Modeling Prepayment Behavior In Financial Transactions Backed By Automobile Loans

Seddik Meziani, Ph.D., (E-mail: meziania@mail.montclair.edu), Montclair State University

Abstract

Securitization is a powerful financing tool that has gained prominence in recent time. In this study, securitization refers to the process whereby securities are issued to investors using a dedicated pool of automobile loans as collateral. A total of 206 outstanding auto loan-backed securities are used to analyze their prepayment risk. A thorough analysis of voluntary prepayment behavior identifies the key variables that influence prepayment behavior. These variables explain about 69% of its variation.

Introduction

Asset securitization is one of the most significant financial innovations in the global capital markets during the past 15 years or so. This financial procedure consists of transforming previously illiquid financial flows from a variety of sources into tradable asset-backed securities. It has substantially enhanced the management of corporate balance sheets and is widely expected to continue to evolve well into the new millennium. Securitization is also a means of raising capital at times when equity markets are more difficult to tap.

The extraordinary growth of the asset-backed market has allowed the creation of a variety of secured instruments. Asset-backed securities which are securities backed by non-mortgage assets include (but are not limited to): automobile loans and leases, credit and department store charge card receivables, computer and other equipment leases, accounts receivables, legal settlements, small business loans, student loans, boat loans, franchise loans, time share property loans, and manufactured housing loans. Note that this list of assets does not perhaps do justice to the flexibility of this financing technique given the diverse structuring alternatives available and the unlimited potential of asset combinations.

As with mortgage-backed securities, the main risk to the holders of asset-backed securities including those backed by auto loans is the prepayment risk associated with early prepayment of principal. Prepayment risk arises when a borrower exercises the option to pay back a loan before maturity to the financial institution that originated the loan. Thus, the actual cash flows on the securities can deviate substantially from expected cash flows.

Prepayment risk has been thoroughly investigated in the more mature residential mortgage market where much of the quantitative technology for analyzing the relative value of fixed-income instruments has been developed. This research has predominantly focused on measuring the observed rates of prepayment in order to use the estimates in broader mortgage valuation models.

Published research on prepayment risk in the auto loan market, on the other hand, is to the best of our knowledge minimal, even though auto loans have been a leading underlying asset in the asset-backed market from the outset. This lack of research is due in our opinion to the fact that there are very little data publicly available with which to fashion expectations about auto loan behavior. The data presented in this study provide one of the first publicly available, systematic reviews of auto prepayment experience.[1] This, in itself, extends the literature on prepayment risk.

Readers with comments or questions are encouraged to contact the author via email.

Second, this study recognizes that the conditional prepayment rate (CPR) used to measure prepayment for mortgage-backed securities cannot be used as a measure of automobile prepayment speed because the shorter term of auto loans results in a large portion of each monthly payment being principal. A prepayment rate that produces a higher paydown than the CPR is clearly a more accurate measure of auto prepayment speed.

Finally, with an expansive database on hand and the use of a model that generates a more appropriate prepayment rate, this study assesses auto prepayment risk in light of the key variables that can potentially trigger prepayment. Lack of knowledge concerning the factors that trigger prepayment adds to the investor's uncertainty and makes it difficult to estimate the instrument's yield and effective maturity. These uncertainties will, of course, be reflected in an instrument's return.

These variables include type of issuer (bank and nonbank issuers, sub-prime issuers, and domestic and foreign car manufacturers); proportion of new versus used car purchases; weighted average maturity (WAM); weighted average coupon (WAC) of the pooled loans; and age of the pool backing the transaction. These key variables explain about 69 percent of auto prepayment behavior. Given the complexities of asset-backed securities and the noise observed in the data, such explanatory power indicates that the model is successful in capturing the primary factors that affect prepayment.

Other factors that could have an indirect impact on financial flows from automobile loans are also assessed: the business cycle, seasonality in interest rates, and interest rate levels of related types of loans such as home equity loans/lines that can be used to refinance car loans. Their impact as auto prepayment drivers appears to be negligible.

The ABS Market—A Historical Background

Asset-backed securitization is a rapidly growing business that started in the mid-1980s, and did not take off until later in the decade. It has substantially enhanced the management efficiency of corporate assets and liabilities.[2] Given the success of mortgage-backed securities (MBS), it is not surprising that other payment streams that could benefit from the securitization process were sought.

Table 1
U.S. Annual Issuance of ABS by Collateral, 1985-1999 ($ mil)

Issue Year	Credit Total	Manufactured Auto	Equipment Cards	Student Housing	Leasing	Loans	Others
1985	1,135	797	--	--	--	--	338
1986	10,041	9,661	--	--	380	--	--
1987	9,855	6,522	2,410	184	--	--	739
1988	16,079	5,897	7,420	848	64	--	1,851
1989	21,785	7,823	11,326	1,970	--	--	666
1990	37,187	12,623	22,466	1,048	118	--	932
1991	40,299	15,046	20,833	1,316	385	--	2,720
1992	45,156	19,771	15,762	2,661	1,295	--	5,658
1993	54,994	25,268	19,597	2,459	3,668	597	3,406
1994	64,727	13,204	31,943	4,342	2,755	2,352	10,132
1995	90,302	23,471	46,975	5,739	2,657	3,345	8,116
1996	131,890	39,220	54,850	8,060	9,340	11,000	9,420
1997	150,100	45,680	47,610	9,310	7,760	16,970	22,770
1998	149,000	45,890	46,480	14,870	9,570	15,760	16,430
1999	185,787	73,147	50,427	21,667	11,253	12,267	17,027

Source: Merrill Lynch, Salomon Smith Barney, and Standard & Poor's

Initially most asset securitization other than that from real estate involved two types of collateral: loans to purchase automobiles and balances outstanding on credit cards. Table 1 shows that just over $13 billion (or 83 percent of total issuance) of these two assets were issued as public securities in 1988. Toward the late 1980s as

investors' acceptance grew and the market expanded with more sophisticated technology in structuring cash flows what was once a market for just automobile loans and credit card receivables has mushroomed to a number of asset classes. A number of such payment flows have since been used and these debt issues are now known, collectively, as asset-backed securities (ABS). While any predictable payment stream can be used as collateral on debt issues, the most frequently used are automobile, credit card, manufactured housing, equipment leases, and student loan receivables. Table 1 shows their share at 91 percent of total issuance in 1999.

In spite of the proliferation of asset classes, the market continues to treat well-known asset types such as loans to purchase automobiles differently. There is significant liquidity in these issues and narrow spreads are usually the rule. For the newer and less developed asset classes, the investor universe is considerably smaller and liquidity is less prevalent. As a result, there is a yield premium in their market execution.

The development of the ABS market has also led to a change in the time length of securities that can be placed in the capital markets. Up to 1987, virtually all collateralized debt issues were very short, with average lives of between one and two years. But additional collateral classes, increased investor comfort with the nature of ABS, and better international participation have led to a market with more demand for longer maturities.

Table 2
Percentage of Initial U.S. ABS Credit Ratings by Major Rating Category

Issue Year	AAA	AA	A	BBB	BB	B
1985	75	25	0	0	0	0
1986	61	39	0	0	0	0
1987	73	23	5	0	0	0
1988	76	19	1	3	0	1
1989	66	15	11	6	0	1
1990	74	12	12	1	1	0
1991	66	15	17	2	0	0
1992	66	14	18	3	0	0
1993	59	15	19	7	0	0
1994	60	9	26	4	1	0
1995	55	11	23	10	1	0
1996	52	7	26	12	3	0
1997	49	9	26	12	4	0
1998	45	10	24	16	4	1
1999	46	11	21	16	4	2

Source: Merrill Lynch, Salomon Smith Barney, and Standard & Poor's

Securitization commonly involves several different tranches with different risks and returns. The least risky bonds will often have a triple-A ('AAA') rating, which is the highest possible rating. The major rating agencies have progressively provided transactions with multiple initial credit ratings to contribute to the ABS market's rapid growth. Throughout the 1980s and the early 1990's, an initial rating of 'AAA' represented 60%-75% of all publicly rated loan classes (see table 2). It was closely followed by double-A ('AA'), which accounted for 25%-40% of all ratings. During this period, the 'A' rating was rather infrequent and triple-B ('BBB') and lower ratings were virtually nonexistent. By 1993, innovations in credit enhancement allowed both 'A' and 'BBB' shares of initial ratings to expand to around 25%, and 15%, respectively. In the late 1990s, 2%-4% of classes were assigned with initial ratings of 'BB' or 'B." Indeed, the credit enhancement mechanism evolved from being simply a letter of credit (LOC) or the credit of a corporate parent of the issuer as the guarantor of the transaction to a combination of LOC and the senior /subordinate cash flow structure.

For the latter, the subdivision of cash flows from the underlying assets became more refined to enhance the credit of senior classes, thereby allowing lower credit ratings to be assigned to these subordinated classes. Furthermore, better pricing efficiency and stability of ratings also motivated issuers to opt for cash flow subordination as a means of credit enhancement and thus created a need for multiple ratings. Although pricing

efficiency continues to improve, stability of ratings, on the other hand, is largely dependent on the state of the economy and could thereby experience some volatility due the current weakness of the economy. Indeed, delinquencies and losses leading to bankruptcy filings tend to rise as the economy weakens.

Review of the Prepayment Literature

Prepayment risk has been thoroughly investigated in the residential mortgage market because it was shown to affect the value of mortgages and mortgage-backed securities substantially. Recent work on mortgage prepayment includes the work of Peters et al. (1984) who examine the prepayment experience of a nationwide sample of conventional mortgages. Approximately half a million mortgages are classified into 921 cohorts and used in a least squares model. The conditional prepayment rate is regressed on several variables including refinancing costs, the difference between the contract and market rate, borrower's age, and the size of the property. The authors find that the refinancing costs have the dominant impact on prepayment.

The application of a proportional hazard model to mortgage prepayment is originally due to Green and Shoven (1986). By accounting for possible censorship in the data (mortgages that do not prepay during the sample period), their model constituted a significant improvement over traditional estimation techniques. The explanatory power of their study rests on a single independent variable they describe as a "lockin," defined as the difference between the face and market values of the mortgage divided by the initial principal amount. In order to account for property appreciation over time, they adjust the initial principal amount by the regional housing price index. Although they obtain extremely significant estimates for the "lockin" variable, their model was limited to interest-related mortgage prepayment. As a result, terminations due to factors such as regional mobility and family size or the need to upgrade the quality of housing could not be accounted for in their study.

Quigley (1987) elaborates on the work of Green and Shoven by including household mobility factors. He shows that mobility (and therefore prepayment) is positively correlated with household size and education. However, the sign of the coefficient of the borrower's income is found unstable over time. Most importantly, Quigley pointed to the significance of the assumption underlying the proportional hazard.

Schwartz and Touros (1989) apply a log-logistic hazard model on aggregated GNMA mortgage pools and argue that the prepayment experience is consistent with the log-logistic function. Their prepayment estimates are subsequently integrated in a valuation model for mortgage-backed securities.

Using also a log-logistic hazard model similar to that of Schwartz and Touros (1989), Giliberto and Thobodeau (1989) make an important contribution by analyzing individual data and including borrower-specific variables. The authors provide a theoretical framework to analyze a borrower's decision. They show that a borrower's wealth depends on the gain form exercising the prepayment option. In particular, they find that the interest rate volatility slows down prepayment because a borrower's wealth depends on the value of continuing to hold the prepayment option. Their data, however, is limited to borrowers who prepay but do not move.

Cunningham and Capone (1990) compare the prepayment experience of ARM versus FRM between 1982 and 1985, a period marked by volatile interest rates and house prices. [3] Their results support the option-based notions that the dominant factors are the current equity net of moving costs for the default option, and the equity variable in case of prepayment.

Another strand of research on prepayment risk focuses on the yield between GNMAs and Treasury bonds. Researchers have modeled prepayment rates using the difference in yields between these two assets as one of the explanatory variables. For example, Ronn, Rubinstein, and Pan (1996) create a synthetic, nonprepayable GNMA composed of a "dedicated" portfolio of Treasury securities that exactly matches the cash flow stream promised by the mortgage pool. They then attribute any difference between the cost to construct the matching portfolio and the observed GNMA price to the prepayment option.

Finally, most Wall Street firms and money center banks have also examined prepayment rates for various

loan markets. Their models remain proprietary. They may discuss the performance of their models, but they do not reveal the methodologies underlying the models. For example, Carron et al. (1988) discuss the prepayment model at First Boston (now Credit Suisse First Boston). The Prudential-Bache prepayment model is outlined in Hayre, Lauterbach, and Mohebbi (1988). Although their calibration procedures have not been revealed, these models are believed to include the same factors as those introduced by Richard and Roll in 1989 in one of the most comprehensive models for estimating prepayment.

The success of these proprietary models is usually claimed to be quite high, in terms of very high correlations between actual and fitted prepayments in sample results. Some models achieve an R-squared of 99 percent. Once prepayment rates are projected, they can be used to forecast cash flows, a step necessary to pricing asset-backed securities (ABS).

This study extends the literature by examining the effects of prepayment risk on the auto market. This paper draws somehow on the spirit of the study by Peters et al (1984) and Giliberto and Thibideau (1989) because it also accounts for the aging effect in receivables backed by auto loans. It also aspires to be as comprehensive as Richard and Roll's (1989) by attempting to identify all of the key variables that can potentially trigger auto prepayment risk. Auto prepayment is modeled using borrower characteristics from a large sample of individual loans mostly provided by Standard & Poor's, a leading international agency with extensive experience rating both MBS and ABS. Our prepayment data are comprehensive because they are regionally diversified and, unlike many MBS studies, not restricted to borrowers who have not moved.

Data and Methodology

We use a two-step procedure to explore the prepayment behavior of transactions backed by auto loans. Because there is no publicly available research in the field, our first step assesses auto loan prepayment behavior following traditional methodologies underlying prepayment models in the more mature residential mortgage market. Our reasoning is that these classes of assets, although quite distinct from each other, might share enough characteristics to rationalize a search for the drivers of auto prepayment in the more established mortgage prepayment literature. We theorize that the primary factors that determine prepayment in the mortgage market, such as the prevailing rate at which the mortgage can be refinanced or the age of the mortgage, could have a similar impact on prepayment in the auto loan market.[4]

There are enough differences between these two categories of assets to consider using a model for calculating auto prepayment speed that is quite different from the one used to gauge prepayment speed in mortgage studies. Indeed, the key variable in this model is the absolute prepayment speed (ABS), which is the key standard notation the industry uses for auto prepayment speed (see Appendix for a more detailed discussion of ABS). The ABS we use in this study is a voluntary prepayment rate excluding loan defaults. Prepayments that result from repossessions are more appropriate to an analysis of defaults.[5]

In the second step, we use regression analysis to estimate the impact of each variable in the model on the dependent variable ABS. To evaluate a variable's potential impact on ABS, we observe its effect on the adjusted R-squared. Ranging from 0 to 100, the adjusted R-squared measures the percentage of variation in ABS that can be explained by the variables in the model. The R-squared approaches 100 when these variables account for all of the observed variation over time. A regression model with high-adjusted R-squared produces estimates of ABS variations that closely track actual movements. Note that R-squared is known to give little information on the accuracy of the model when used for extrapolations, but its ability to identify factors driving prepayment is widely recognized in the literature.

In the mortgage prepayment literature, prepayment rates are usually measured from single mortgage pass-throughs such as thirty- and fifteen-year GNMA, FHLMC, or FNMA issues, which securitize huge volumes of residential mortgage loans. This is necessitated by the monthly reporting cycles of these government agencies and such differences in the features of the underlying mortgages as reset periods and caps and floors. Because transactions backed by auto receivables are usually more straightforward, we can calculate and compare prepayment

rates from a variety of loan originators, which adds more depth and coverage to our study and should have a positive impact on the accuracy of our results.

Data for this study come from the files of five categories of issuers:

1. Domestic car manufacturers (General Motors Corp., Ford Motor Co., and Chrysler Corp.)[6];
2. Foreign car manufacturers (BMW AG, Daimler-Benz AG, Nissan Motor Co. Ltd., Saab, and Volvo);
3. Banks such as BancOne Corp. and Chase;
4. Nonbank issuers such as The Money Store, World Omni, and Olympic Financial Ltd.; and
5. Sub-prime issuers such as First Merchants Acceptance Corp. and Gulf States Acceptance Co., known as GSAC.

The original database includes 7568 data points. It was then aggregated at the pool level because the objective of this study is to identify the factors underlying auto prepayment risk, not forecast auto prepayment speed. Hence, our model estimates the prepayment activity of pools of loans, not of individual loans. This means that differences at the loan level such as underlying loan rates, which largely depend on the credit profile of the borrowers, and maturities are ignored. As a result, each pool is treated as a homogeneous collection of loans with contract rates equal to the weighted average coupon (WAC) of the pool and maturity equal to its weighted average maturity (WAM). This treatment of the pools is consistent with current market practices, and the model sacrifices little realism in this respect.

Some of the heavily subsidized pools are extracted from the database because such loans have abnormal characteristics, and therefore do not belong to the same population of study. (These abnormal characteristics result in unusual prepayment speeds.) To identify these pools, we use the ratio of WAC over the two-year Treasury as a threshold, under the assumption that a loan with a rate equal to or lower than the two-year Treasury is considered to be subsidized.[7]

Note also that the majority of the pools analyzed have some level of seasoning since the study focuses only on securitized transactions. Table 3 shows that the weighted average seasoning for the transactions used in this analysis is approximately six months.[8]

Table 3
Pool Seasoning (months)

Seasoning	Count	Weight	Product	Seasoning	Count	Weight	Product
0	19	0.09	0.00	12	5	0.02	0.29
1	33	0.16	0.16	13	4	0.02	0.25
2	21	0.10	0.20	14	9	0.04	0.61
3	24	0.12	0.35	15	5	0.02	0.36
4	18	0.09	0.35	16	2	0.01	0.16
5	16	0.08	0.39	17	1	0.00	0.08
6	10	0.05	0.29	19	1	0.00	0.09
7	9	0.04	0.31	20	1	0.00	0.10
8	5	0.02	0.19	24	1	0.00	0.12
9	7	0.03	0.31	25	1	0.00	0.12
10	8	0.04	0.39	37	2	0.01	0.36
11	4	0.02	0.21	---	---	---	---
Total Weighted Average Seasoning					206		5.69

Preview of the Modeling Process

Among the explanatory variables we test to assess their impact on ABS are the type of issuer, the pool's WAM and WAC, the proportions of new and used cars in the pooled loans, and the age of the pool backing the transaction. We also test the geographic location of the loan, in case prepayment activity varies by region.

Categorical variables that could have an indirect impact on ABS are also tested: These are the business cycle and seasonality in interest rates.

To assess the impact of seasonality or cyclical changes in auto loan prepayments during the year, we include dummy variables representing the months of the year in the estimating equation. Kohn (1974) and Barth and Bennett (1975) demonstrate patterns in the behavior of interest rates: rate increases during certain seasons of the year and decreases during other seasons. Mortgage prepayment studies find repayment rates especially high from late spring to early fall when homeowners are more likely to move for reasons such as of home construction, the school year, and the weather, and low during the winter months. We might well ask whether seasonality patterns can affect auto prepayment speed, especially when interest rates tend to be low.

The seasonal prepayment pattern we explore refers to the marginal influence of each particular month of the year, all else equal. In estimation of the auto prepayment model, coefficients for the months of the year relate to influences that vary systematically with months and are not captured by the other explanatory variables. In other words, these monthly coefficients are partial derivatives that attempt to measure the effect of a change in ABS, holding everything else constant.

To capture the pure economic refinancing incentive and following Richard and Roll (1989), we use the ratio between the loan contract rate (i.e., the pool's WAC) and the prevailing rate at which the loan can be refinanced. The lower this ratio is, the greater the financial incentive to prepay. This measure differs from the widely adopted differential between the loan contract and the prevailing rate.[9] The rationale for this choice comes from the fact that a borrower has a financial incentive to prepay a loan if making the current payments costs more than a new loan at the current rates. We further investigate the effects of other refinancing opportunities on prepayment by also considering interest rates on related loans such as home equity loans or lines that can be used to refinance car loans.

The other candidate variable is interest rate volatility. The argument for including it in the model is a direct application of option pricing theory. Greater volatility increases the likelihood that an option will be "in the money," and so raises its price. To the extent that an auto loan (like a mortgage) contains an embedded option, greater volatility increases the value of that option, making its holder (the borrower) more likely to exercise the option or prepay the loan. We thus expect loan prepayments to be positively related to volatility.[10]

We include several macroeconomic variables in the model to evaluate their impact on prepayment. We first test industrial production, three-month change in interest rates (as the standard predictor of the future direction of rates), housing starts, sales of existing homes, and nonfarm employment, but ultimately dropped them from the model for lack of significance. We tested housing starts and sales of existing homes to determine whether they can impede consumers from refinancing auto loans. We tested percentage changes in nonfarm employment with the idea that increases in employment levels might lead to greater activity in the automobile market and higher ABS.

Of the macroeconomic variables we considered, none was statistically significant. That macroeconomic variables do not add significantly to this prepayment model suggests either that virtually all relevant macro information is already incorporated in the prevailing loan rates in the interest ratio we used, or that the choice of the variables itself measures the effect poorly. Another plausible explanation is that the prepayment data do not embody enough cycles of the economy to determine a statistically significant relationship between these variables and ABS. This, however, is highly doubtful, considering that our database extends over 14 years (1985 through 1998), a period that saw a fairly representative range of interest rates environments and both recessionary and expansionary cycles of the economy.

Note, however, that we were unable to regress the prepayment rate on the percentage growth in GDP because our prepayment data are monthly whereas GDP is released on a quarterly basis. This is certainly a disappointment to us especially since Peters et al. identified GDP growth as a significant variable in their mortgage prepayment study.

Of all the potential variables discarded because of their lack of explanatory power, the insignificance of the

volatility of interest rates is particularly surprising. No independent significant effect of volatility on auto prepayment rates is found. This result seems counterintuitive and goes against a body of research on option value. The only meaningful argument we can advance to justify this puzzling result is that volatility is already implicitly included in the interest rate via the ratio between the loan contract rate and the prevailing market. An increase in volatility would tend to reduce this ratio and increase prepayments, and vice versa. Therefore, it is not necessary to specify volatility separately in the estimating equation.

Table 4
Prepayment Summary Statistics for Types of Issues (%)

All Types	Life of Transaction	1-12 months	13-24 months	25-36 months	37-48 months
Mean	1.50	1.62	1.45	1.19	0.97
Median	1.39	1.56	1.43	1.20	0.97
Std. Dev.	0.47	0.49	0.29	0.28	0.31
Maximum	3.26	3.25	2.82	2.91	1.87
Minimum	0.87	0.85	0.99	0.43	0.36
Bank	**Life of Transaction**	**1-12 months**	**13-24 months**	**25-36 months**	**37-48 months**
Mean	1.48	1.72	1.62	1.26	1.00
Median	1.48	1.75	1.60	1.26	1.03
Std. Dev.	0.34	0.36	0.27	0.34	0.31
Maximum	3.22	2.91	2.80	2.91	1.87
Minimum	0.91	0.88	1.01	0.72	0.42
Domestic Manufctr.	**Life of Transaction**	**1-12 months**	**13-24 months**	**25-36 months**	**37-48 months**
Mean	1.35	1.45	1.34	1.18	0.97
Median	1.33	1.39	1.34	1.25	0.98
Std. Dev.	0.25	0.31	0.17	0.24	0.24
Maximum	1.95	2.05	2.01	1.68	1.49
Minimum	0.93	0.91	0.99	0.43	0.36
Foreign Manufctr.	**Life of Transaction**	**1-12 months**	**13-24 months**	**25-36 months**	**37-48 months**
Mean	1.23	1.36	1.30	1.16	0.89
Median	1.19	1.35	1.28	1.20	0.87
Std. Dev.	0.19	0.31	0.24	0.17	0.42
Maximum	1.59	1.97	1.97	1.39	1.39
Minimum	0.87	0.85	1.02	0.81	0.45
Nonbank	**Life of Transaction**	**1-12 months**	**13-24 months**	**25-36 months**	**37-48 months**
Mean	2.15	2.30	1.41	0.93	N.A.*
Median	1.72	2.05	1.39	0.92	N.A.
Std. Dev.	0.80	0.75	0.20	0.36	N.A.
Maximum	3.26	3.25	1.83	0.97	N.A.
Minimum	0.98	1.25	1.17	0.90	N.A.
Sub-Prime	**Life of Transaction**	**1-12 months**	**13-24 months**	**25-36 months**	**37-48 months**
Mean	1.71	1.60	1.57	1.09	N.A.*
Median	1.80	1.63	1.46	1.06	N.A.
Std. Dev.	0.80	0.25	0.44	0.22	N.A.
Maximum	0.31	1.94	2.82	1.45	N.A.
Minimum	1.21	1.04	1.06	0.86	N.A.

High prepayment activity accelerated the paydown of the nonbank and sub-prime issues.
N.A. = Not available.

Preliminary Results: ABS Decreases as Pool Ages

We use our database of 206 pools to calculate the summary statistics shown in Table 4. These statistics are calculated over the life of the transactions and in successive twelve-month increments for all categories of issuers. Regardless of type, average prepayment speed starts off high in the first twelve months of the transaction and gradually decreases as the pool ages. The difference between the first twelve and the last twelve months of the transaction is especially noticeable for the finance issuers—the banks, nonbank, and sub-prime quality issuers.

Table 4 also shows that, as a group, the obligors of either domestic or foreign car manufacturers show credit repayment patterns different from those who obtain loans directly from finance companies. Because finance companies lend at the prevailing market rate, their loan rates tend to be more costly than those offered by car manufacturers. Thus, the cost of borrowing as measured by the WAC of the pool seems to have a direct impact on prepayment speed—when the pool's WAC increases, so do prepayments. Pools from car manufacturers have exhibited the same tendency in their nonsubventive securitized transactions.

Of the three types of finance issuers, the nonbank group experienced the highest average prepayment speed over the transaction life at 2.15%, followed by the sub-prime group at 1.71% and the bank group at 1.48%. The sub-prime prepayment speed is surprisingly high, considering that the voluntary prepayment speeds are net of cumulative gross losses, and that obligors whose credit quality is marginal according to bank guidelines are generally not in a position to prepay once they secure a loan.[11] This result could provide ammunition for the Federal Deposit Insurance Corporation, which is currently considering sharply higher capital requirements (from 8% of assets to 16%) for lenders in risky sub-prime consumer loans because of suspected leniency in their lending practices.[12]

In comparison, much lower prepayment speeds on average are displayed by the domestic car manufacturers at 1.35% ABS, and foreign car manufacturers at 1.23% ABS. Diminished prepayment activity is a direct result of the generally lower rates on loans offered by financing entities of manufacturers. Inducement to borrowers to purchase a car typically range from 400 to 1,000 basis points below market rates; giving the borrower less incentive to pay off the loan than a borrower with a current market rate automobile loan. Car manufacturers often offer rates like this, which are determined by the borrower's credit history and the down payment relative to the total value of the vehicle, to reduce their car inventories or gain market share.

Further Results

An appropriate linear regression model was fit to monthly data to study the impact that the key pool characteristics have on auto prepayment speed. These characteristics include the WAM, the WAC, seasoning, the month and year the transaction was rated by a ratings agency such as Moody's or Standard & Poor's, the percentage of new vehicles as opposed to used in the pool (NEW), and monthly pool balances.

All the regressors are also checked for multicollinearity, that is, a dependent variable regressed on two or more highly correlated independent variables. After examining the correlation matrix, we conclude that multicollinearity is not a concern. As a general rule, multicollinearity is a serious problem if the correlation coefficient is greater than about 0.8.[13] The correlation coefficient between the estimated regression coefficients for the WAC of the pools in the study and their proportion of used cars–two variables that might cause particular concern–is 0.28. A high correlation between two variables would cause a problem with interpreting the regression results.

Table 5
Regression Results

Estimates	Value	Std. Error	T-value
Bank	2.0339	0.5487	3.7069
Nonbank	1.6446	0.6217	2.6455
New	-0.3685	0.1164	-3.1165
Wam	-0.0160	0.0042	-3.8048
Wac	6.0681	1.3567	4.4727
Poolage	0.0111	0.0025	4.4114
Bank:New	-0.3685	0.1164	-3.1164
Fgnmg:New	0.4020	0.1815	2.2145
Dommfg:Wam	0.0181	0.0079	2.2986
Dommfg:Wac	-5.8086	1.8174	-3.1961
Nonbank:Wam	-0.0425	0.0080	-5.2902
Nonbank:Wac	8.0623	2.4836	3.2462
Bank:Wac	8.0863	1.9700	4.0997

Table 5 shows the variables that are significant at the conventional 0.05 critical value. As in residential and commercial mortgage studies, prepayment speed is particularly sensitive to the cost of borrowing. High interest rate obligations tend to prepay faster than low-rate obligations as evidenced by the size and sign of the WAC coefficient in Table 5. For example, VOLVO 1993-2, a deal with the lowest WAC in our database, also experienced the lowest prepayment activity, at 0.32% ABS. This suggests that investors interested in structured securities backed by auto loans who may be concerned about the prepayment risk of automobile pass-throughs should participate in pools dominated by low-interest rate contracts, because they are the least likely to prepay at a high speed.

Prepayment speed is also sensitive to the proportion of contracts backed by new car loans in a pool. This prepayment driver is represented by the variable NEW in Table 5. The negative sign of the variable's coefficient indicates that the higher the proportion of these contracts in the pool, the lower its prepayment speed. Our database shows that in recent years the proportion of used car contracts has substantially increased, especially in pools securitized by the finance companies. Because obligations on used cars carry higher coupons, the group's prepayment activity is higher than that of the car manufacturers as seen in Table 4.

This result also clearly reinforces the importance of WAC as an indicator of higher prepayment activity. For example, within the bank group, our database shows that the Citibank Grantor Trust 1988-1 deal experienced a relatively lower average prepayment speed of 1.33% ABS than Ponce Federal Bank 1988-B at 1.89% ABS. The Ponce Federal Bank transaction, which includes a higher proportion of used cars (65% versus 17%), carried a higher WAC (16.7% versus 11.88%) than the Citibank deal. These two pools were purposely chosen from the same bank group for the same time span so that variation in type or interest rate environment does not explain the difference in results.

Contracts issued by finance companies (BANK and NONBANK) also tend to prepay faster than those issued by domestic and foreign car manufacturers. The higher refinancing activity shown by their obligors is due to the generally higher rates and longer terms of the loans. Unlike the financing arms of the car manufacturers, they do not subsidize their rates for competitive purposes.

Seasoned auto contracts as indicated by POOLAGE in Table 5 are also more likely to experience faster refinancing activity than newly originated auto contracts. This is not surprising, considering that prepayments due to such factors as sale, trade-in, or repossession of the vehicle are insignificant early in the life of the obligation. This indicates that investors considering securities backed by auto loans should be particularly attentive to the average seasoning of the pool. The higher the seasoning, the higher the prepayment risk the pool is likely to experience. Seasoning is also identified as an important prepayment driver in the MBS literature. Circumstances that require home buyers to sell their homes and move are found to be fairly rare for the first several months of the mortgage, due both to the costs of moving and to the small likelihood that family or occupational circumstances would have changed much since purchasing the home.

Contract length or WAM also tends to affect prepayment speed. Its negative sign indicates that prepayment is higher for short-term contracts than for long-term contracts. Hence, it is reasonable for an investor to assume that, everything else equal, a security backed by a sixty-month automobile receivable will prepay more slowly than a security backed by a twenty four- or a thirty six-month receivable. Our guess is that obligors likely to choose shorter-term maturities have more resources and are therefore more likely to prepay for a variety of reasons including, a desire to own new cars more frequently.

Our results also show that some of the variables we tested combine to affect prepayment speed. We have seen why contracts structured by banks are more likely to prepay than contracts structured by automobile manufacturers' financing operations. We also see that pools with a significant proportion of new car contracts are less likely to prepay because these obligations carry lower coupons than on used cars. The negative sign of the interaction variable BANK: NEW in Table 5 may indicate that although auto contracts structured by banks prepay at a higher rate, ABS could be reduced in pools backed by a high proportion of receivables on new car loans. Similarly, the negative sign of the interaction variable NONBANK: WAM indicates that although NONBANK pools are also high-prepay pools, their high prepayment speed could be reduced if a high proportion of longer-maturity loans are included. And the negative sign of DOMMFG (domestic car manufacturers) WAC indicates that pools structured by U.S. manufacturers can experience higher prepayment speeds if enough unsubsidized loans are included.[14]

Conclusion

We believe our analysis provides academicians and market analysts alike a basic analysis of voluntary auto prepayment behavior as a good first step toward fully understanding what determines the prepayment speed of securitized automobile loans. Overall, our results indicate that prepayment speed is particularly sensitive to the interest paid by the obligor, the length of the contract, and whether the vehicle is used or new. Our model also shows that interaction variables can be important indicators of auto prepayment. In some cases an interaction can adversely affect the prepayment speed of structures known for their low ABS such as those issued by the domestic car manufacturers.

Suggestions for Future Research

Much remains to be done, however, to fully assess prepayment speeds in deals backed by automobile receivables. For example, industry trends that fuel auto securitization should be incorporated in any analysis. An important new factor in the leasing industry is residual risk, reflecting the fact that more and more drivers return their cars at the end of a lease rather than purchase them, hence softening the used car market. One needs to know to what extent depressed car resale values may force car dealers to offer lower interest rates as an incentive to reduce their inventories of used cars. We know from our study that a high proportion of used cars in a pool tends to accelerate prepayment speed because of higher coupons, so this information is important.[15] 🕮

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Appendix

Absolute Prepayment Rate Produces Higher Paydown

The absolute prepayment rate (ABS) is the industry's standard measure of automobile prepayment speed. Devised by First Boston in 1986, it measures monthly prepayments as a percentage of the pool's original receivables balance. The conditional prepayment rate (CPR), which is the standard measurement of prepayment for mortgage-backed securities (MBS), calculates the amount of prepayments conditional on the amount outstanding in the previous month. Because the shorter term of auto loans results in a large portion of each monthly payment being principal, the consensus is that ABS, which produces a higher paydown than the same CPR, is a more accurate measure of auto prepayment speed.

The monthly ABS prepayment rate is provided by the formula:

$$ABS = \frac{[(PF_1 / PF_2) - (CB_1 / CB_2)]}{[((n+1) * (PF_1 / PF_2)) - (n * ((CB_2 / CB_2)))]}$$

Where PF_1 and PF_2 designate the pool factors for the interval over which ABS is calculated. CB_1 and CB_2 represent the contractual balances over the same interval. The number of months gone by since pool issuance is represented by n.

The pool factor or the ratio of the remaining pool balance outstanding to the original balance is given by:

$$PF = \frac{PoolBalance}{OriginalPoolBalance}$$

The contractual balance or the percentage of the original loan pool balance is expressed as follows:

$$CB = \frac{OriginalBalance * [(1 + (WAC / 12)^{WAOM}) - 1 + (WAC / 12^n)]}{[(1 + (WAC / 12)^{WAOM}) - 1]}$$

where WAC is the weighted average coupon, and WAOM is the weighted average original maturity.

[1] Although the data used in this study come from a variety of sources, the author is greatly indebted to his former colleagues at Standard & Poor's Structured Research Group for providing an important part of this data.

[2] From a balance sheet perspective, securitization allows originators or sellers to improve performance measures such as ROA, ROE, and leverage. The securitization process involves the sale of the entire collateral to the securitization vehicle and as such any reserves for items such as losses and bad debts that are recognized in income accounting do not have to be recognized under ABS, thus improving net income.

[3] An adjustable-rate mortgage (ARM) has a coupon rate that tracks interest rate movements. In general, an ARM floats off a benchmark index plus a margin, bound on each reset date by periodic and lifetime caps. While homeowners choosing fixed-rate mortgages (FRMs) lock in their borrowing costs, those choosing ARMs face the uncertainty of fluctuating interest rates. This basic characteristic leads to inherently different prepayment risk strategies in ARMs and FRMs.

[4] The interest rate factor is a well-established source of prepayment risk in the mortgage market.

[5] When analyzing excess spread over same-duration Treasuries, for example, both default and voluntary prepayments result in a reduced amount of excess spread realized over the life of the pool. Therefore, it is important to distinguish these variables to allow for a more accurate analysis of the key variables that drive auto prepayment.

[6] The Chrysler pools included in this study predate its merger with Daimler-Benz AG.

[7] Four pools whose ratios are equal to or less than one were removed under this assumption.

[8] Prepayment information for newly originated pools is much harder to obtain since it can be provided only by the original issuers.

[9] See Green and Shoven (1986), or Hayre et al. (1988).

[10] The effect of volatility on option value is discussed by many authors including Black and Scholes (1973).

[11] The sub-prime finance companies tend to deal with less creditworthy borrowers.

[12] The FDIC has noted mounting losses due to bank failures occasioned by sub-prime lending. For more detail, see "FDIC May Boost Curbs on Riskier Loans," *The Wall Street Journal*, January 25, 2000.

[13] See Kennedy (1997) for further detail.

[14] Recall that domestic car manufacturers tend to structure low prepayment pools because they include a high proportion of subsidized loans.

[15]The inclusion of residual risk in auto prepayment research is far from being a minor research endeavor considering that the financial service industry treats transactions backed by auto leases where residual risk originates and auto loans (potentially affected by this risk) as two different asset groups. In this case two separate and hard to compile databases need to be reconciled.