ASSET BACKED SECURITIES - BACKED BY SUBPRIME AUTOMOBILE LOANS:

An examination of correlation coefficient between different variables in relationship to rising automobile loan default rate

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Abstract

Securities backed by the subprime mortgage loan and its related derivatives had a detrimental effect on the financial industry and global economy for many years following the 2008 financial meltdown. As the U.S and rest of the world on its recovering path from the financial crisis, subprime automobile lending is growing at an alarming rate. An article by Reuters titled "How the Fed fueled explosion in subprime loan" attributes the growth of subprime auto loan in recent years to Federal government’s bond buying programs arguing the record-low interest rate is driving investors’ demand for subprime securities products.

This research exams subprime auto securities originated from 2008 to 2014 and applies the simple linear regression model to show the correlation between various variables effecting the default rate on subprime auto loans. The data indicates that despite the credit quality continued to deteriorate, auto-backed securities' performance remain stable. The result shows default rate is positively correlated with the interest rate on the loan. Decreasing interest rate and stronger credit enhancement on the securities are the reasons that many of the securities remains trip A rated under both S&P and Fitch rating. Despite the heated discussion regarding the credit bubble, the research result indicates that the current state of auto credit market remains healthy.
# TABLE OF CONTENTS

Acknowledgements........................................................................................................... 1

Part I: Background on Securitization.................................................................................. 2

Chapter 1: History of the Auto Loan Securitization......................................................... 2
  Development of the Asset-Backed Securities Market...................................................... 2

Chapter 2: Basics of Asset-Backed Securities................................................................. 5
  Auto Loan Characteristics............................................................................................... 5
  Definition of Subprime Loan......................................................................................... 9
  Mechanics of Securitization......................................................................................... 11

Chapter 3: The Growth in Subprime Auto Asset-Backed Securities................................. 13

Part II: Data .................................................................................................................... 15

Chapter 4: Current State of Subprime Auto Loan Market.............................................. 15

Chapter 5: A look at the Deteriorating Lending Standard............................................... 19

Chapter 6: Subprime Auto Loan

  Error! Bookmark not defined.

Part III: Methodology and Analysis.................................................................................. 29

Appendix A Charts & Graphs............................................................................................ 35

Bibliography .................................................................................................................... 50

ACADEMIC VITA............................................................................................................. 52
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Chapter 1: History of the Auto Loan Securitization

Development of the Asset-Backed Securities Market

Asset Securitization is an innovative way for lenders to raise fund in the capital market by selling their predictable future cash flows receivable. Through asset securitization, asset-backed securities or ABS are created for investment purpose. ABS are backed by a pool of commercial, consumer loans or any types of receivables with steady streams of cash flow. Asset securitization began in the United States in 1970. One of the earliest type of ABS was issued by Ginnie Maes in 1970 to free up the capital tied up in mortgage origination. Over the next 40 years, this securitization technique was applied to many other assets with similar cash flow characteristic. These assets includes commercial fleets, sporting contracts, commercial real estate, credit card receivables, student loans, residential mortgages and automobile loans. By facilitating the funding for consumer purchase, asset securitization has lowered the borrowing cost for borrower and improved American's life style. It is estimated that more than 23 trillion dollars of principal amount of asset-backed securities has been issued over period of 1970 to 2009. Over the next 30 years, with the abundance of investor's fund to invest and combined with a robust demand from home buyers and speculators,

1Asset Securitization
mortgage originator's underwriting guidelines had slowly deteriorated, carelessly originated billion dollars worth of loan to consumer with low credit score - Subprime mortgage loan. Home price continued to raise during this period further worsening the problem. By 2006, the housing market begins to show signs of oversupply and housing price began to stall. Many subprime home owners were highly leveraged and when housing price begin to fall in 2007, delinquencies and default rate rose.

This inverse relationship between housing price and delinquency rate is proven by a MIT professor Christopher Palmer. In his research paper Why Did So Many Subprime Borrowers Default During the Crisis, Palmer argued that high mortgage default rate in 2008 is mainly due to decline in housing price that left subprime borrower with negative equity on their house.(8) He further argued that if 2008 borrower had faced the price that average 2003 borrower did, the mortgage default rate in 2008 would have been 5.6% instead of 12%.(15)

Palmer's theory can also be explain by a concept called non-recourse loan. unlike many European countries, which lender can seize borrower's other asset in the case of default, American borrowers are not personally liable, when a borrower defaults, the lender is only limited to seize the collateral - the house. Because of this non-recourse feature built into the mortgage loan, when the market value of the house falls below the mortgage principal or commonly known as "under the water", delinquency increases. A method called "Strategic default" is a technique commonly used by borrowers with their house "under the water" to avoid monthly mortgage payment. A strategic default is the decision to stop
making mortgage payments not because of the financial difficulties but because of the benefits to default outweighs to continue paying the mortgage.

Investor's fears and panic quickly spread from the mortgage-backed securities to other types of asset-backed securities and eventually the entire capital market was froze. ABS market contracted substantially during 2008 and 2009. To stimulate consumer consumption, federal government introduced a stimulus plan called "TALF" or Term Asset-Backed Securities Loan Facility in 2008 to help the auto ABS market to recover from the crisis. Additionally, another program funded by the federal government to assist major American auto manufacturers called "cash for clunkers". As result of these federal programs, consumer demand for auto increased and consequently, boosted auto ABS capital market.
Chapter 2: Basics of Asset-Backed Securities

Auto Loan Characteristics

Almost all of the auto ABS have the following five features.

- Differ from debt financing, ABS is a sales of asset
- Need for credit enhancement for ABS
- ABS is issued through a Special Purpose Entity
- ABS requires the servicing during the loan period of the underlying asset
- ABS credit risk derived primarily from the credit of the underlying loans

An auto loan is a contractual agreement between a borrower and a lender. It is a type of secured loan whereby the vehicle served as collateral for the loan. Lender claims the ownership of the vehicle until the loan is fully paid off. During the course of the loan period, if the borrower is unable to make loan payment, lender can repossess the vehicle from the borrower. Since the vehicle served as a collateral, its primary risk an auto loan associated with is the market value of the vehicle. In the case of the borrower default, lender will repossess the vehicle and sell it at market value to recover the loan. Unlike the time consuming mortgage foreclosure process, the vehicle repossessions process is much simpler and straightforward. If the collateral value is impaired, the lender would also suffered a loss.

Auto loan can be secured by both new or used vehicles. Used vehicles included pre-owned and certified. Certified vehicles are vehicles that have been inspected, refurbished and
certified by manufacturers. Unlike other used vehicles, certified vehicles are still covered by manufactures' warranty. Depreciation is a major reason for the decline in a vehicle's value. The rate of the depreciation tend to vary by manufactures, vehicle make, model and years, depending on the durability and the length of the warranty on the vehicle. Generally, used vehicles have flatter depreciation curves than new vehicles.

Auto loan has many similarities and differences from residential mortgage loan. Similar to residential mortgage, auto loans are secured by collateral, both loans can be prepaid without penalty. Auto loan has shorter loan period, smaller loan amount and most importantly, unlike residential mortgage loan backed by house, auto loan is backed by vehicles whose market value is generally lower than the loan value. Loan-To-Value ratio for auto loan tend to be over 100%.

For auto loan, "advance rate" (same as Loan-to-value ratio) is a key measurement for the underlying collateral, this rate measures the loan balance at origination as a percentage of the sales price. The lower the advance rate, the more equity an borrower has in the vehicle. A high advance rate can cause the vehicle to become "under the water", therefore increase the likelihood of default.

Unlike mortgage loan, when the borrower default, the foreclosure process is long and expensive. This is not the case for an auto loan default, lender repossess the vehicle, the process is quicker and less expensive. However, if the vehicle's market value is less than the
loan amount, the lender would incurred a loss. The amount of the loss would be the difference between loan balance and market value of the vehicle minus any related fee for sales of the asset.

Like all loans, auto loan also has a annual percentage rate also known as APR charged on the loan. The interest rate charged on the loan often reflect the interest rate market environment and the underlying credit quality. loans that are characterized by the originator as riskier loan generally have a higher APRs when compared to less riskier loans.

Although auto loan borrower can prepay their loan without any penalty, it is uncommon to see refinancing in auto loans. A research conducted by the auto loan securities rating agency DBRS suggested that prepayment in the retail auto loans are very stable and generally uncorrelated to the interest rate movement. DBRS states:

"...refinancing activity in the auto loan sector is muted for two reasons. First, the depreciating nature of the collateral results in a reduced incentive for lenders to offer refinancing. Second, auto loans have a very short term to maturity reducing borrowers' incentive to seek refinancing."

The principle balance of the automotive loan are often exceed the value of its related vehicle during earlier years of a loan. Defaults during these earlier years are most likely to result in losses due to faster vehicle depreciation. The longer term payment period has add additional risk to such loan because with longer term loan, slower rate of amortization of principal balance of a longer term loan would cause the value of the financed vehicle worth
less than the remaining principle balance of the loan. It's also worth to note that the
delinquencies and defaults tends to be greater for loan with higher advance rate or loan-to
value ratio.\textsuperscript{2}

\textsuperscript{2}\textit{IBISWorld Auto Leasing, Loans & Sales Financing in the US}
Definition of Subprime Loan

An auto loan can be broadly divided into prime or subprime based on the credit quality of the borrower. A key metrics such as FICO score measures consumer's credit quality and the likely hood of default. FICO score is widely used by the auto lender.

Prime and subprime and further divided into five groups of credit score range from best in credit quality to worse credit quality. Consumer with best credit quality typically carry a FICO score of 750 or above. Credit score above 750 would fall into the super prime category. IBISWorld report published in 2014 estimated the super prime loans has about 38% of the total auto loan market. Super prime loans have grown significantly with increasing regulation after financial crisis. super prime segment expect to decrease in the near future as interest rate remains low and investors are seeking for higher yield products.

Next category is the Prime category, consumer with credit score between 700-750 would fall into the category. Prime loans estimated to represent about 26.4% of the total market share. Below the prime category is the Nonprime, consumer with credit score between 640 and 700 would fall into nonprime category, Nonprime holds about 16.1% of the market shares.

Consumers with credit score between 580 and 640 would fall into the subprime segment. Auto subprime loans currently holds 9% of the total markets. This segment is expected to grow quickly in the future predicted by IBISWorld report. As interest rate increase, the spread for prime loan will decrease thus lender will try to expand this

\[3\] FICO Score Trend in Today's Economic Uncertainty

\[4\] FICO Score Trends: US Credit Risk Summary Report
segment of the market to generate more income. Below the subprime segment is the
deep Subprime market, these are consumer with credit score of 580 or lower. Deep subprime
segment currently holds about 10.5% of the market. IBISWorld report also expect deep
subprime segment to grow quickly over the next couple years. For the purpose of this
research, the term subprime included both subprime and deep subprime segments.
Mechanics of Securitization

Securitization is a process which pooling together financial asset such as auto loans, credit card receivables and then repackaged the pool of loans into a bond sell it to investors. The process promotes liquidity in the market place and reduce the borrowing cost for the borrower. The process begins with consumer take out a loan to finance the vehicle purchase. The dealer or financing company will look into consumer's credit quality, if consumer's credit meets dealer's loan requirements, the dealer would originates the loan. The dealer or financing company then turns around and sell these loans to the investment banks in exchanged for capitals to originate more loans.

To diversify the loan pool, the bank buys loans from different location within the country, then divide the loan pool into different trenches and send it to a bankruptcy remote entity also known as SPV or Special Purpose Vehicle. A SPV is a trust that is set up to purchase the loan it originates. Once the loans are moved to SPV, SPV then issues bond using all the loans as collateral and make coupon payment to the investors on monthly basis. The coupon payments are generated by the monthly payment borrower send to the SPV. The performance of the bond is based on the quality of the consumer credit quality of the underlying loan pool. For example, if one individual default on their loan or stop paying the installment payment, the cash flow for the overall pool will decrease thus decreasing the
value of the bond. In practice, Asset backed securities are more complicated than simply divides pool of cash flow equally among the bond investors. A typical asset backed security is divided into three or four levels of seniority also known as trenches. Each trenches contain different level of risks and thus different credit rating and coupon payment rate. If one individual default on their loan, the lower trench absorbs the loss while the higher trenches are protected until the lower trenches are completely wiped out. To compensate investor for the higher risk, lower trenches receives a higher coupon payment and higher trenches receives lower coupon payment. Different trenches also attract investors with different risk appetites, thus making the bond more marketable.

To increase the marketability of the auto ABS and to reduce investor's risk, credit enhancements are provided in the form of overcollateralization or subordination. Overcollateralization is the most common form of the credit enhancement in a auto ABS transaction. Issuer will typically committed additional collateral to the loan pool to shield against the depreciation in the vehicle, as the loan pool amortized, this additional collateral will also decrease. Subordination can be created by divide the loan pool into several classes of notes. subordinated classes of notes have a lower priority of when receiving fund therefore provided protection from losses to the senior classes notes.
Chapter 3: The Growth in Subprime Auto Asset-Backed Securities

There are four major key drivers that fuels the growth in the auto industry and the auto lending during the past five years. These drivers are:

1. Government program like CARS (Car Allowance Rebate System Program) and TARP (Trouble Asset Relief Program) to stimulate the economy during the crisis.

2. Low interest rate pushing institution investor to demand more securitized Subprime auto loan products for higher return.

3. Increased new car sales resulting higher used car value. The demand for new car were also fueled by old average vehicle age. NADA estimated that the average national vehicle age on the road is 11.1 years.

4. Improved Marco economy environment: lower unemployment rate, growing consumer confident and improved capital market for consumer loan.

IBISWorld estimates a total subprime auto loans of 10.1 billion in 2014 with 4.5% annual growth rate, out of the 10.1 billion, 75.2% will be used car loans and 24.8% will be new car loans. These estimates suggests that the majority of the subprime loan are made through the purchases of used car. Below are few external drivers effecting the subprime auto loan

1) New Car sales

2) Yield on 10-year Treasury note

3) Per capita disposable income

4) Aggregate household debt.
Easier access to the consumer credit was the main driver behind robust new car sales growth post-recession. Alone with the government economy stimulation programs such as CARS and TARP provide the credit to encourage consumer to purchase the car. With growth in the new car sales, used cars supply increased thus making more favorable for subprime consumer to take advantage of the used car market.

Potential Federal Reserve Bond buying program signals future interest increase resulted in more consumer wanting to take advantage of the current low interest rate which generate more demand for car sales.

Per capital disposable income is expected to increase for subprime consumers. Subprime consumers are highly sensitive to cash on hand and have more limited access to credit.\(^5\) Consequently, changes in their incomes significantly affect their sentiment and vehicle purchase.

Aggregate household debt measures total debt a family currently holds including student loans, credit card debt, and mortgage and car loan. This is a key indicator of consumer demand for a vehicle. Historically, during periods of economic growth and rising incomes, consumers tend to take on more debt to finance purchase, a higher household debt are generally corresponds with the higher subprime automotive borrowing. Aggregate household debt expect to increase in the year of 2015\(^4\)

\(^4\) Smooth ride: Greater Car Sales and Investor Interest Will Drive Industry Growth
Part II: Sampling Population

Chapter 4: Current State of Subprime Auto Loan Market

According to the Federal Reserve Bank of New York data, auto loans made to borrowers with credit score less than 660 have nearly doubled since 2009. Scale and size of the current auto subprime loan market can provide a benchmark to assess the health of current state of the auto loan market. For example, subprime mortgage loan grew from 300 billion dollars in 1997 to 600 billion dollars in 2006. Comparing growth rate in subprime mortgage to current to the subprime auto loans market, which only has a tenth size of the subprime mortgage loan, we can see that auto loan only represent small portion of the total capital market. According to the Citi research report “Global Securitized Product Strategy” issued on November 6th, 2014, subprime auto loans currently represent only 23% of the total auto loan market share, lower than the 25% to 30% of the market pre-crisis market share.

Over the past five years, subprime borrowing has grown significant in size. The subprime loans have increased from 19.9% to 23% of the total automotive financing market. Within the subprime industry, 88.3% of the revenue come from car loans and 11.7% comes from leases based on Experian Automotive data. This suggest that majority of the subprime

\[\text{Experian: State of Automotive Finance Market First Quarter 2014}\]
origination are in forms of loans. Nationally, auto loan accounts for approximately 6.4% of the total average aggregate household debt, household auto debt fell to 5.9% of the total aggregate household debt as consumer deleveraging debts. Lower homeownership rate following the financial crisis, high vehicle age, historical low interest rate and recovering economy, has propelled the auto debt grew to 7.1% of the average household debt to in 2013. New York Fed Consumer Credit Panel published total auto loan origination in 2014 by FICO score. See Figure 1 below.

Figure 1. Total Auto Loan Origination By FICO Score on 2014

Notes: As of second quarter of 2014, the FICO score with 620 or less represent 22% of the total auto origination according to data from New York Consumer Credit panel.

The pie chart in figure 1 depicts consumer with 760 or better FICO score currently has the most market share, about 30%. Consumer with credit score 620 or lower (Subprime) represents 22% of the total origination in 2014.
Figure 2 is another graph depicting increasing auto loan origination following the 2008 financial crisis. The graph grouped consumers with different ranges of credit scores to show the growth in each group. The figure shows auto loan origination by the FICO score from 2000 to 2014. Loan origination for credit scores of 620 or less were at the peak during 2005 and 2006. The origination fell to the lowest in history during the 2009 financial crisis for all levels of credit score consumers. Auto loans with credit scores of 620 or lower and FICO scores between 620 and 659 are the two groups experiencing the most growth in loan origination since the decline during the financial crisis. The 760 credit score group only grew 2% per year during the same period. In 2014, the total auto loan origination were 92.9 billion dollars which is still well below a total of 102.6 billion dollars origination during 2006. This strong growth did not continue...
into 2013, the origination in FICO score less than 620 were 3.65%, 4.31%, 6.44% and 1.35% in 2010, 2011, 2012 and 2013 respectively.

The auto loan is also fundamentally different from the mortgage loan. Historically, U.S mortgage loan default rate is negatively correlated with the housing prices. If housing price falls, delinquency rate on mortgage would increased. This unique relationship between housing price and delinquency rate suggests that people buy house for speculative purpose. Artificial demand were created during the housing bubble that pushed housing price higher, with higher price, more artificial demand were created. This artificial demand is the catalysts for any asset bubble. There is no speculative element in automobile, therefore no artificial demand. New vehicle's value depreciates the most at the point of purchase. For borrower, the vehicle is used to commute to and from the work and generally defaults on other loans such as credit or student loan before defaulting on auto loan. Based on the above reasons and current state of the auto loan market, it would be an overstatement to conclude that there is a credit bubble in overall auto loan financing. However, with the fierce competition in the auto and auto finance industry, we believe the lending standard has been deteriorating.
Chapter 5: A look at the Deteriorating Lending Standard

The selected sample securities on both the new vehicle and used vehicle loans shows mixed results. Based on our study, we found that the lending standard for used vehicle is deteriorating, new vehicle loan securities shows increasing is credit quality. We believe the 50 prospects selected for this study is a good representation of the overall auto loan asset back securities market.

Subprime auto financing is a highly fragmented market with no one individual institution holds more than 5% of the total market share. Many loans are originated from the used vehicle dealers. A method called "Buy Here Pay Here" or BHPH. Some of the loan are done through a private placement with no public information on the loans. To measure the scale of the subprime and lending standard, this research focuses on a few of the largest key players in the industry. Super prime and nonprime securities were also sampled for comparison purpose. Keep in mind that the securities chosen for this research purpose is only a sample size and might not truly reflect the overall auto subprime market. Nonetheless, the asset-backed-securities have been carefully chosen based on the similar fundamental characteristics and covers varieties of different vehicle makes and models.

For securitized used vehicle loan, we have chosen Santander and AmeriCredit for this study. Santander Holdings USA, Inc., is a subsidiary of Banco Santander, S. A. A well-
known global bank headquarter located in Spain. The bank has assets of 1.3 trillion euro as of September 30, 2011. According to Citi Group's weekly consumer ABS report, 57% of the bank's earning derive from the North America and Latin America region. Santander Consumer USA, also known as SCUSA, the servicer of the SDART securitization, is also owned by the Santander. Santander’s subprime auto lending United States operation is the major revenue generator for the company, accounting 54% of the profit. SCUSA grew rapidly through acquisition activity after financial crisis. It's presence in the auto subprime loan makes Santander a good candidate for this study. Key indicators to gauge credit quality include Loan-to Value ratio, borrower's affordability measures such as Debt-to-Income and Payment to-Income Ratios, loan terms and as well as the FICO credit score for overall loan pool.

Figure 4. Total Amount Securitized with the selected sample securities (In Millions)
Figure 4 depicts the total amount of the auto loan securitized and issued by Santander during 2007 through 2014, with no issuance in 2008 and 2009 and record issuance of 11 billion dollars in 2012.

AmeriCredit Corp. is another major player in the auto subprime lending market. AmeriCredit became a subsidiary of General Motors Holding LLC on Oct 1, 2010 following a merger with GM Financial and the company was renamed General Motors Financial Company, Inc, also known as AMCAR. A Total of 20 AMCAR securities were sampled and the statistical data were draw from prospectus to study key figures such as proportion of new vehicle and used vehicle, Loan to Value, Average Principal Balance, Delinquency data and etc.

For comparison purpose, the sample securities were categorized into the used vehicle securities and new vehicle securities. If more than 75% of the loan pool contains used vehicle loans, we categorized as used vehicle loan, same approach were taken for new vehicles loan. AMCAR and SDART are used vehicles securities. FORD, TOYOTA, HYDUNDAI and KIA are new vehicle loan securities.

The data shows that securities issued by AmeriCredit (AMCAR) and Santander (SDART) are backed by used vehicle loan pool, used vehicle represent more than 75% of the total loan pool. Only 20% to 30% of the loan within its loan pool are new vehicle loans. Compare AMCAR’s issuance with santander’s issuance from period 2010 to 2014. Data shows decreasing porportion in used vehicle loan. For Ford the new vehicle loans percentage
of total pool were as high as 88.14% and average about 85.11% through out last ten years issuance. For Hyundai and Kia, the portion of new vehicle loans based on total number of receivables are 98.99% and 99.62% . Hyundai and Kia’s loan pool contains almost entirely new vehicle loans. See figure 5 below

Data in figure 5 is taken directly from prospectus of the securities issued by the auto loan finance companies. The graph shows the percentage of the new vehicle within the loan pool is increasing. Among five issuers (AMCAR, SDART, FORD, HYUNDAI and KIA) AMCAR and SDART's new vehicle loans show the most significant growth from 2009 to 2014. For example, in AMCAR's 2005 issuance, the new vehicle loans represent only 23.31% of the total loan pool but by 2014 the new vehicle represents about 45% of the total
loan pool. SDART is showing similar trend. This suggest that the subprime borrowers are shifting to more new vehicle purchase.

Figure 4 shows total Auto ABS issued by each company. The graph shows many of the current major players in the market did not exist before the financial crisis. ALLYA, SDART and AFIN are all emerged from the financial crisis and taking advantage of the auto boom. We can also draw a conclusion that the industry is becoming more competitive than it was five years ago.

For securities with more than 75% new vehicle loans, credit quality is actually improving. Figure 6 indicates Ford, Toyota and Hyundai tend to extend loans to consumer with better credit score. The weighted average FICO score for Ford, Toyota, Kia and Hyundai are 714, 724, 742 and 743 respectively. Compare major automobile manufacturers’ average FICO score to AMCAR and SDART, the weighted average FICO score are 574 and 587 respectively, which is significantly lower. Intuitively, loan interest rate for AMCAR and SDART are higher to compensate investor for riskier loans.
Figure 7 illustrates that interest rate has dropped 200 to 400 basis point for both new vehicle securities and used vehicle securities over period of 2005-2014. For new vehicles securities, the average interest rate on the loan is 4% as of 2013. For the same period, AMCAR and SDART carry an average interest rate of 14% and 16% respectively. Based on AmeriCredit and Santander's average FICO score within the loan pool, the sample securities falls into subprime category.
This portion of the research examines individual securities issued by Santander or SDART and AmeriCredit or AMCAR over a period of 5 to 10 years. Figure A1 shows the total issuance for SDART, since 2007, the total issuance is on average 6 billion dollars except in 2012. The size of issuance nearly doubled to 11 billion from 2011 to 2012. However, total issuance decreased in 2013 to 7 billion.

SDART securities issued on 2010, 2011, 2012, 2013 and 2014 show decrease in the proportion of the used vehicles loans within the loan pool. In 2010's issuance, this proportion was 82% used, 18% new, but in the 2014's issuance, used vehicle decreased to 68% and new vehicle loan increased to 32% of the total loan pool. AMCAR's securities also show similar decrease in used vehicle loans and increase in new vehicle loans. Figure B1 suggests subprime lenders are shifting origination to new vehicle purchase. Changes in the proportion
of new and used vehicles loan will effect on securities' collateral or LTV ratio. New vehicle's value decrease significantly at the point of the purchase, loan balance usually exceed the market value of the vehicle thus the auto loan often have a loan to value ratio of greater than 100%. The value of the new vehicle also tend to depreciate faster than the used vehicle, and the principal balance for new vehicle tend to be larger. Increasing new vehicle loans in the loan pool would also increase the average loan to value ratio or LTV on ABS. Figure 6 is a distribution of the LTV ratio for 2012 and 2013. The graph shows LTV in the range of 100% to 120% group is decreasing within the loan pool in 2013 compare to 2012. However, the LTV in the range of 120% - 150% or greater group represent more shares within the loan pool. This suggests the overall collateral value on the securities is decreasing as more new vehicle loans are added to the securities. Subprime lender overall risk increases as collateral value decreases. More new vehicle loan origination also increase the principal balance. Figure B5 indicates the increasing average principal balance on AMCAR securities from 2006 to 2013. Although these changes are notable, however, these chances should be study in relationship to default rate. The effect of the change LTV ratio and average principal balance on auto default will be discuss.

SDARTs’ subprime auto securities issued in 2014. Some car makes tend to be more popular than others. Dodge, Chevrolet, Nissan and Ford are among the most popular car choices for subprime borrower. These four brands represent almost half of the total loan pool. See graph below.
Weighted average FICO score is another key credit quality measurement for ABS. Figure B3 is the weighted average FICO for 22 AMCAR's ABS issued on 2009 through 2014. On 2009-1 issuance, the average FICO score is slightly above 600, by 2014, securities with same credit rating has a weighted average FICO score of 550. To gain a better understanding for why this figure has dropped significantly over past five years. FICO score is taken from each of the securities' prospectus issued over past five years and then divided into four groups of FICO score of 660 and above, 600-650, 540-599 and less than 540. Figure B4 shows the percentage of each FICO score group in a loan pool from 2009 to 2013. FICO score 540 or less group increased from 10% in the loan pool in 2009 issuance to nearly 28% of the loan pool in 2013 issuance. Credit score of 660 and above decreased from 12% in 2009 to 4% in 2013. Deteriorating credit quality also shown in the SDART's 2014 issuance.
Figure A4 is a distribution of the FICO score in the loan pool. Over 60% of the total loan pool has credit score of 600 or lower.

![Distribution of the Receivables by FICO Score](image-url)
Part III: Methodology and Analysis

Based on the sample auto-backed asset securities, there is no doubt that the credit quality is deteriorating as more subprime auto loans are being issued. During the subprime mortgage crisis, mortgage default rate was negatively correlated with the housing price, this is mainly because of the homeowners default strategically to discharge their mortgage debt when their houses were "under the water". To find out if the similar characteristics exits within the subprime auto loans, The regression analysis used. All modeling and calculation are made through the use of Microsoft Excel.

Assumptions

The average principal loan balance is used as a measure of new car sales price. we assumes the average principal loan balance is a good representation of the car sales price. We have also assume the sample subprime securities discussed above are good representation of the total subprime auto loan market.

Multiple loan quality measuring variables such as LTV, average principal ,and interest rate were taken from each of the sample prospectus and compare with the S&P Auto Default Index. The LTV ratios are taken from a sample of 21 SDART subprime auto loans issued during 2010 to 2014 and compares with the S&P auto default index which tracks default rate on all auto loans in the U.S market. Average principal balance and APR were also taken from the same sample prospectus. To find the correlation between each variabiles and the default rate, a scatter plot is draw based on the sample population, the line of best fit is derive from the relationship between the variable and the default rate. The slope of each
"best fit line" represents how each variable is correlated with default rate and how strong is the correlation.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Equation</th>
</tr>
</thead>
<tbody>
<tr>
<td>APR</td>
<td>y = 0.362x - 0.048</td>
</tr>
<tr>
<td>Average Loan Principal Balance</td>
<td>y = 0.020x + 0.012</td>
</tr>
<tr>
<td>LTV</td>
<td>y = -0.199x + 1.133</td>
</tr>
</tbody>
</table>

Based on the line of best fit equation, the result shows the average loan principal balance is the least correlated with the S&P auto default index. The weak correlation could be explained by the fact that post crisis subprime loan generally have a longer loan term, which lowers the monthly payment. Below is a distribution of the percentage loan term in a same class of subprime loan issued by Santander. As evidence by the graphs, loan term between 60 months to 72 months experienced the most significant growth from 2011 to 2013.
LTV ratio is negatively correlated with the S&P auto default index. Intuitively, the used car tend to have lower LTV ratio and majority of the subprime loan are made through used car purchase. This explains the inverse relationship between the LTV and the S&P auto default index.

The stronger correlation exist between interest rate on the loan and the default index. This could be because of the interest rate has already reflects borrower's credit condition at the loan origination. Interest rate also has the most impact on the borrower's monthly payment. As long as the interest rate remain at a reasonable level, large increase in the auto default rate is unlikely. Below figure shows the AmeriCredit's subprime auto loan APR for both used and new car. Interest rate have been decline steadily since the financial crisis.

Figure B7
Below are graphs depicting the correlation between each of these variables.

### S&P Auto Default Index Vs. LTV

**Equation:** $y = -0.199x + 1.133$

![S&P Auto Default Index Vs. LTV](image)

### S&P Auto Default Index Vs. Changes in Average Loan Principal Balance

**Equation:** $y = 0.020x + 0.012$

![S&P Auto Default Index Vs. Changes in Average Loan Principal Balance](image)
S&P Auto Default Index Vs. APR on the loan

\[ y = 0.362x - 0.048 \]

- S&P/Experian Auto Default Index
- Linear (S&P/Experian Auto Default Index)
CONCLUSION

The surge in the auto loan origination was fuel by the increase auto sale in U.S. The research result reveals the default rate is highly correlated with the interest rate on the loan. S&P auto Default Index shows a steadily decline on auto default rate during past five years. Possible reasons for declining default includes longer auto loan term, improving unemployment rate, deleveraging U.S consumers and low interest rate. On corporate side, within the auto loan, prime loans originate by major manufacturers' financing arm remains in good credit condition and even increasing in credit quality for some manufacturers. According to a report by Citi Global Securitized Product Group, there has never been a principal loss of any public issued prime loan due to strong credit enhancement on the securities. The subprime auto loan originate by AmeriCredit and Santander showing decrease in credit quality. However, the regression shows the default rate is most correlated with the interest rate. With the Fed's quantitative easing policy, the interest rate expect to remain low for a period of time. In addition, tighter regulation is expected to effect this industry. The Consumer Finance Protection Bureau (A federal agency regulates consumer lending practices) recently announced its plan to extending its supervision of larger auto lenders. It levied an 80 million dollars fine against Ally Bank related to subprime auto loan affecting 235,000 consumers.
Figure 3. Total Auto Loan Origination Growth Rate from 2000 - 2013 By FICO Score
Figure A3

SDART 2014 Distribution of the Pool of Receivables by Vehicle Make

Figure A4

Distribution of the Receivables by FICO Score
Figure A5

Distribution of the Original Mileage

Figure A6

Loan-to-Value Distribution
Figure A7

SDART Weighted Average Loan Interest Rate 2010-2014

Figure A8

SDART Average Original Principal Balance
Figure B5

AMCAR's Average Principal Balance

Figure B6

AMCAR's Weighted Average Interest Rate
Figure B7

AMCAR's Interest Rate for New and Used Vehicle

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<tr>
<th>New</th>
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<tr>
<td>2005-1</td>
<td>16.5%</td>
</tr>
<tr>
<td>2006-1</td>
<td>16.0%</td>
</tr>
<tr>
<td>2007-1</td>
<td>15.5%</td>
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<tr>
<td>2008-1</td>
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<td>14.5%</td>
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Figure B8 AMCAR's Average Principal Balance for New and Used Vehicle

AMCAR's Average Principal Balance

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<tbody>
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Figure B9 AMCAR’s Total Delinquency and Repossessed Rate

Figure B10 AMCAR’s delinquency rate by days
Figure C1

Percentage of New Vehicle with the Loan Pool

Figure D1

Ford's New Vehicle as Percentage of Total Loan Pool
Figure D2

Ford's Average Loan Principal Balance

Figure D3

Ford's Weighted Average Interest Rate on Loan
Figure D4

Ford Weighted Average FICO Score

Figure E1

Toyota's Weight Average Interest Rate on Loan
Bibliography


Palmer, Christopher. "Why Did So Many Subprime Borrowers Default During the Crisis: Loose Credit or Plunging Prices?" (2013). Print.


Bloomberg Terminal - data on 50 auto securities are pull from the Bloomberg Terminal
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