine large banking organizations were asked whether they used credit scoring models to evaluate applications for small business loans as of June 1997 and, if so, when they began doing so. Fifty-five banks had adopted small business credit scoring by that date. The survey data were augmented using financial statements filed with bank regulators (Call Reports) and other sources. The data set includes many variables such as bank size, the number of branches, the number of bank subsidiaries, the ratio of small business loans to all business loans, CEO tenure and education, a measure of concentration in banking markets, and dummy variables for the location of the bank's headquarters.

The authors used two different statistical approaches. In the first, they estimated a hazard model to predict the probability of a bank's adopting small business credit scoring in a given year using data spanning the years 1993-97. In that regression the only variables with explanatory power were the bank's size and a dummy variable indicating that the bank's headquarters was located in the New York Federal Reserve District. In the second approach, they used a Tobit model to estimate the number of years, as of 1997, a bank has used credit scoring for small business loans. In that regression, bank size, a headquarters in the New York Federal Reserve District, and the number of subsidiary banks had some explanatory power.

Adoption of Financial Innovation: Internet Banking

The second paper in this session analyzed banks' decisions to implement transactional Internet banking, i.e., a web site or a direct computer connection to the bank that allows consumers to make payments or transfer funds across their accounts. In their paper, **Marsha Courchane** of Freddie Mac, **David Nickersen** of Colorado State University, and **Richard J. Sullivan** of the Federal Reserve Bank of Kansas City show that these adoption decisions are significantly influenced by market structure and the degree of uncertainty about consumer demand, hence the title of their paper: "Financial Innovation, Strategic Real Options and Endogenous Competition: Theory and Application to Internet Banking."

The authors begin by suggesting a novel way of thinking about banks' technology adoption decisions in terms of "real options." Many factors influence the timing of banks' adoption decisions, but real options theory suggests an additional factor — the value of waiting until additional information about consumer demand is revealed. By waiting, a bank can increase the probability that it invests at a scale that is appropriate for the size of the market. But the value of this option (waiting for more information) is weighed against the cost of delay — the lost opportunity to pre-empt one's competitors.

Courchane, Nickerson, and Sullivan present a theoretical model to illustrate the significance of real options on the adoption decisions of banks. They show that when there is more uncertainty about demand, banks tend to delay their adoption decisions because there is a higher probability that if they invest too early, the size of their investments may not be well matched to the size of the market. In that case, the option value of delaying the adoption decision is higher. They also show that the value of pre-empting one's competitors is likely to depend on the size of the bank relative to that of its competitors. In other words, larger institutions may gain more from investing earlier because their decisions are likely to influence the subsequent decisions of their rivals.

Having demonstrated the theoretical significance of real options in the context of banks' adoption of technology, the authors test their model using a data set of more than 1600 commercial banks in the 10th Federal Reserve District (Kansas City). In the first quarter of 2000, 13 percent of these banks had implemented transactional Internet banking, about the same share as observed nationally. Courchane, Nickerson, and Sullivan attempt to explain the pattern of adoption across banks using a logistic regression that takes into account demographic factors and the characteristics of banks and their rivals in a given market.

They use per capita income and the share of the population attending college as measures of demand uncertainty. In some regressions, they control for any effect of bank size by including bank assets and the square of bank assets. In other regressions, they use the bank's share of deposits or its share relative to its largest rival in a given market. They also include dummy variables that indicate whether the bank is part of a large bank holding company or is a new bank. Finally, they control for market structure using a rival concentration index — the sum of the squared market shares of deposits for a bank's rivals in a given market.

Courchane, Nickerson, and Sullivan report that a bank's likelihood of adopting transactional Internet banking is higher in markets with higher per capita income and college attendance. This is consistent with the hypothesis that banks are less likely to delay if there is less risk of inadequate demand. Larger banks are also more likely to adopt sooner than smaller banks. Banks that are part of a large bank holding company are much more likely to offer Internet banking, as are banks with a larger share of deposits, either in absolute terms or relative to their largest rival. Finally, they report that a given bank is less likely to adopt Internet banking when the market is dominated by a few large institutions — a high rival concentration index. Each of these results is consistent with the authors' hypothesis that larger banks are likely to enjoy a larger first mover advantage than smaller institutions or banks that compete against a few dominant banks.

The discussant, **Robert De Young** of the Federal Reserve Bank of Chicago, began by describing how deregulation, changing market structure, and the changing product mix of banks might be important in explaining the diffusion of banking technologies. He argued that geographic deregulation has introduced a wedge between large and small banks. While large banks have increased their scale and scope through mergers and acquisitions, most small banks retain their local focus. Larger banks introduced new, standardized products and services based on scaleable technologies that require less person-to-person contact with customers. These new products and services often required significant fixed investments but, thereafter, entailed lower marginal costs. In contrast, De Young argued, smaller banks continue to focus on lending relationships, using more labor than their counterparts at large banks.

De Young argues that both papers are consistent with these patterns. Both credit scoring and Internet banking represent scaleable, albeit less personal, technologies, and large banks were quicker to adopt them. He pointed out that neither paper addresses the issue of reverse causation — while the diffusion of technology may depend on industry structure, competition, and business strategies, it is also the case that the adoption of new technologies often induces changes in industry structure, competition, and business strategies.

Information Technology and Property Rights: Financial Services Competition

This session dealt with the effects of financial innovation on firms and their customers and on the legal incentives provided to encourage innovation. **Robert Marquez** presented the paper "Information Technology and Financial Services Competition," co-authored by **Robert Hauswald**. Marquez and Hauswald are both from the University of Maryland. This paper examines the issue of how improvements in information technology (IT) affect competition, pricing, and profitability for financial services. The focus is on two potential improvements that may result from advances in information technology. First, superior IT may improve banks' screening technology. Second, superior IT may result in greater dissemination of information.

In their model, financial intermediaries compete for borrowers of varying credit quality. In the simplest version of the model, an improvement in IT improves only one bank's screening technology. That bank becomes better at distinguishing between good and bad borrowers and therefore can do a better job of pricing loans to attract good borrowers while avoiding making loans to bad borrowers. As other lenders recognize that their screening technology is not as good, they realize that they are now attracting a higher proportion of borrowers the first lender does not want. These borrowers are, on average, riskier than the borrowers these banks were able to attract prior to the first bank's innovation. In response, these banks compete less aggressively for all loans.

The result is that a higher share of good borrowers may get loans, but average interest rates will also be higher. The bank with the superior screening technology will earn more profits and will devote more resources to screening. This is an environment in which customers (borrowers) receive relatively few of the benefits of an improvement in technology.

But it is also possible that an improvement in IT implies that information spillovers increase. In that case, the information advantage of one bank over another may decrease. The result is more competition for borrowers and lower average interest rates. In this case, borrowers enjoy more of the benefits of an improvement in technology. But bank profits would be lower than in the first case. In reality, improvements in IT are likely to have both effects: improving the competitive position of firms that invest heavily in IT while also increasing information spillovers that benefit all lenders and, therefore, borrowers. The net effect of improvements in IT on interest rates and bank profits is unclear.

This tradeoff suggests a potential role for intellectual property in financial services. By investing resources in suppressing spillovers (perhaps via trade secrets or patents), a lender can enjoy more of the gains from an improvement in IT and would therefore use its screening technology more intensively. But if spillovers are simply too strong, it may be too costly to prevent them, so banks will not try.

Information Technology and Property Rights: Patents

John R. Thomas from Georgetown University's law school introduced the patent rights perspective with his paper "Patenting Pricing on the Nines? An Overview of Patents on Financial Services and Other Methods of Doing Business." In a now famous 1998 decision (*State Street Bank v Signature Financial Group*), the Court of Appeals for the Federal Circuit decided that methods of doing business were patentable.[8] This reversed what most had assumed — on the basis of more than a century of legal decisions — that business methods, in themselves, were not patentable subject matter. Thomas's paper examines the potential impact of this decision.

Under U.S. patent law, patents may be granted for inventions that are useful, novel, and nonobvious. A useful invention is both operable and provides a tangible benefit. A novel invention will not have been described in a previous patent or publication or some other publicly available source of information. A nonobvious invention would not have been viewed as obvious to a person of ordinary skill in the relevant field at the time the invention was made.

Since America's first patent act in 1793, patentable inventions have been limited to certain broad categories of subject matter, including processes, machines, or composition of matter. Despite this broad statutory language, the courts crafted a number of exceptions that precluded the patenting of business methods, mental steps, algorithms, or laws of nature. These doctrines stated that subject matter of this sort was unpatentable *per se*. Their reasoning was assumed to be a logical extension of the long-established precedent that patent law does not protect abstract ideas. To receive patent protection, inventors must claim discrete, operable products and processes, not broad categories of generalized intellectual concepts. By protecting downstream technology rather than upstream knowledge, patent law is said to preserve "the basic tools of scientific and technological work" for all to employ.

But in the State Street decision, the Federal Circuit decided that the invention in question — a computerized system for allocating gains and losses in an investment portfolio to distinct mutual funds — was not an abstract idea but a "programmed machine that produced a useful, concrete and tangible result." In other words, the decision turned on the practical utility of the invention in question. Thomas provided a number of examples of business method patents subsequently issued by the U.S. Patent and Trademark Office (PTO).

The decision and the subsequent surge in patenting of business methods have provoked an intense debate. Supporters argue that developing new business methods requires research and development and,

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[8] 149 F.3d 1368 (Fed. Cir. 1998).

thus, has to be protected to the same extent as traditional inventions. They also argue that future technological progress is likely to depend as much on improved methods of doing business as on improved manufacturing techniques. They argue that patents are needed as an incentive to develop new business methods and that it would be inappropriate to deny an incentive to one field while granting it in another.

Opponents of the decision question why the patent system was extended so significantly without any examination of empirical evidence about the likely effects of such changes. They argue that business method patents may stifle competition and raise barriers to entry. For example, economic analyses suggest that network industries may exhibit lock-in effects, allowing a first mover to attain and preserve a dominant position. In such an environment, the erroneous granting of an important patent could decide an industry's structure and composition even if the patent is eventually invalidated. They argue further that the likelihood that business method patents will be granted erroneously is higher than that for other technology fields because the PTO does not know the prior art, most of which are trade secrets.

The discussant, **Robert Hunt** of the Federal Reserve Bank of Philadelphia, pointed out that the Marquez-Hauswald model could easily be generalized to a model of financial innovation. Unlike most other markets, however, innovations in this market could make consumers worse off rather than better. The key distinction is that any competitive advantage enjoyed by lenders in this model results from adverse selection, which can be made worse if there are no information spillovers. Hunt argued that lenders' access to new technologies is clearly an important factor in determining welfare effects of innovations in financial services. An important question, then, is how patents on technologies that are relevant to financial services may affect spillovers and access to new technologies.

Turning to the Thomas paper, Hunt presented data on the quantity of business method patents being granted and, in particular, the number of these patents relevant to financial services. He showed that while patents for business methods can be found going back to the 1880s, their numbers became significant only after about 1995. Presenting data on R&D spending and investments in information technology, Hunt argued that financial services should really be thought of as a high technology industry. In that case, the intuition of a number of dynamic models of patents and innovation should apply to financial services. That intuition suggests that patents should be relatively hard to get in most high tech industries. But this is the opposite of what has been happening, which, Hunt argued, is a reason for concern about the future rate of advance in financial services. He addressed the question of patent quality by displaying a recently issued U.S. patent on a method of swinging on a swing.

Summary

This conference brought together dozens of economists to discuss how firms that provide payment and other financial services innovate and how those innovations are diffused throughout the industry. Given the economic importance of efficient payments systems, and the financial services sector more generally, it is somewhat surprising to discover that researchers have paid relatively little attention to these issues. This is especially true for empirical studies, which are remarkably scarce. The papers presented at the conference, then, represent a significant contribution to this literature.

The papers presented at the conference show that innovation and diffusion in payments and financial services more generally are influenced by many of the same factors relevant to the study of other industries, factors such as firm size, market structure, competition from rivals, or uncertainty about demand. We also learned that the changing share of consumer expenditures accounted for by different means of payment clearly depends on technological progress and changes in relative costs. Verifying such relationships for financials services is complicated by a relative scarcity of data. A number of papers presented here were able to generate new results on the basis of new data collected by the authors.

But we also learned that forms of payment and other aspects of financials services differ in important ways from the manufacturing sector, the traditional subject in studies of technological

innovation and diffusion. For example, several papers have demonstrated theoretically and empirically that network effects influence technology adoption decisions and likely the decision to innovate in the first place. Network effects may also influence who benefits from using payment cards. In lending markets, adverse selection influences how the gains from financial innovations are shared among producers and consumers. And while firms have traditionally enjoyed intellectual property protection over improvements in the hardware and software they use every day, it is now possible for them to patent financial instruments and methods of doing business. At present, it is unclear how that change will affect the rate of financial innovation and the diffusion of innovations.

Finally, an important conclusion drawn from this conference is that much more research remains to be done. This can be facilitated by the increased availability of data relevant to these studies. And if attendance at the conference is any guide, significant progress may be achieved through the collaboration of economists who study payments, banking, finance, and industrial organization.

Innovation in Financial Services and Payments

Conference Speakers and Discussants

Jalal Akhavein, *Moody's Risk Management Services*
David Balto, *White & Case, LLP*
Paul W. Bauer, *Federal Reserve Bank of Cleveland*
Sujit Chakravorti, *Federal Reserve Bank of Chicago*
Marsha Courchane, *Freddie Mac*
Robert DeYoung, *Federal Reserve Bank of Chicago*
W. Scott Frame, *Federal Reserve Bank of Atlanta*
Gautam Gowrisankaran, *Federal Reserve Bank of San Francisco*
Robert Hauswald, *University of Maryland*
Patrick Higgins, *Federal Reserve Bank of Cleveland*
David B. Humphrey, *Florida State University*
Robert M. Hunt, *Federal Reserve Bank of Philadelphia*
Elizabeth Klee, *Board of Governors of the Federal Reserve System*
Robert Marquez, *University of Maryland*
James J. McAndrews, *Federal Reserve Bank of New York*
David Nickerson, *Colorado State University*
Anthony M. Santomero, *Federal Reserve Bank of Philadelphia*
Joanna Stavins, *Federal Reserve Bank of Boston*
Richard J. Sullivan, *Federal Reserve Bank of Kansas City*
John R. Thomas, *George Washington University Law School*
Ted To, *Bureau of Labor Statistics*
Lawrence J. White, *New York University*