Recent Developments in Consumer Credit and Payments

BY MITCHELL BERLIN

On September 20-21, 2007, the Research Department and the Payment Cards Center of the Federal Reserve Bank of Philadelphia held their fourth joint conference to present and discuss the latest research on consumer credit payments. Approximately 75 participants attended the conference, which included six research papers on topics such as liquidity constraints, the rise in bankruptcy, and the financial mistakes made by credit card holders. In this article, Mitchell Berlin summarizes the papers presented at the conference.

In his opening remarks at the conference, Charles Plosser, president of the Federal Reserve Bank of Philadelphia, noted that innovation in electronic payments has led to major changes in the financial industry. The process of innovation has allowed new entrants into the industry, expanding the availability of consumer credit and permitting more opportunities for smoothing consumption over time. Plosser reminded conference participants that rapid growth in innovation often leads to excesses and mistakes and that progress is necessarily uneven. He stressed that the Fed's mandate is to evaluate innovations in the context of economic efficiency, effective monetary policy, and an efficient payments system. This mandate provides the rationale for this conference, which brought together researchers whose papers address fundamental issues about consumer credit.

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LIQUIDITY CONSTRAINTS

In the first paper, **Jonathan Levin** of Stanford University reported the results of a study (with **William Adams** and **Liran Einav**) that provided evidence for the economic significance of liquidity constraints in the market for subprime auto loans. The authors also sought to uncover the underlying sources of these constraints. Broadly, liquidity constraints refer to limits on an individual's ability to borrow because of various frictions in credit markets, especially those due to incentive problems that arise when borrowers are better informed than lenders about their risk of default. When such borrowing limits are significant, an individual's ability to make purchases depends heavily on his or her cash on hand.

Levin and his co-authors examined a sample of applications for loans at a large subprime auto lender between June 2001 and December 2004. In addition, they examined the details of the loan contracts for the applications that were accepted and the repayment history on all loans through April 2006.

First, they examined general borrowing patterns for evidence of liquidity constraints. They found that 44 percent of car buyers made the minimum down payment; that is, a large share of buyers borrowed no more than the absolute minimum, even though a higher down payment would have reduced their loan rate significantly. Strikingly, the authors found that both applications and sales revealed a marked spike in February. Levin explained that February is the time of year when consumers receive tax rebates and have more cash on hand to make a purchase.[1] When the authors split their sample into customers who were eligible for the earned income tax credit and those who weren't, the February spike remained only for those who were eligible. This provided fur-

[1] He noted that this explanation for the time-of-year effect was actually provided by the subprime lender.

ther support for the tax rebate explanation for the spike in the data.

Levin and co-authors then turned to formal econometric tests for evidence of liquidity constraints. They estimated the distinct effects of higher loan payments (measured by a higher car price) and of higher minimum down payments on customers' probability of purchasing. Levin and co-authors argued that a customer who is not liquidity constrained would care only about the present value of total loan payments: A dollar spent today to cover the down payment should have the same effect on the borrower's purchasing decision as an appropriately discounted dollar spent tomorrow to repay the loan. On the contrary, they found that a $100 increase in the minimum down payment had the same effect on the probability of purchase as a $900 increase in the car price, evidence that purchase decisions were strongly affected by customers' ability to come up with the initial cash. Levin and co-authors argued that the alternative explanation — that customers discount future car payments at an annual rate of 427 percent — was implausible.

Next, the authors tried to uncover the underlying sources of liquidity constraints, in particular, the relative effects of *adverse selection* and *moral hazard*. The authors defined adverse selection as the tendency for borrowers who have a higher risk of default to take out larger loans, while they defined moral hazard as the tendency for borrowers with larger loans to default more often.[2] In either case, contracting is made more difficult when the borrower is better informed than the lender about his or her risk of default.

[2] Note that, in this context, both adverse selection and moral hazard operate through the size of the borrower's loan.

To disentangle the effects of adverse selection and moral hazard, the authors first estimated a Tobit model of customers' desired down payment and found that observably riskier customers — for example, customers with low credit scores or lower incomes — had a lower desired down payment, a finding consistent with adverse selection.

The authors then estimated the effect of larger loan size on the probability of default. They argued that this effect includes both moral hazard — the higher probability of default due to larger loan size — and adverse selection — the tendency for riskier borrowers to take out larger loans. The authors proposed the following procedure to disentangle these effects.

Since the explanatory variables used to estimate customers' desired minimum down payment included most of the observable factors that a lender would use to estimate a borrower's risk, the authors argued that the residual from the Tobit regression was a measure of the borrower's private information, including the borrower's private information about his or her probability of default.[3] This residual could then be included along with the loan size (and other control variables) in a regression that explained the probability of default; the authors interpreted the coefficient on loan size as the moral hazard effect and the coefficient on the residual as the adverse selection effect. Regression results provided evidence for both adverse selection and moral hazard but showed that moral hazard was twice as important quantitatively.

[3] In this context, the residual refers to the portion of the customer's down payment decision that can't be explained by factors that the researcher can observe and include in the regression, such as the customer's FICO score.

Levin and co-authors suggested that improvements in credit rating technologies probably played an important role in the strong growth of subprime markets in the 1990s.

Their regressions also showed that the customer's FICO score had a very strong relationship to the probability of default; that is, observing the borrower's credit rating provided lenders with a lot of information about borrower risk. Levin and co-authors suggested that improvements in credit rating technologies probably played an important role in the strong growth of subprime markets in the 1990s.

THE RISE OF HOUSEHOLD BANKRUPTCY

The next speaker, **Borghan Narajabad** of Rice University, discussed the results of his work on the underlying causes of the increase in consumer bankruptcies in the mid-1990s. He argued that prior research had failed to adequately explain why the rise in bankruptcies coincided with other developments in credit markets. In particular, the 1990s had also witnessed a significant rise in credit card debt and usage and increased variation in credit terms offered to customers. His theoretical model was designed to yield these empirical predictions in addition to the rise in bankruptcies. According to Narajabad's explanation, an improvement in lenders' screening technology permitted them to better differentiate high-risk from low-risk

borrowers. In turn, lenders could profitably offer more credit to all borrowers, but it was profitable to provide the largest increases in credit limits to lower risk borrowers. Also, the general increase in the availability of credit increased both credit card usage and the number of bankruptcies.

The main elements of Narajabad's stylized theoretical model were: (i) individuals have the need for credit to cover their consumption needs for an uncertain amount of time; (ii) they are differentiated according to the risk that their income would remain low for a long time; (iii) individuals know more about their underlying risk than lenders; (iv) borrowers have an incentive to default on loans when the debt burden is large compared with their costs of defaulting; and (iv) at some cost, lenders can screen borrowers and become better informed about the borrower's risk type.

Outlining the underlying logic of his model, Narajabad first analyzed the borrowing decision. He explained that the amount borrowed in each period prior to the (uncertain) time when the borrower could repay was determined by the following marginal condition. The marginal utility of higher consumption financed by borrowing must equal the marginal cost of borrowing. This marginal cost has two elements: first, the loss of future borrowing capacity as the borrower moved nearer to his or her credit limit and, second, the higher debt payments once the borrower has the capacity to repay.

From this marginal condition, Narajabad showed that the model generated two of the patterns observed in the data. The model predicted that an increase in the credit limit would lead to an increase in borrowing, mainly because the constraint on future borrowing capacity is relaxed when the credit limit is increased. The model also predicted a rise in bankruptcies with an increase in borrowing limits. Since a borrower can reach the credit limit before having enough income to repay existing loans, he or she may choose to default if the debt load is sufficiently high.

Turning to the lender's decision, Narajabad explained that his model predicted that an improvement in the lender's screening technology induced lenders to increase borrowers' credit limits, with a disproportionate increase in the credit limits for lower risk borrowers. Thus, the model explained the increased variation in credit terms observed in the data.

Narajabad then turned to a quantitative exercise to see how well the model actually matched the data. The estimation technique seeks to match selected statistics describing consumer use of credit cards in the 1990s, as measured by the Survey of Consumer Finances from 1992 and 1998. These statistics included the ratio of credit limits to income in both years, the ratio of credit card debt to income in both years, default rates for 1992, and the variance of credit limits in the two years. Narajabad explained that he explicitly chose not to match default rates in 1998 when he estimated the model. The model's ability to match the actual rise in defaults would be an important test of its success.

Narajabad concluded that the model was broadly successful in matching the data. He found that the model could generate approximately one-third of the increase in defaults from 1992 to 1998. Narajabad also explained that his model rejected alternative explanations for the increase in bankruptcies. A reduction in the stigma attached to filing for bankruptcy predicts a counterfactual decline in credit to higher risk borrowers, while a reduction in the transaction costs of lending does not predict the greater variation in credit limits across different customers.

WHO MAKES MISTAKES?

Barry Scholnick of the University of Alberta discussed the results of his study (with **Nadia Massoud** and **Anthony Saunders**) of financial mistakes made by credit card holders. They examined the prevalence of certain types of mistakes, as well as the types of customers who made these mistakes. The main question motivating their study was whether mistakes were made predominantly by wealthy customers, who might make mistakes because the impact on their total wealth is trivial, or by poor and less educated customers, who might make mistakes because of a lack of financial sophistication.

Scholnick and his co-authors constructed a database extending from December 2004 to June 2006 that combined: (i) confidential data (from a Canadian bank) about individual cardholders that included customers' credit card accounts, deposit accounts, and credit scores; (ii) demographic information about the individuals in a customer's postal code, which the authors used as a proxy for the individual customer's demographic traits;[4] and (iii) information about residential property transactions in the postal code. Scholnick emphasized the unique features of this data set. The small number of households in the Canadian postal zones (approximately 200) minimizes the measurement error created by using an aggregate in place of the individual's actual wealth.[5] Furthermore, monthly data on customer balances provided a detailed picture of the evolution of customers' liquid wealth holdings over time. The authors viewed the comprehensiveness and

[4] To protect customers' privacy, the bank identified customers' postal zones but not their addresses.

[5] By comparison, U.S. ZIP codes have 10,000 households.

detail of this data set as one of the paper's main contributions.

The authors considered four types of mistakes: a cash advance, a delinquent payment, a transaction that exceeds the credit limit, and a simultaneous delinquency and overlimit in a single month. These mistakes range from frictional to moderately consequential. The cash advance triggers only a moderate fee, while the other mistakes may affect a consumer's credit report in addition to triggering a fee. In each case, the authors considered the transaction a mistake only if the customer had adequate bank balances to avoid the penalty, for example, if the customer could have avoided a delinquency by making a payment from a deposit account.[6]

The authors showed that a significant fraction of total transactions were mistakes. For example, while delinquencies occurred in 10.3 percent of observations, mistakes accounted for 4 percent of the observations (adjusting for precautionary balances). In addition, they found that consumers make consequential mistakes more often than frictional mistakes. The authors argued that this provides evidence that the mistakes were not caused by rational inattention. If customers were simply not paying attention because it was not worth their time, the authors expected frictional mistakes to be made more often than more costly mistakes.

The authors then turned to the question: Who makes credit card mistakes? The authors estimated panel logit regressions for 75,000 customers, a separate one for each type of mistake and for each definition of precautionary cash balances. In general, the authors found that less wealthy cardholders were more likely to make mistakes. More specifically, renters were significantly more likely to make mistakes than homeowners, and individuals with more business and investment income were, for the most part, significantly less likely to make mistakes. Those individuals with a larger share of total income derived from government payments — another indicator of lower wealth — were more likely to make mistakes. Scholnick argued that these results were not consistent with the view that mistakes were mainly committed by wealthier customers, rationally allocating their attention.

Consumers make consequential mistakes more often than frictional mistakes.

Although individuals with higher assessed risk were more likely to make mistakes, the authors found no evidence that mistakes were associated with subsequent defaults. Since mistakes typically trigger fees, the authors argued that this result is inconsistent with bankers' claims that fees are assessed to compensate the bank for defaults.

THE AGE OF REASON

John Driscoll of the Federal Reserve Board reported on recent research (with **Sumit Agarwal, Xavier Gabaix,** and **David Laibson**) that explored the pattern of financial decision-making over an individual's lifetime. He and his co-authors found that across a wide range of financial transactions, the quality of financial decisions followed a U-shaped pattern; that is, financial decision-making improved until an individual reached his or her 50s and then declined as he or she aged. Driscoll and his co-authors argued that this age of reason effect could be explained by a model in which an individual's analytic capabilities decline roughly linearly from age 20 onward, while experience with financial matters increases thoughout the individual's life, but at a decreasing rate over time. The net effect yields improvements in financial performance until (roughly) age 53; beyond this age, the decline in cognitive ability dominates.

Using proprietary data sets from a national financial institution, the authors considered financial decision-making in 10 separate contexts, including a number of decisions involving home equity loans, auto loans, and credit cards. In addition to providing information about the terms of the financial transaction, for example, fees and rates, the data sets include substantial demographic information about the individuals.

Driscoll provided a detailed discussion of the empirical results for home equity loans and home equity lines of credit. The authors examined the average annual percentage rate paid by borrowers in each of six age buckets, controlling for various demographic characteristics and various measures related to a borrower's risk of default, including FICO score. The authors found that the rate paid by borrowers followed a U-shaped pattern, declining continuously until age 50 to 60 and rising subsequently. This is precisely the same pattern the authors discovered for many other products, but for home equity loans and lines of credit, the authors had additional evidence supporting their hypothesis that this U-shaped pattern was related to

[6] Of course, a customer might be delinquent or go over the limit on credit card payments to maintain his or her bank balance above some level, so-called precautionary balances. Accordingly, the authors used various definitions of mistakes, each corresponding to a different measure of precautionary balances.

the quality of the borrower's financial decision-making.

Specifically, the loan rate depended on the borrower's loan-to-value ratio (LTV); the lender charged a higher rate for higher LTVs, although it increased in discrete jumps. As part of the application, the lender required borrowers to estimate the value of their homes, and the lender subsequently performed its own appraisal. If the lender's estimated LTV was significantly higher than the borrower's estimated LTV, the loan officer would direct the borrower to a higher-priced loan. But if the lender's estimated LTV was significantly lower than the borrower's estimated LTV, the loan officer would not direct the borrower to a lower-priced loan. The authors defined a rate-changing mistake as one in which the borrower's estimate was significantly different from the lender's estimate, and they found that such mistakes led to an average increase of 125 basis points for loans and 150 basis points for lines of credit (holding constant the borrower's risk and other demographic characteristics). The authors found that the U-shaped pattern existed only for customers who made rate-changing mistakes. This supported the authors' claim that the quality of the customer's financial decision-making — in this case, the ability to accurately value one's house — underpins the higher loan rates paid by the young and the old.

The authors also studied balance transfer offers in which customers received low teaser rates for balances transferred to a new card. However, this rate applied only to the balances transferred; all new purchases were charged a high rate, and all payments on the new card were applied first to the transferred balances. For the customer, the optimal strategy during the teaser rate period is to make all purchases and payments on the old card. The authors found that one-third of the customers who transferred balances identified the optimal strategy within the first month, one-third figured out the strategy before the sixth month, and one-third never learned during the teaser rate period. They also found that the percent of borrowers who discovered the optimal policy at some point was first increasing in age and then decreasing in age — an inverse U-shape — with the highest percentage for borrowers between ages 35 and 44. On the other hand, the fraction that never learned the optimal strategy displayed a U-shape, again with the lowest percentage for borrowers between ages 35 and 44. Driscoll and co-authors' interpretation of these results was that middle-aged people were both most likely to act optimally and least likely to remain permanently confused. They also argued that the somewhat younger peak of financial performance may reflect the greater analytic skill required to determine the optimal strategy.

Driscoll said that he and his co-authors had explored and rejected a number of alternative explanations for the U-shaped pattern. In particular, the pattern could not be explained by age-related variation in default risk or by borrowing to meet medical expenses. Driscoll argued that they could not rule out cohort effects but that for credit card and auto loans the data indicated the same U-shaped pattern for 1992 data, 10 years earlier than the sample considered in the paper. He argued that replicating the U-shape for an earlier period is inconsistent with the argument that cohort effects were driving results.

For the customer, the optimal strategy during the teaser rate period is to make all purchases and payments on the old card.

IS IT OPTIMAL TO FORGET DEFAULTS?

Ronel Elul of the Federal Reserve Bank of Philadelphia presented his research (with **Piero Gottardi**) that examined the rationale for laws requiring bankruptcies to be erased from an individual's credit files. Elul explained that the Fair Credit Reporting Act (FCRA) requires bankruptcies to be expunged after 10 years and that laws restricting the use of old information are common outside the U.S. Elul and Gottardi's research showed that forgetting is optimal under some conditions and also that it must be imposed by government mandate; that is, it would never arise through private contractual arrangements.

Elul and his co-author examined a model with both adverse selection and moral hazard.[7] In particular, there were two types of borrowers: a safe borrower who never defaulted and a risky borrower who could lower his or her probability of default by expending costly effort. The authors assumed that all loan contracts were single-period contracts, and they focused their attention on Markov perfect equilibria, those in which lenders can observe only

[7] In this context, adverse selection refers to borrowers' being better informed about their intrinsic risk than lenders when loan contracts are signed and moral hazard refers to borrowers' knowing more about risk-taking behavior subsequent to receiving the loan.

whether a borrower has defaulted or repaid a loan in the previous period.[8]

In their model, reputational concerns lead risky borrowers to exert high effort. By assumption, a risky borrower would always choose low effort without reputational concerns, and no lender would make a loan to a risky borrower who chooses low effort. Although lenders are unable to directly observe a borrower's type, they can observe whether the borrower has defaulted in the previous period. A default by a borrower indicates to all lenders that the borrower is a risky type, and once a borrower has defaulted he would automatically be excluded from the loan market. After a number of initial periods of low effort, a risky borrower who has not yet defaulted may choose to exert high effort to maintain his or her reputation.[9] As long as the borrower doesn't default, he or she is indistinguishable from a safe borrower and receives the same loan rate.[10]

Into this setting Elul and Gottardi introduced a stylized representation of the FCRA. Once a borrower has defaulted, the default is stricken from the record with some probability. The authors asked: Under what conditions would introducing a positive probability of forgetting increase consumer welfare?

Elul explained that the possibility of forgetting introduces a tradeoff. On the one hand, forgetting reduces the risky borrower's incentive to exert high effort because it reduces the penalty for default (exclusion from the loan market forever). This negative effect on incentives is manifested as a larger initial number of periods in which the risky borrower exerts low effort, before reputation-building incentives kick in. However, permitting borrowers to re-enter (which requires forgetting) also has a beneficial effect, because aggregate output is reduced when risky borrowers who would have exerted high effort are excluded from the loan market.

> Consumers are quite sensitive to the price differential between fixed- and adjustable-rate mortgages.

Elul presented his and Gottardi's general result that forgetting will be efficient under certain conditions. In particular, they showed that some amount of forgetting will be efficient when agents don't discount the future too heavily; when gains from exerting high effort are sufficiently high; when low effort is not too inefficient; and when the fraction of low-risk borrowers is high enough. Under these conditions, the additional output when borrowers re-enter the market outweighs the negative effect on incentives in initial periods.

The authors also explained that forgetting requires a government mandate; that is, it could not be implemented through private contracts. The reason is that any lender who unilaterally chose a policy of forgetting would attract only risky borrowers and would suffer losses.

SUBSTITUTION BETWEEN FIXED- AND ADJUSTABLE-RATE MORTGAGES

In the final presentation of the conference, **James Vickery** of the Federal Reserve Bank of New York presented the results of his research into the elasticity of substitution between fixed-rate mortgages (FRMs) and adjustable-rate mortgages (ARMs). He argued that consumers are quite sensitive to the price differential between fixed- and adjustable-rate mortgages; specifically, he found that a 20-basis-point increase in the rate on FRMs (relative to ARMs) would cause a 17-percentage-point decline in the market share for FRMs.

Vickery explained that the regulatory cutoff for conforming mortgages — the maximum size for loans that can be purchased and insured by the government sponsored enterprises (GSEs) — creates a discontinuity at the conforming loan limit. He argued that the supply of fixed-rate mortgages falls discontinuously at the conforming loan limit because loans can't be as easily securitized without a guarantee from the GSEs. The greater difficulty of securitizing loans affects the supply of FRMs more than the supply of ARMs because FRMs subject the lender to interest rate risk if they are kept on the lender's balance sheet. As long as the relative demand for FRMs and ARMs is affected by their rates, but not by the conforming loan limit per se, the discontinuity permitted Vickery to identify the demand curve for FRMs.

Vickery estimated the coefficient of substitution between fixed- and adjustable-rate mortgages in two steps: First, he estimated the change in the market share of fixed-rate loans at the conforming loan limit; second, he estimated the size of the difference in the rates on conforming and nonconforming loans. The coefficient of

[8] Elul and Gottardi argued that such equilibria are more realistic than those that can arise when contracts might be conditioned on past behavior in complicated ways.

[9] The risky borrower doesn't begin to exert high effort until enough risky borrowers have defaulted. At this point, lenders assess a high probability that someone who has not yet defaulted is a safe borrower. Said differently, the value of establishing a reputation rises as the fraction of high-risk borrowers in the population decreases.

[10] That is, the model always yields a pooling equilibrium.

substitution is simply the ratio of the change in market share of FRMs to a given difference in the rates.

To carry out the first step, he estimated an empirical model in which the probability of a loan's having a fixed rate depends on the relative rates on FRMs and ARMs — permitting the relationship to differ before and after the conforming loan limit — as well as a number of control variables. Vickery used two different techniques to deal with the likelihood that households with a greater preference for fixed-rate loans might adjust their behavior to keep their loan below the conforming limit. The first approach was an instrumental variable approach in which Vickery constructed a dummy variable indicating whether 80 percent of the house value exceeded the loan limit. Vickery argued that the house price was plausibly exogenous with respect to consumers' relative preference over types of mortgage loans. His second approach was to simply drop observations near the conforming limit.

Vickery presented his main results using the Monthly Interest Rate Survey (MIRS), a sample collected monthly from depository institutions (sample period 1992-2005), which includes important contractual characteristics but which has no information about borrower characteristics. Using the MIRS data, Vickery found that the FRM share fell discontinuously by 14.3 percent using the instrumental variable specification and by 20.4 percent using the specification dropping observations near the conforming loan limit. Vickery reported similar, but somewhat smaller, effects using a different data set, the Survey of Consumer Finances, in which respondents provide extensive information about household characteristics. He argued that data about mortgage rates and sizes are likely to be more accurate when reported by financial institutions rather than households and that the MIRS estimates were more likely to be correct.

Vickery then estimated the difference between the rates on conforming and nonconforming loan limits. His preferred estimates used data from Bankrate.[11] This data set contains a detailed description of the loan contract associated with a particular rate, especially information about any pre-existing customer relationship between the lender and borrower and information about the borrower's FICO score. Using this data set, Vickery estimated that the difference in the rates on a conforming and nonconforming loan ranged from 27 basis points for a 30-year FRM to nine basis points for an ARM that reprices after the first year. Using pricing information from the MIRS data set, Vickery found similar, but somewhat smaller, estimates. Vickery argued that the Bankrate estimates were more likely to be correct because of the greater contractual detail.

The coefficient of substitution is the ratio of the change in the market share of FRMs to the difference in the rates between FRMs and ARMs at the conforming loan limit. Using his preferred estimates, Vickery calculated that (holding constant macroeconomic factors such as the yield curve) a 20-basis-point increase in the rate on a fixed-rate loan would lead to a 17 percent decline in the market share of fixed-rate mortgages.

Vickery then explained the results of a thought experiment in which he asked how much the share of fixed-rate loans would decline in the U.S. if mortgage rates were the same as in England, where adjustable-rate mortgages are much more common. He estimated that the average share of FRMs would decline from 76 to 37 percent using UK rates.

[11] Bankrate, Inc. is a company that provides information on financial rates.

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