Collateral Value and Strategic Default: Evidence from Auto Loans

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Abstract

This paper provides novel empirical evidence that borrowers are sensitive to the value of the collateral and willing to respond strategically in auto loan repayment. I exploit two sources of quasi-experimental variation in collateral value–which is unrelated to borrowers' ability to pay–to study borrowers' strategic behavior. Unanticipated changes in vehicle import taxes and imposing loan-to-value restrictions for certain vehicles change the value of those that are already pledged as collateral, affecting borrowers' incentives to repay without affecting their ability to pay. The estimates in my sample suggest that 10% increase in the collateral value corresponds to an 18% drop in default rate. Consistent with the strategic default hypothesis, I also find that effect is stronger for borrowers with higher outstanding loan balances and no significant impact on the prepayment rate.

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Introduction

Borrowers can default due to two reasons– an inability to pay or strategic reasons. Inability to pay is caused by a dramatic, negative economic event that results in financial hardship, such as job loss or divorce. A strategic default is a decision by borrowers to stop making payments, despite having the ability to do so, in order to maximize their wealth. Importance of strategic considerations in borrowers' default decision is a central question in the household finance literature, since the cause of default decision is important in both ex-ante policy issues (e.g: maximum loan-to-value ratio restrictions, underwriting standards, and mortgage insurance) and ex-post policy issues (e.g: loan modifications and foreclosure moratoriums).

Using policy induced variation in collateral value and rich microdata, this paper tests whether borrowers respond strategically to changes in collateral value in auto loan repayment. The option-theoretic models of default suggest that borrowers strategically default if the value of the collateral is sufficiently low (Foster and Van Order (1984), Kau et al. (1987) and Titman and Torous (1989)). However, due to countervailing non-financial factors, such as moral aversion to default, emotional attachment (Guiso et al. (2013),Bhutta et al. (2017)), fear over the perceived consequences of default (White (2010)) and financial illiteracy(Burke and Mihaly (2012)), borrowers may choose to stay put even though their financial incentives suggest that the default is optimal. Previous literature does not provide compelling evidence on how changes to the collateral value affect borrowers' default behavior and, therefore, it remains unclear the extent to which borrowers strategically respond to changes in collateral value.[1] Understanding the impact of collateral value on

[1]Even though many papers demonstrate that default more likely ceteris paribus, for borrowers who experience a larger drop in collateral value, (e.g., Deng et al. (2000), Bajari et al. (2008), Foote et al. (2008), Scharlemann and Shore (2016)) a causal interpretation is not possible due to omitted variable bias. One notable exception is Palmer (2015). He shows the price declines causally explain disproportionate share of subprime defaults came from mortgages originated in 2006-2007.

default is particularly important in designing ex-ante policies.[2] If collateral value does not play an important role in borrowers' default behavior, then it limits the scope for credit market regulations such as loan-to-value restrictions.

The greatest challenge of empirically identifying the effect of collateral value on default is finding a source of variation in collateral value that is otherwise uncorrelated with borrowers' ability to pay. Borrowers' ability to pay is often not observed and borrowers who experience a larger drop in collateral value are also likely to experience binding cash-flow constraints, introducing bias to a naive regression of default on collateral value. For instance, time-varying local demand shocks affect both borrower liquidity and collateral value. Even if borrowers' liquid assets can be observed it may not help since strategic defaulters are likely to systematically hide liquid assets to disguise their behavior as an inability to repay their loans (Guiso et al., 2013) or actually have poor cash balances due to different reasons. Other unobservable borrower characteristics can also confound causal interpretation. Characteristics such as initial credit quality–which is related to borrowers' ability to pay–could determine factors such as the type of collateral, level of maintenance and time of purchase.

In this paper, I overcome the identification challenge by exploiting several policy changes in Sri Lanka which affected the values of the vehicles pledged as collateral without affecting auto loan borrowers' ability to repay in the short term. The first setting uses three unanticipated import tax changes that affected only certain types of vehicles to generate exogenous variation in collateral value.[3] Import taxes were *increased* for new 3-wheelers[4] twice during my sample period and import taxes for cars with engine capacity less than 1000cc were *reduced* once. Tax increases for 3-wheelers make new 3-wheelers

[2]There is empirical evidence that shows strategic behavior in response to changes in cost of default (Mayer et al. (2014),Yannelis (2017) and Artavanis and Spyridopoulos (2018)) and these are more helpful in ex-post policies.

[3]Vehicle imports are taxed heavily in Sri Lanka and taxes are one-off and should be paid by the importer before the vehicle is cleared from the Sri Lanka Customs Department.

[4]These are also known as auto-rickshaws, tuk-tuks or trishaws. These are motorized vehicles with three wheels that are mainly used as taxis in Sri Lanka.

more expensive and this would force some of the potential buyers who would have purchased a new vehicle to the used vehicle market increasing demand for used 3-wheelers. As a result, the value of 3-wheelers already pledged as collateral would increase (see Figure 1) and this would, in turn, weaken borrowers' incentives to strategically default. The tax increases do not have any effect on borrowers' ability to repay, at least in the short term. Similarly, for cars with engine capacity less than 1000cc the tax decrease would increase the incentives to strategically default. Using these tax changes as *treatments*, I apply the standard difference-in-difference methodology to estimate the effect of the change in collateral value on default. I define as *treated* the loans to purchase vehicles affected by the tax changes, originated prior to the respective tax change. In the case of 3-wheelers, I define *control* as the loans to purchase other types of vehicles, that were not subject to the tax increase and in the case of cars with engine capacity less than 1000cc, I define small cars with engine capacity greater than 1000cc as the *control* sample. All the loans were originated before the respective tax change. I expect the default rate for 3-wheelers to decrease following tax increases and default rate for cars with engine capacity less than 1000cc to increase following the tax decrease. Throughout, I include loan fixed effects to account for unobserved borrower characteristics and district-month fixed effects absorb any time-varying differences across borrowers at the district level.

The second setting is based on loan-to-value restrictions imposed by the Central Bank of Sri Lanka. Before January 2017, all auto loans were subject to a maximum loan-to-value ratio of 70%. In January 2017, the Central Bank of Sri Lanka issued a directive increasing the maximum loan-to-value for some types of vehicles and decreasing it for certain other types of vehicles. This directive was only applicable to new vehicles, and maximum loan-to-value ratio for all used vehicles remained unchanged at 70%. Consider a vehicle type whose maximum loan-to-value ratio was reduced. This decrease in maximum loan-to-value increases the down-payment required to purchase a new vehicle and would force some of the borrowers who would have purchased a new vehicle to the used vehicle

market. The down-payment requirement for a used vehicle of the same type would be much lower due to higher maximum loan-to-value ratio and lower valuations. As a result of the higher demand, the value of these vehicles pledged as collateral before the reform will increase, reducing the borrowers incentives to strategically default without immediately affecting their ability to pay. Similarly, for the types of vehicles whose maximum loan-to-value ratio was increased, borrowers' incentives to strategically default would increase. In this setting, I use a generalized difference-in-differences approach with dummy variables indicating each vehicle type after new loan-to-value ratio rules came in to effect.

Using a large proprietary database of auto loan performance from a major non-bank financial institution in Sri Lanka, first I present evidence which supports the baseline hypothesis that policy changes outlined above have a significant impact on the values of assets already pledged as collateral. Next, I estimate the impact of these changes on default rate. I find strong evidence for the significant effect of collateral value changes on borrowers' default decisions. Default rate of borrowers who experienced a 10% increase in the collateral value following the tax changes decreases by 0.3%. The unconditional probability of default prior to the tax change is 1.7% and the estimated effect corresponds to a 18% lower probability of default. I also find that the self-cure rate increases by 16% following the tax increase. The effect is very large compared to the mean self-cure rate of 5% prior to the tax increase. Evidence from loan-to-value restriction reform presents similar effects of the collateral value on default. Default rates of vehicle types whose maximum loan-to-value ratio was reduced decreased, and vice versa.

Main threat to my identification is the violation of the parallel trends assumption. Parallel trends assumption for above tests is that default rates of different vehicle types would have trended similarly if there were no regulatory changes. Graphical evidence presented suggests that even though treatment and control groups differ in the absence of treatment, they move in parallel–providing support for the parallel trend assumption. Placebo tests that simulate the reforms at earlier dates confirm that the results are not

driven by preexisting trends in different types of vehicles.

The second identification concern is that some of the liquidity-constrained borrowers who would have defaulted could be prepaying after collateral value increases and vice versa. In Sri Lanka this effect is unlikely to be significant as auto loan borrowers face a severe prepayment penalty, sometimes as high as 25% of the outstanding loan amount. During my sample period only 0.16% of the loans were prepaid. Nonetheless, I use difference-in-difference estimates to confirm that tax changes did not have a significant impact on the prepayments. I provide further cross sectional evidence consistent with strategic default hypothesis. I find that effect of collateral value is stronger for borrowers with higher outstanding loan amount.

One final concern I address is if liquidity-constrained borrowers are able to extract their equity in the form of a secondary loan following the increases in collateral value, then my results would be picking up the impact of relaxed liquidity constraints. Detailed monthly level data allows me to track the total loan balance from month to month and I do not observe any increase in loan balance after value increases and regulations do not allow borrowers to use the same asset as the collateral for a secondary loan with another lender. In private conversations, management of the lender also confirmed that there were no equity extractions following the collateral value increases.

I contribute to the literature by empirically identifying the effect of collateral value on default. I present evidence that borrowers respond strategically to changes in collateral value via their default decision and this has policy implications not just in the auto loan market, but also in mortgage, student loan and credit card loan markets.

This paper also adds to the thin literature on determinants of auto loan default. Agarwal et al. (2008) and Agarwal et al. (2007) study the relationship between borrower consumption choices and future auto loan performance.

1. Theoretical and Institutional Background

1.1 Strategic Default

The literature has traditionally modeled mortgage default using option pricing theory, where borrowers default if expected utility from continuing to make loan repayment falls below the utility from defaulting (e.g: Foster and Van Order (1984), Kau et al. (1987) and Titman and Torous (1989)). In a frictionless world in which there are no transaction costs of prepaying a loan and no penalties for defaulting on a loan, it is optimal for the borrower to default if the current value of the collateral is less than the outstanding loan balance. However factors such as creditor recourse, increased cost of credit, expectations of future price increases and value of the option to default in the future are likely to reduce the utility from defaulting. As a result it makes sense for borrowers not to default even when the collateral value is less than the outstanding loan balance (Kau et al. (1994), Bhutta et al. (2017)). On the other hand, when frictions such as liquidity constraints and access to credit are binding, those make the financial incentives irrelevant (Adams et al. (2009), Deng et al. (2000) and Kau et al. (1993)).

Disentangling the defaults due to financial incentives and illiquidity has important policy implications. For instance, during the recent US foreclosure crisis, policymakers had to decide between inducing lenders to reduce payments or principal in order to prevent mortgage defaults (Fuster and Willen, 2017). Payment reductions relax borrowers liquidity constraints and principal reductions increase borrowers lifetime utility. Reducing principal is an efficient way of dealing with strategic default. If most defaults are driven by liquidity constraints, other interventions such as payment reductions can be more efficient (Eberly and Krishnamurthy, 2014). Research on this topic can inform policy not just in mortgage market, but in other household lending markets such as student, auto and credit card loan markets as well. Policies such as income based repayment or allowing student borrowers to deduct interest payments would be effective if student borrowers exhibit

strategic behavior when repaying student loans (Yannelis, 2017). Further, if consumers are willing to respond strategically via loan repayment, then the cost of moral hazard in implementing debt relief programs would be high (Mayer et al., 2014). Understanding the causes of default would also inform policy issues such as penalties for default and caps on loan-to-value ratios, etc.

Despite policy relevance, little formal empirical evidence exists on whether borrowers strategically default. Although many papers demonstrate that default more likely ceteris paribus, for borrowers who experience a larger drop in collateral value. (e.g., Deng et al. (2000), Bajari et al. (2008), Foote et al. (2008) and Scharlemann and Shore (2016)) a causal interpretation is not possible due to omitted variable bias. One notable exception is Palmer (2015). He shows the price declines causally explain disproportionate share of subprime defaults came from mortgages originated in 2006-2007. The main challenge in understanding strategic default is that these defaults are not directly observable and borrowers are incentivized to mask strategic defaults as inability to pay. Borrowers' financial utility from defaulting and budget constraints are likely to be correlated through observable as well as unobservable characteristics. For example, local job market conditions, which has a direct impact on borrowers liquidity, are likely co-move with the demand for collateral. Moreover, borrowers' utility is driven by initial down payment, loan terms or time of purchase, which may be associated with unobservable borrower characteristics. A few recent papers use changes to repayment incentives that do not affect borrower liquidity to understand borrowers' strategic behavior. Mayer et al. (2014) found that households who were aware of the announcement of a large scale mortgage modification program responded by defaulting, despite the ability to pay. Yannelis (2017) shows that removing bankruptcy protection and increasing wage garnishment reduced defaults on student loans. Artavanis and Spyridopoulos (2018) use a foreclosure moratorium to identify strategic defaults. Gerardi et al. (2017) use detailed data on borrower income, employment status and consumption to control for borrowers' ability to pay.

Some studies, however, have suggested that borrowers strategically default less often than their financial incentives suggest. Foote et al. (2008) find that only 6.4% of the borrower who are underwater chose to strategically default using data from Massachusetts in early 90s. Bhutta et al. (2017) show that borrowers do not chose to walk away from their houses until they are deeply underwater. Gerardi et al. (2017) find that 96% of low equity borrowers with the ability to pay remain current on their mortgages. Guiso et al. (2013) and Bhutta et al. (2017) argue that "behavioral" factors such as moral aversion to default and attachment to house etc are more important in borrowers' default decision. Guiso et al. (2013) find that 82% of the borrowers in their sample think strategic default is morally wrong. Another reason borrowers may not respond to financial incentives could be financial illiteracy. Some borrowers may not have the ability to estimate the costs and benefits of strategic default and/or may not have a good knowledge of default consequences (Burke and Mihaly, 2012). Guiso et al. (2013) argue that their finding of a social contagion effect is due to borrowers learning about the default consequences by observing other people who strategically default.

1.2 Tax Changes

This paper uses three unanticipated import tax changes to generate exogenous variation in the collateral value: November 2015 and April 2016 tax increase on 3-wheeler imports and November 2014 tax reduction on cars with engines less than 1000cc.

1.2.1 Tax Increases on 3-wheeler Imports

Number of 3-wheelers, which are mainly used as taxis, on Sri Lankan roads increased steadily prior to 2015, increasing from about 400,000 in 2007 to more than 1 million in 2015. This rapid increase has raised concerns regarding air pollution, increased traffic and increased road accidents caused by 3-wheelers. As a part of Sri Lankan government's efforts to reduce the growth of number of 3-wheelers, the import tax of 3-wheelers was

increased in two separate occasions, in November 2015 and April 2016. As a result the price of a new 3-wheeler increased from LKR 505,000 to LKR 610,000 in November 2015 and to LKR 638,600 in April 2016. Both the changes in tax came into effect the next day after the announcement. This increase in price of brand new 3-wheelers had an indirect effect on the value of existing 3-wheelers in the country. Increase in price reduced the demand for brand new 3-wheelers while increasing the demand for used 3-wheelers which in turn increased the value of used 3-wheelers. Figure 1 plots the mean price of a new Bajaj (by far the most popular brand) 3-wheeler imported from India in each month and the value of used 3-wheeler originally imported in 2012, 2013 and 2014. Following each tax increases value of used 3-wheelers increases by about 10%. It is also clear from Figure 2 that the increase was unanticipated as the number of brand new 3-wheelers purchased did not increase prior to the announcement. The pronounced spike just after the announcements is due to the sale of the dealer inventory that was imported before the tax increase.

1.2.2 Tax Reduction on Cars with Engine Capacity less than 1000cc

In the national budget proposals for year 2015, it was proposed in November 2014, that import taxes for motor cars under the 1000cc engine capacity to be reduced. The proposal came into effect the following day after the announcement. As can be seen from figure 8, this resulted in a price drop of about 25% for cars with engines less than 1000cc that were imported after the tax reduction. Import taxes for small cars with engine capacity greater than 1000cc were not affected. This tax reduction had an indirect negative effect on the value of used cars with engines less than 1000cc(I present formal evidence later in the paper) as new cars of the same type became more affordable. Therefore we would expect borrowers who purchased small cars with engine less than 1000cc to default more, relative to the borrowers who purchased cars with engines greater than 1000cc, following the tax reduction.

1.3 Changes to Maximum Loan-to-Value Ratio

In a bid to clamp down on the vehicle imports weighing on the country's balance of payment, on 14 September 2015, the Central Bank of Sri Lanka directed banks and NBFIs to restrict the maximum loan-to-value to 70% per vehicle for all types of vehicles, but was withdrawn after few days by the Ministry of Finance. Central Bank directive eventually came back in to effect from December 1, 2015.

Subsequently, in November 2016, government proposed that maximum loan-to-value ratios to be revised again in its 2017 national budget proposals. In January 2017, the Central Bank of Sri Lanka issued a directive clarifying the budget proposals and directing lenders to implement the budget proposals. According to the directive the maximum loan to value ratio was revised to 25% for 3-wheelers and to 50% for motor cars, SUVs and vans from the previous 70% blanket maximum. Maximum loan-to-value ratio applicable to trucks and buses was revised upwards to 90%. The directive only affected new vehicles and vehicles that are less than one year old and the maximum loan-to-value ratio of 70% for used vehicles was not affected. Even though the directive did not change the maximum loan-to-value ratio applicable to motorbikes, lenders started exploiting a loophole in the directive by capitalizing documentation fees, registration fees and insurance premium for the first year. This effectively increased the maximum loan-to-value ratio to about 80%. This loophole did not have any notable impact on other types of vehicles since these capitalized costs are very small compared to the valuation of other types of vehicles. For example, fixed costs associated with a motorbike purchase is about LKR 20,000 and this is approximately 10% of the value of the most popular Honda DIO motorbike. For a 3-wheeler the fixed costs are about 3.75% and for a standard sedan it is only about 1%. Panels A through D in figure 3 show the changes in loan-to-value for new vehicles of each type. It is clear from the figure that loan-to-value restrictions are binding and therefore it is likely to have a significant impact on the used vehicle values. Given the

high interest rates charged by the NBFIs, borrowers are likely to maximize their down-payment to minimize the interest payments in the future. This means, for example, after the restrictions significant fraction of borrowers who wanted to purchase a new car, SUV, van or a 3-wheeler will not be able to afford the high down payment and will likely to look for a used vehicle which is less expensive and also the down payment requirement is only 30%. Opposite is true for trucks, buses and motorbikes.

The key implication of this change to the maximum loan-to-value ratio for new cars, SUVs, vans and 3-wheelers is that it reduces the demand for new vehicles in these categories, increasing value of vehicles already pledged as collateral. Value of used trucks and buses will move in the opposite direction since the demand for new trucks and buses increases following the increase in maximum loan-to-value ratio.

1.4 Non-Bank Financial Institutions (NBFIs)

NBFI segment is an important part of the Sri Lanka's financial sector and it represents 13% of the total assets of the deposit taking institutions. As of the end of 2014, there were 56 NBFIs and many of which are involved predominantly in auto loan business. As of December 2014 auto loans represented more than 70% of the NBFI sector lending portfolios. These institutions attract relatively higher risk borrowers who are not able to obtain an auto loan from commercial banks. Banks are not big players in the auto loan market. Auto loans by NBFIs are processed very quickly, often within few hours as opposed to few weeks by a commercial bank, and borrowers are charged a high interest rate. NBFIs rely on aggressive collection practices to minimize losses. A typical auto loan is a fixed rate with a 4- to 6-year maturity and a severe prepayment penalty. NBFIs are regulated by the Central Bank of Sri Lanka. Regulatory requirements include minimum capital adequacy ratios and are required to be listed on the Colombo Stock Exchange.

2. Data and Sample Construction

2.1 Data

The data used in this paper come from one of the 5 largest non-bank financial institutions (NBFIs) in Sri Lanka which represents more than 10% of the total assets of NBFIs in 2014. This data set contains loan level data at origination such as loan amount, valuation of the vehicle, loan term, interest rate and borrower characteristics for all the loans issued by the NBFI from January 2012 to August 2017 (396,551 loans). The data set also includes month-by-month stream of payments made by the borrower as well as whether the loan is in default in each month. 3-wheelers account for 55% of the NBFI's portfolio and 15% of the loans are for motorbikes. Cars account for 11% of the loans and vans and trucks are 5% and 4% respectively.

2.2 Sample Construction

Empirical analysis uses three primary data sets constructed from the above data set. For the first set of results, which uses tax increases for 3-wheeler imports as treatments, data is restricted to loans to purchase vehicles before June 2015 and final payment date is after August 2016. Three wheelers are the treated sample and other types of vehicles are considered the control sample. Two separate samples were constructed from this data set using loan-month observations around each tax increase. Observations in these samples are at loan-month level and the main outcome variable is whether the loan is in default in a particular month. Samples consist of loan-month observations three months before and after the tax increase. Summary statistics for these samples are given in the first two columns of Table 1. Compared to other types of vehicles, 3-wheeler loans have a shorter term, higher interest rate, higher loan-to-value ratio and more brand new vehicles.

Second set of results uses the import tax reduction for cars with engines less than 1000cc as the treatment. The sample used for this test consists of loan month observations

from September 2014 to March 2015 for small cars and cars with engines greater than 1000cc are considered the control sample. The summary statistics of this sample is given in columns (3) and (4) in Table 1 and both treatment and control groups are similar based on the observable borrower and loan characteristics.

Third set of results uses the change in maximum loan-to-value ratio in January 2017 as a natural experiment. This sample is restricted to auto loans originated between January 2013 and June 2016. Sample consists of loan-month observations from August 2016 to April 2017. Summary statistics for this sample are reported in the last four columns of Table 1. Compared to other types of vehicles, cars, SUVs and vans have longer terms and significantly lower interest rates. Motorbike owners are younger and 42% of them are single.

3. Empirical Methodology

The goal of this paper is to identify if borrowers respond strategically to changes in collateral value despite having the ability to pay. The primary challenge of estimating the effect of collateral value on default is that a number of omitted variables drive both collateral values and liquidity constraints. These include aggregate demand shocks and borrowers creditworthiness. Therefore, a naive regression of the decision to default on value of the collateral is unlikely to provide causal interpretation. Ideally, we want random shocks to the value of the collateral that do not have any impact on borrowers' ability to repay. In the absence of an ideal experiment, I use policy induced variation in vehicle import taxes and maximum loan-to-value ratios to generate exogenous variation in collateral value. This section details how each policy change is exploited to estimate the causal effect of collateral value on default decision.

3.1 Import Tax Changes

In November 2015 and April 2016, there were two unanticipated increases of import taxes for 3-wheelers and in November 2014 the import taxes for cars with engines less than 1000cc were reduced. In the case of 3-wheelers, tax increases reduced the demand for new 3-wheelers and increased the demand for used ones, in turn increasing the value of 3-wheelers pledged as collateral for auto loans prior to tax increases. Similarly for cars with engines less than 1000cc, the value of such cars already pledged as collateral would decrease.

First, to verify the baseline hypothesis–that tax changes impact the value of treated vehicles (i.e. 3-wheelers and cars with engines less than 1000cc) originally purchased prior to tax changes–I use the valuations of *used* treated vehicles pledged as collateral before and after each tax change. The valuation appraisals are conducted by third party licensed valuers. I implement the following equation using other used vehicles and cars with engines greater than 1000cc as control samples for 3-wheelers and cars with engines less than 1000cc respectively.

$$log(valuation)_{ivtd} = \alpha_v + \alpha_{td} + \sum_m \beta_m \ Treated \ Vehicle_i \times m + \epsilon_{ivtd} \tag{1}$$

where i,v,t and d represent borrower, vehicle model-manufacturing year, month of loan origination and district respectively. m represents number of months since the tax increase. m is negative for months before tax change and positive for months after. This regression includes vehicle model-manufacturing year and district-month fixed effects.

Next, using each of tax change as treatment, I implement standard difference-in-difference research designs. In the 3-wheeler samples I use other types of vehicles as the control group. For cars with engines less than 1000cc, I use small cars with engines greater

than 1000cc as the control group. Specifically, I estimate the following equation:

$$Y_{itd} = \alpha_i + \alpha_{td} + \beta \; After \; Tax \; Change_{itd} \times Treated \; Vehicle_{itd} + e_{itd} \tag{2}$$

where Y_{itd} stands for the outcome variable for loan i in time t in district d. In the baseline specification Y_{itd} is a dummy variable that indicates whether the loan i is in default in month t. Y_{itd} is equal to one if the loan is in default in month t and zero otherwise. Loan level fixed effects (α_i) are included to capture any time-invariant characteristics of the borrower. $District \times Month$ fixed effects (α_{td}) account for common shocks across all loans in a given district. $After \; Tax \; Change_{itd}$ is a dummy variable equal to zero for the period before the tax change and one after the tax change. For the November 2015 tax increase sample, months after November 2015 have a $After \; Tax \; Change_{itd}$ equal to one and for the April 2016 tax increase sample, months after April 2016 have a $After \; Tax \; Change_{itd}$ equal to one. $Treated \; Vehicle_{itd}$ is a dummy variable equal to one for treated vehicle type and zero for control sample. The parameter of interest is β, which captures the change in default rate in the treated sample following the tax changes. I expect the β to be negative for 3-wheelers and positive for cars with engines less than 1000cc.

3.2 Loan-to-Value Restrictions

In November 2015, Central Bank of Sri Lanka restricted maximum loan-to-value ratio for any type of auto loan to be 70% (i.e. a minimum down-payment of 30%). In January 2017 this limit was revised for new vehicles that are less than one year old. This change was initially proposed in late November 2016. According to the revised limits, a person buying a new car, SUV or van is required to make 50% minimum down-payment and for a new 3-wheeler the minimum down-payment requirement was increased to 75%. Down-payment requirement for new trucks and buses was reduced to 10%. Even though the minimum down-payment for new motorbikes remained 30%, in an effort to grow the motorbike

portfolios to compensate for declining 3-wheeler loans, lenders started capitalizing upfront fixed costs such as insurance and fees, effectively increasing the maximum loan-to-value ratio to about 80% for motorbikes (see section 1. for more details).

As a result of the unanticipated changes to the down-payment requirements, the values of used cars, SUVs, vans and 3-wheelers would increase as buyers who would have bought a new vehicle are now forced to buy a used vehicle. Similarly the values of used trucks, busses and motorbikes would decrease. I expect the default rates of vehicle types whose down-payment requirement increased to decrease and vice versa in response to changes in collateral value.

First, to verify that the loan-to-value restrictions indeed had an impact on the valuations of vehicles previously pledged as collateral, I implement the following specification:

$$log(valuation)_{ivtd} = \alpha_v + \alpha_{td} + \sum_p \beta_p Jan\ 2017\ \text{-}\ Jun\ 2017_i \times I(type = p)_{itd} + \epsilon_{ivtd} \quad (3)$$

where i,v,t and d represent borrower, model-year of the vehicle, month of origination and district respectively. The sample used in this regression is the used vehicles pledged as collateral between August 2016 and June 2017. Dummy variable *Jan 2017 - Jun 2017* $\times$ $I(type = p)_{itd}$ takes the value one for auto loans of vehicle type p(where $p \in$ *(3-wheeler, bus/truck, car/SUV/van, motorbike)*) originated between January 2017 and June 2017(i.e. after restrictions) and zero otherwise. This specification includes model-year fixed effects and origination month-district fixed effects.

Next, I implement the following specification to understand the effect of changes to loan-to-value on default rate .

$$Y_{itd} = \alpha_i + \alpha_{td} + \sum_p \sum_q \beta_{pq}\ I(type = p)_{itd} \times I(t \in q)_{itd} + e_{itd} \quad (4)$$

where for loan i in month t in district d, this regresses Y_{itd}–a dummy variable that indicates

whether the loan i is in default in month t–on a dummy variable which equals 1 only if loan type equals p (where $p \in$ *(3-wheeler, bus/truck, car/SUV/van, motorbike)*) and t is in period q. q indicates whether t is before the announcement (i.e. $t <$ November 2016), before the implementation (i.e. December 2016 $< t <$ January 2017) or after implementation (i.e. $t >$ February 2017). Coefficients of interest are β_{pq} which measures the difference-in-differences– i.e. the estimated change in the difference between vehicle type p and control group default rates in time period q relative to the time period before the announcement (i.e. $t <=$ November 2016). Loan level fixed effects (α_i) are included to capture any time-invariant characteristics of the borrower. $District \times Month$ fixed effects (α_{td}) capture monthly effects that affect all borrowers in a particular month t in a given district d.

4. Results

Subsections 4.1 and 4.2 use the import tax changes and then for loan-to-value restrictions respectively as natural experiments to evaluate the impact of collateral value on default. In each subsection, I first verify that reforms I am using as natural experiments have significant impact on the values of vehicles already pledged as collateral. Next, using variation in collateral value due to reforms, I provide evidence that suggest borrowers respond strategically to changes in collateral value.

4.1 Import Tax Changes

4.1.1 Tax Increases on 3-wheeler Imports

To verify that November 2015 and April 2016 tax increases impact the values of 3-wheelers already pledged as collateral, I implement equation 1 using loans to purchase *used* vehicles before and after each tax increase. I expect the valuations of used 3-wheelers to increase after each tax increase. i.e. β_m to be positive and significant when $m > 0$.

Results of this estimation is presented graphically in figure 4. Panel A shows the impact after November 2015 tax increase and Panel B shows the impact after April 2016 tax increase. Y-axis plots the estimated β_m coefficient. These figures suggest that value of the used 3-wheelers increased by about 10% following each tax increase relative to other vehicle types. The figure also suggests that values of all used vehicles moved in parallel prior to tax increases.

Having established that tax increases have a positive significant impact on the value of collaterals for 3-wheeler borrowers, I turn to the impact of collateral value on default. Table 2 looks at the impact of increase in import taxes for new 3-wheelers on the default rate of 3-wheeler loans originated prior to tax increases. This table implements the difference-in-difference estimates in equation 2 where 3-wheeler loans are considered the treated sample and other types of vehicles are considered the control sample. Loans in all the samples were originated prior to April 2015. Columns (1) and (2) use November 2015 increase as the treatment and sample consists of loan-month observations three months before and after the tax increase. Treatment in columns (3) and (4) is the April 2016 tax increase and same three month time frame is used to construct the sample. This table uses all the other types of vehicles as the control sample. Column (3) and (4) excludes loans to purchase cars as in April 2016 there was an amendment to the import tax structure of the cars as well.

The regressor of interest is *Time* $\times$ *3-wheeler* and it is negative and significant across all specifications. These results suggest that the monthly default rate of 3-wheeler loans originated prior to tax increase reduced by 0.3% and 0.5% compared to other types of vehicles after November 2015 and April 2016 tax increases respectively. Given the mean default rate of 1.7%, this reduction is highly economically significant. This implies that the default rate reduces by 18% to 29% following the tax increase due to the increase in value of the collateral.

Columns (2) and (4) of table 2 shows that results are robust to inclusion of loan and

borrower related controls. Samples in these columns were constructed using the same restrictions. In these regressions I include loan origination month fixed effects control for difference in the time of loan origination.

Identification using difference-in-difference method relies on the parallel trend assumption. i.e. default rates of both treated and control groups would have trended similarly if there were no tax increases in the treatment sample. Two panels in figure 5 show that there was no differential trends between treatment and control groups prior to treatment. Figure 5 estimates the following equation:

$$Default_{itd} = \alpha_i + \alpha_{td} + \sum_m \beta_m \ 3\text{-}wheeler_i \times m + \epsilon_{ivtd} \tag{5}$$

where i,t and d represent borrower, month of loan origination and district respectively. m represents number of months since the tax increase and negative ms indicate months prior to tax increase. This regression includes loan and district-month fixed effects.

Y-axis of the figure 5 plots the estimates of β_m against m. Prior to the tax increases, the estimated difference between treatment and controls groups is virtually zero. However, following the tax increase, the default rate of 3-wheelers drop significantly relative to the default rate in the control group.

One possible concern with my methodology is that other vehicle type borrowers are not an adequate control group because they are too different from 3-wheeler borrowers. One key difference is that 3-wheelers are purchased by less affluent borrowers and other types of vehicles such as cars are purchased by more affluent borrowers. One may worry about the possibility that an unobserved shocks affecting less affluent borrowers at the same time the taxes increased. I use a matched sample of motorbikes as the control sample to address this concern. Unlike in the more developed countries, in Sri Lanka motorbikes are purchased mainly by less affluent borrowers who cannot afford a car. Matching was based on borrower characteristics, district and loan origination month using propensity

score matching. Descriptive statistics of the samples before and after are given in the Appendix x. Results of this exercise are reported in columns (1) and (3) in table 3 and results in this sample is much stronger than the results in table 2.

Another concern would be that 3-wheeler owners are systematically different from other vehicle owners since the main source of income for almost all 3-wheeler owners is generated using the 3-wheeler. It is not implausible that some unobservable shock affected only entrepreneurial borrowers around the tax increase. To assuage this concern, I compare default rates of 3-wheelers with matched mini-trucks in columns (2) and (4) in table 3. Mini-trucks are very small trucks with small engines that are used to transport small loads. As is the case with 3-wheelers, mini-trucks generate the main source of income for many mini-truck owners. I select mini-truck borrowers who listed their occupation as "self-employed" or "business" so that they are comparable to the 3-wheeler borrowers in terms of the source of income. Matching is based on the same procedure as above. Descriptive statistics of the samples before and after are given in the Appendix x. Coefficients remain negative and highly statistically significant.

Having established that 3-wheeler default rates decreased following import tax increases, I next look at whether already defaulted 3-wheeler borrowers self-cure more in response to the tax increases. If a borrower's previous default was strategic–i.e. if the borrower was in default despite having the ability to pay–that borrower is more likely to self-cure following the tax increases. Loan i, is defined as a self-cure in time t, if the loan is current in time t, conditional on loan being in default at time $t-1$. Samples were constructed for each month $t-1$, using the loans are in default in that month. Self-cure rate is defined as the fraction of loans that are not in default in month t for 3-wheelers and other types of vehicles separately. Figure 6 shows that the self-cure rate of 3-wheeler borrowers increases sharply following the tax increases. Table 4 Panel A presents the difference-in-difference estimates for the self-cure rates. Following the November 2015 tax increase the self-cure rate increases by 12.3% and self-cure rate increases by 8.1% following

the April 2016 tax increase in 3-wheeler loans. Table 4 Panel B shows that the increase in self-cure is not temporary. This table looks at how many borrowers who self-cured just after the tax increases re-default at anytime in the future. While for other types of vehicles a sizable fraction of the self-cured borrowers re-defaulted subsequently, almost no 3-wheeler borrowers who self-cured re-defaulted. This is consistent with the idea that borrowers who self-cured in response to tax increases did have the ability to pay when they defaulted before the tax increase.

4.1.2 Tax Reduction on Cars with Engine Capacity less than 1000cc

This subsection uses the import tax reduction for cars with engines less than 1000cc as the treatment. The control sample consists of small cars (valuation less than LKR 3 million) with engines greater than 1000cc.

As in the case of 3-wheelers, I first look at the impact of tax reduction on the value of used cars with engines less than 1000cc. I implement the equation 1 using *used* car loans originated before and after the tax reduction in November 2014. Estimation results are presented graphically in figure 8. This figure plots the estimated β_m for each m. We see a significant reduction of the value of used cars with engines less than 1000cc, compared to values of used cars with engines greater than 1000cc. Estimates suggest that the value of used cars with engines less than 1000cc dropped by about 10% following the tax reduction.

Next, I look at the impact of import tax decreases for cars with engines less than 1000cc on default rate. Cars with engines less than 1000cc is the *treated* sample and control sample consists of small cars with engines greater than 1000cc. The tax reduction in November 2014 is considered the *treatment*. Results of this exercise is reported in Table 5. Even though results are only marginally significant, the results suggest that default rate for cars with engines increased by 0.4% following the tax reduction. This is approximately 40% increase in the default rate compared to the default rate prior to tax reduction. Figure 9 presents the estimates of equation 5 graphically.

4.2 Loan-to-Value Restrictions

Results in this section look at changes to borrowers' default behavior in response to changes to the maximum loan-to-value ratios. In January 2017 the Central Bank of Sri Lanka reduced the maximum loan-to-value ratio for *new* cars, SUVs and vans to 50% and for 3-wheelers to 25%. For buses and trucks the loan-to-value ratio was increased to 90%. Prior to this directive all the vehicles had the same maximum loan-to-value restriction of 70%. Only new vehicles were affected by the new regulation and maximum loan-to-value ratio for used vehicles remained at 70%. This change was initially proposed in late November 2016.

In table 6, I provide evidence that changes to the loan-to-value ratios had an impact on the valuations of used vehicles. Results in this table indicate that values of *used* trucks and buses dropped by about 20% relative to the values of used 3-wheelers,cars, SUVs and vans. The sample uses auto loans originated around the rule change to purchase used vehicles. Motorbikes were excluded from this sample as NBFI does not fund purchases of used motorbikes.

Table 7 presents the results of regression specification in equation 4, which estimates the magnitude of borrowers' response to collateral value changes due to changes to the loan-to-value ratios. The unit of observation is loan-month. Column (1) includes loan level fixed effects and district-month fixed effects. Column (2) employs the full set of borrower/loan level controls and vehicle type, district-month and origination month fixed effects.

The dummy variables *Feb 2017 - Apr 2017* $\times$ *Vehicle Type* capture the difference in default rate between a given vehicle type and the excluded vehicle type after the new regulations came to effect (After January 2017) relative to the period before new requirements were announced (before Dec 2016). The dummy variables *Dec 2016 - Jan 2017* $\times$ *Vehicle Type* capture the change in default rate after the announcement but before

implementation. The excluded category is 3-wheelers. I expect the default rates of trucks, buses and motorbikes to increase relative to 3-wheelers after new regulations. As both personal vehicles (cars, SUVs and vans) and three wheelers were subject an increase in the down-payment requirement, it is not clear if the default rate of personal vehicles should increase or decrease relative to the 3-wheelers.

There is a positive and significant increase in default rates of trucks, buses and motorbikes relative to 3-wheelers after the implementation of new loan-to-value ratio requirement(i.e. after February 2017) and a negative coefficient for cars, SUVs and vans relative to 3-wheelers. Coefficients are not significant post-announcement period Dec 2016 to Jan 2017. This pattern is consistent with the idea that decreasing the maximum loan-to-value ratio for new vehicles increased the value of used vehicles, which in turn reduced the probability of default. The estimate of 0.005 for trucks and buses indicates that default rates increased by 0.5% which is about a 10% increase in the prereform default rate. Default rate of motorbikes increased by 0.4%. For cars, SUVs and vans we see a decrease in default rate of about 0.1% compared to 3-wheelers and this difference is only marginally statistically significant. Despite the down-payment requirement for 3-wheelers increasing by 50% compared to 25% increase for personal vehicles, borrowers of both personal vehicles and 3-wheelers responded similarly. This suggests that personal vehicle borrowers are more sensitive to changes in the values compared to 3-wheeler borrowers.

Figure 10 shows the same result graphically and according to this figure there is reason to believe that the parallel trends assumption is satisfied.

5. Placebo Tests

A potential concern for results reported in the section above is that they are driven by different borrower types who are selecting in to different vehicle types. In difference-in-difference it does not matter if borrowers who select in to different types of vehicle have

different default behavior as long as they move in parallel before the treatment. Graphical evidence presented earlier shows that parallel trends assumption is likely to be satisfied for untreated periods. In this section, I provide further evidence of the identifying the assumption by simulating placebo reforms aimed at testing whether the results presented above were the result of preexisting trends. If the previous results are driven by preexisting trends these simulations could also generate similar effects on default.

First I simulate the tax increase in April 2015 before both the tax changes. Three wheeler loans are considered the treated sample and other types of vehicles are considered the control sample. A dummy variable *Sep 2016-Nov 2016* takes the value one if the loan month observation is after the simulated tax change. Sample consists of loan-month observations three months before and after simulated tax changes. Table 8 reports the results of this exercise and column (1) implements the equation (1) and column (2) includes control variables. Non-significant results in both columns suggest that there were no preexisting trends in default behavior providing support for my identifying assumptions.

Next, I simulate the maximum loan-to-value ratio restrictions implemented in January 2017 in August 2016. Sample was constructed using loan-month observations three months before and after August 2016. Observations after August 2016 are considered as treated observations and the estimation results of the specification (2) is given in table 9 Column (1). Column (2) includes controls with fixed effects. Statistically not significant coefficients in both columns suggest that the identification assumption is valid.

6. Robustness

6.1 Prepayment

One concern with the previous results is that liquidity-constrained borrowers may decide to prepay their auto loans, instead of defaulting, when the collateral value increases. Similarly, following a drop in collateral value some liquidity-constrained borrowers who

would have prepaid may decide to default. If this is true, then it is possible my previous results picking up this effect rather than the strategic defaults. I note that this is unlikely due to severe prepayment penalties applicable to auto loan borrowers. Borrowers are typically required to pay 75% of the future interest on top of the balance outstanding if they need to prepay. As a result, prepayments are not very common in auto loans. During my sample period, only 0.16% of the auto loans were prepaid. In any case, I run a robustness test to rule out this alternative explanation.

Similar to the previous regressions I run the equation 2 with Y_{itd} indicating prepayment by borrower i in district d in month t. I include loan fixed effects and district-month fixed effects. Results reported in table 10 suggest that prepayments did not increase significantly following the tax increases.

As an additional test I split the sample into three subsamples based on the loan origination date. First sample includes loan originated between July 2013 and December 2014. Second sample includes loans originated between June 2013 and January 2012 and third sample includes loans originated before January 2012. Most recently originated loans have the highest outstanding balance at the time of tax increase and incentives to strategically default should be strongest in this sample. Results of this exercise are reported in Table 11 and we can see the strongest effect coming from most recently originated loans. This behavior is more consistent with the strategic default hypothesis.

6.2 Equity Extraction

Another concern is that if liquidity-constrained borrowers are able to extract their equity in the form of a secondary loan following the increases in collateral value, then my results would be picking up the impact of relaxed liquidity constraints. Detailed monthly level data allows me to track the total loan balance from month to month and I do not observe any increase in loan balance after value increases and regulations do not allow borrowers to use the same asset as the collateral for a secondary loan with another lender. In

private conversations, management of the lender also confirmed that there were no equity extractions following the collateral value increases.

7. Conclusion

This paper presents new evidence that auto loan borrowers respond strategically to changes in the value of the collateral. I use several policy changes in Sri Lanka to generate exogenous variation of collateral value that is unrelated to borrowers' ability to pay. Results show that following increase in collateral value default rate fell by 10% and self-cure rate increased three fold.

I take a number of steps to mitigate the scope for alternative interpretations of my evidence. I simulate regulation changes in earlier dates to confirm that these results are not driven by preexisting trends. I also match the control sample to treatment sample to assuage concerns about selection bias.

The findings in this paper contribute to the academic debate on importance of borrowers' financial incentives on their default decision and also have direct policy implications. This finding is particularly relevant for ex-ante policies aimed at reducing future default rates. Economically significant impact of the collateral value can be used to justify some of the credit market regulations such as maximum loan-to-value ratios or mortgage insurance.

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Figure 1: Value of Brand New and Used 3-wheelers

This figure shows the value of a brand new 3-wheeler and value of used 3-wheelers in each month. Red solid line represents the mean price of a brand new 3-wheeler purchased in each month. Black dashed lines represent the mean values of used 3-wheelers manufactured in years 2012, 2013 and 2014 in each month. Mean values of used 3-wheelers are calculated using the valuations used for loans to purchase 3-wheelers in each month.

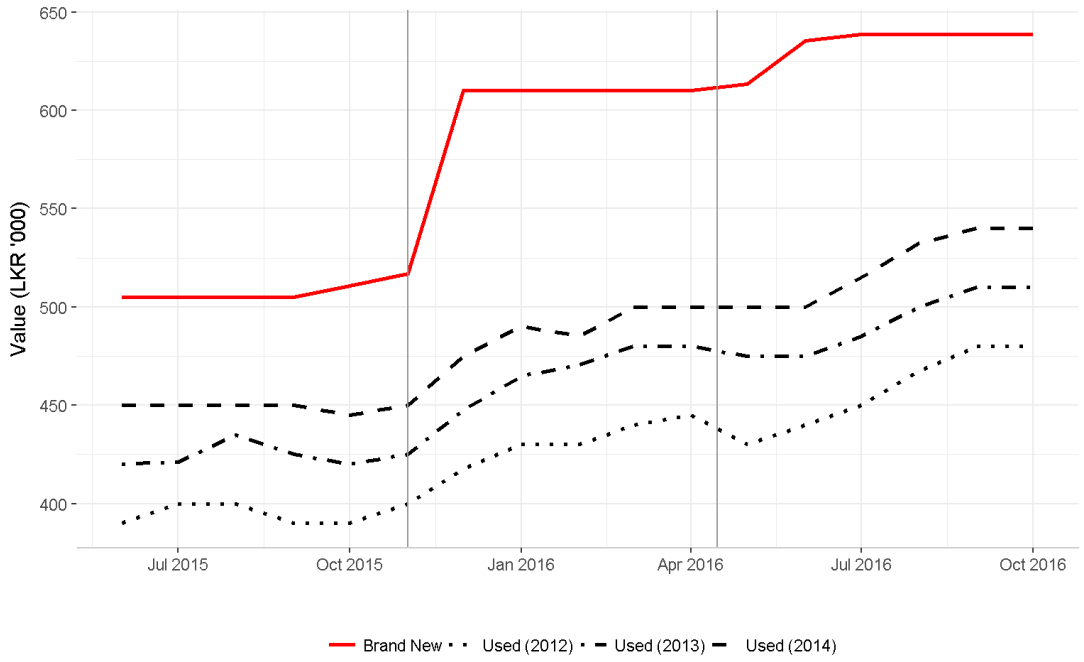


Figure 2: Number of 3-wheelers Purchased

This figure plots the number of brand new (solid red line) and used (dashed black line) 3-wheeler loans originated by the lender in each month. Pronounced spikes just after tax increases are due to sale of dealer inventory already imported to the country.

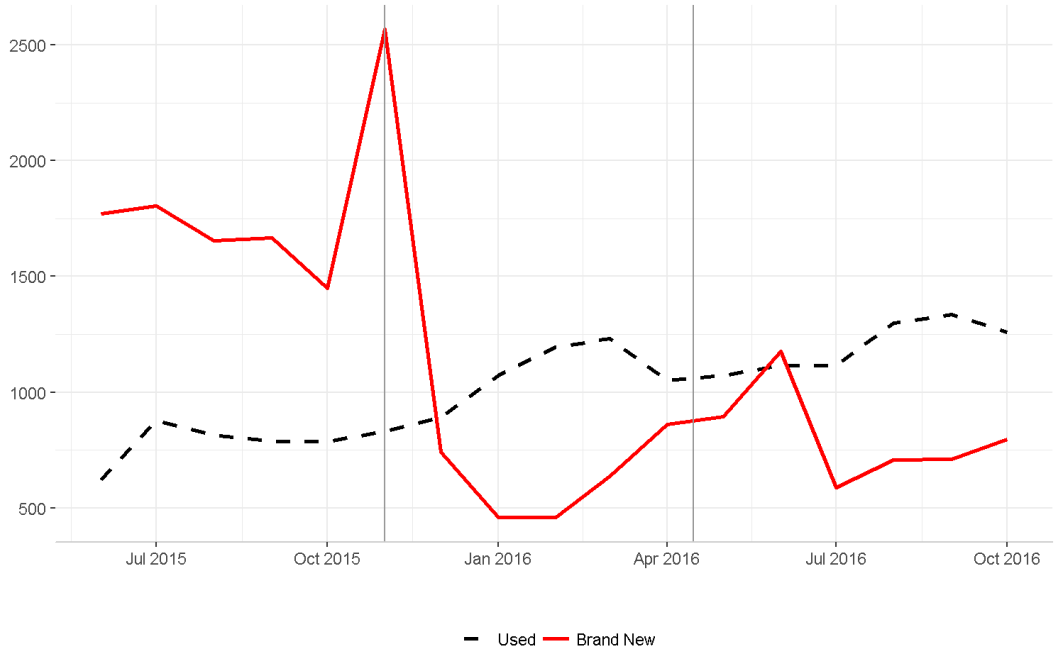


Figure 3: Loan-to-Value Ratios for New Vehicles

This figure shows the changes to loan-to-value ratios of *new* vehicles for different vehicle types. Red solid line represents the median and black dashed lines represent 1st and 3rd quartiles. Maximum loan-to-value ratio was restricted to 70% for all vehicle types beginning December 2015 and after January 2017 different vehicle types were subject to different maximum loan-to-value ratios

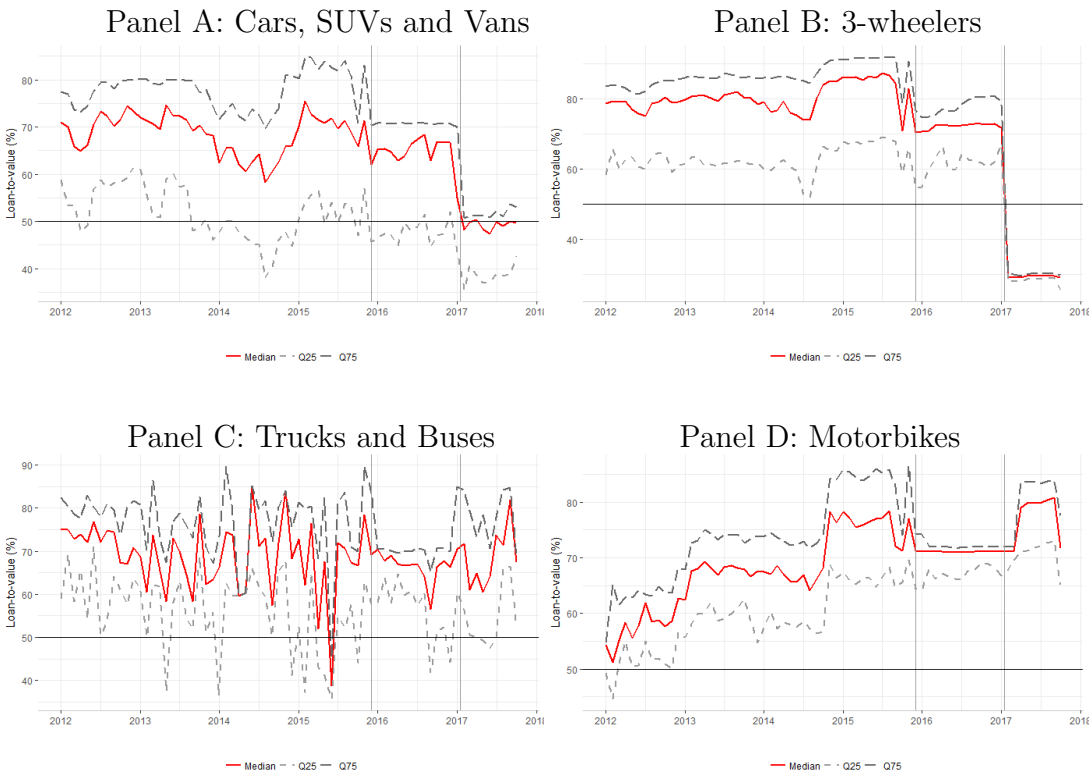
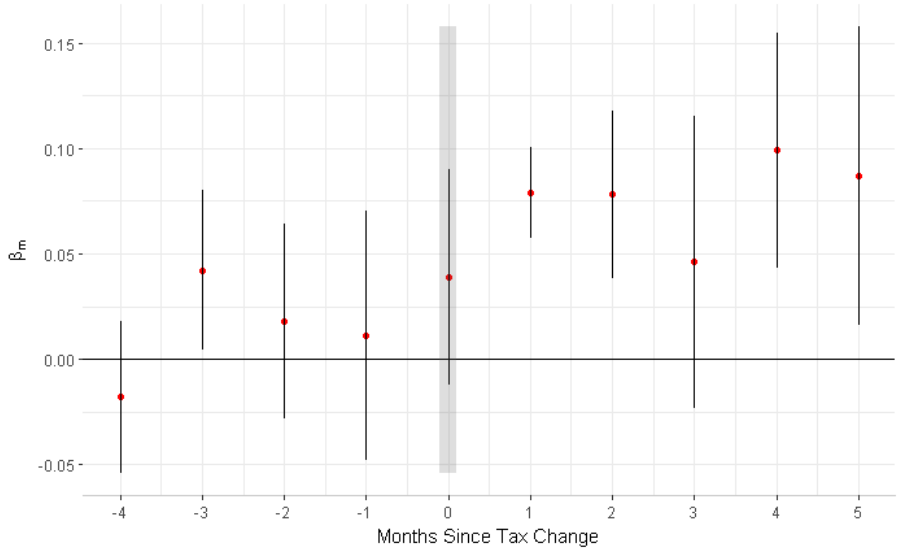


Figure 4: Effect of Tax Increases on Used 3-wheeler Value

The figure shows the difference in the valuations between 3-wheelers (treated) and other types of vehicles (control) before and after each tax increase. Y-axis represents the coefficient estimate β_m from the equation below, against months since each tax increase m. Panel A and Panle B plot the effect of November 2015 and April 2016 tax increases respectively. i,v,t and d represent borrower, vehicle type, month of loan origination and district respectively.

$$log(valuation)_{ivtd} = \alpha_v + \alpha_{td} + \sum_m \beta_m \ \textit{3-wheeler}_i \times m + \epsilon_{ivtd}$$

Panel A: Value after November 2015 Tax Increase



Panel B: Value after April 2016 Tax Increase

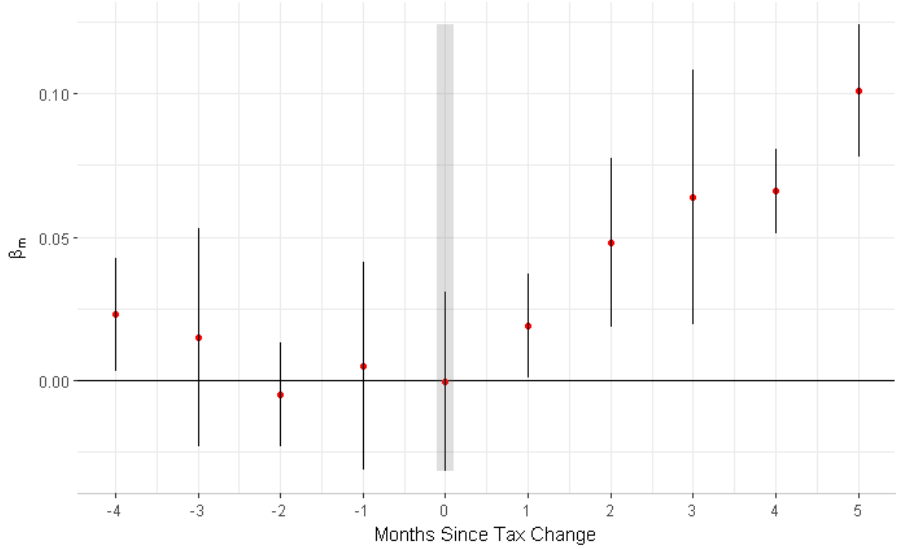
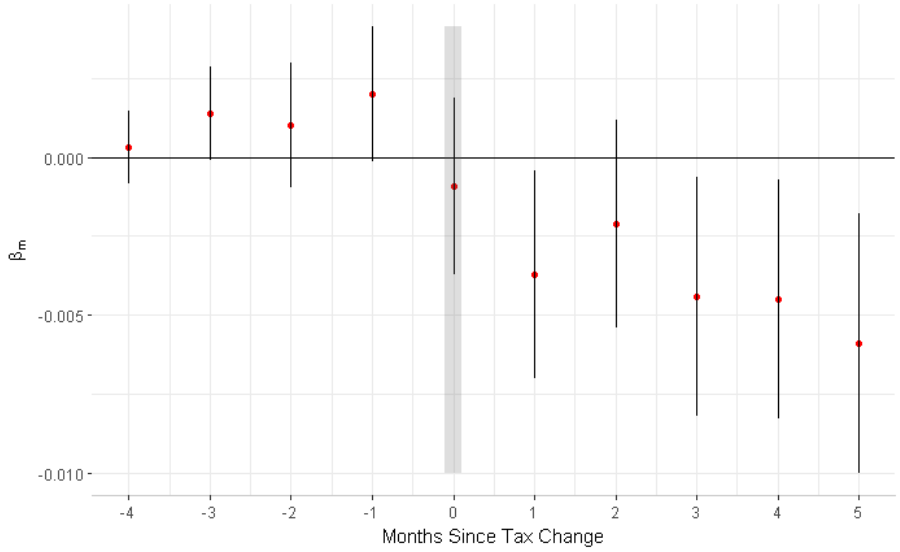


Figure 5: Effect of Tax Increases on 3-wheeler Default

The figure shows the difference in the default rates between 3-wheelers (treated) and other types of vehicles (control) before and after each tax increase. Y-axis represents the coefficient estimate β_m from the equation below, against months since each tax increase m. Panel A and Panle B plot the effect of November 2015 and April 2016 tax increases respectively. i,t and d represent borrower, month of loan origination and district respectively.

$$Default_{itd} = \alpha_i + \alpha_{td} + \sum_m \beta_m \ \textit{3-wheeler}_i \times m + \epsilon_{ivtd}$$

Panel A: Default after November 2015 Tax Increase



Panel B: Default after April 2016 Tax Increase

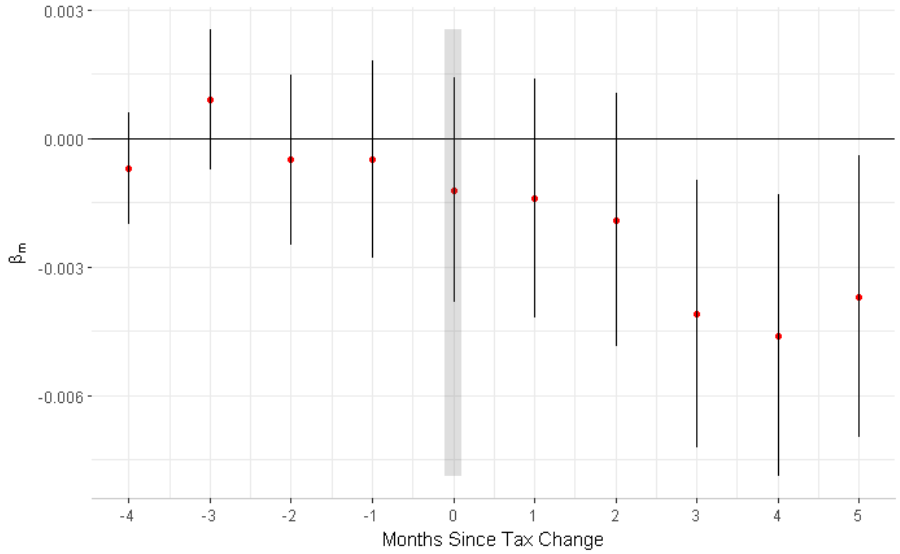


Figure 6: Monthly Self-Cure Rates

This figure plots the difference of mean self-cure rate for 3-wheelers and other vehicles in each month over the period from October 2015 and August 2016. Loan i, is defined as a self-cure in time t, if the loan is current in time t, conditional on loan being in default at time $t-1$. Samples were constructed for each month $t-1$, using the loans are in default in that month. Import taxes for 3-wheelers were increased in November 2015 and April 2016.

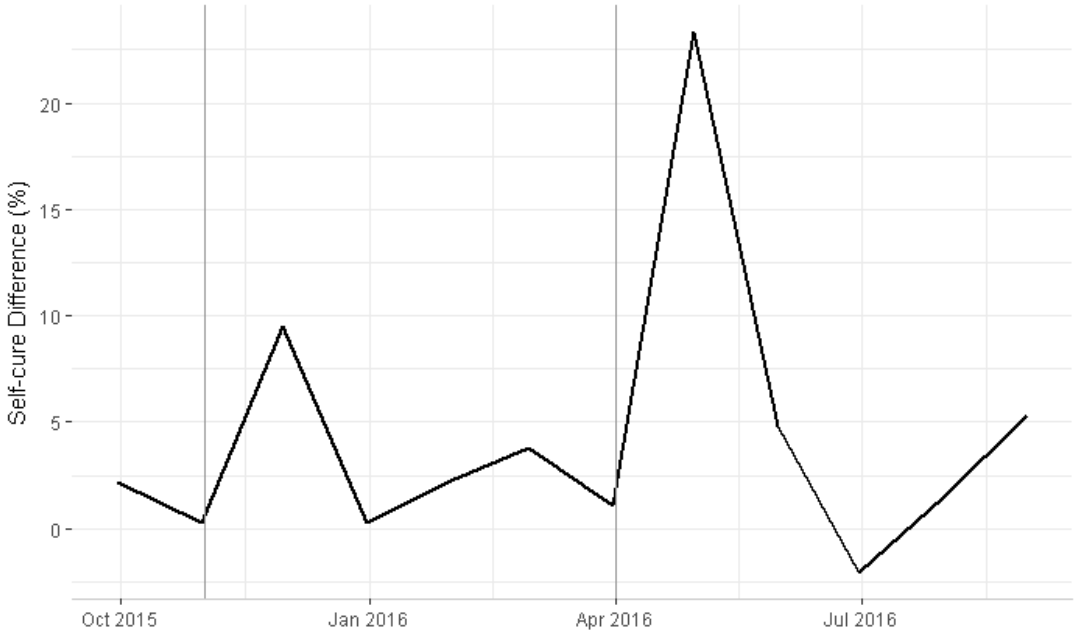


Figure 7: Value of Brand New Cars

This figure plots the values of brand new cars with engines less than 1000cc (solid red line) and engines greater than 1000cc(dashed black line).

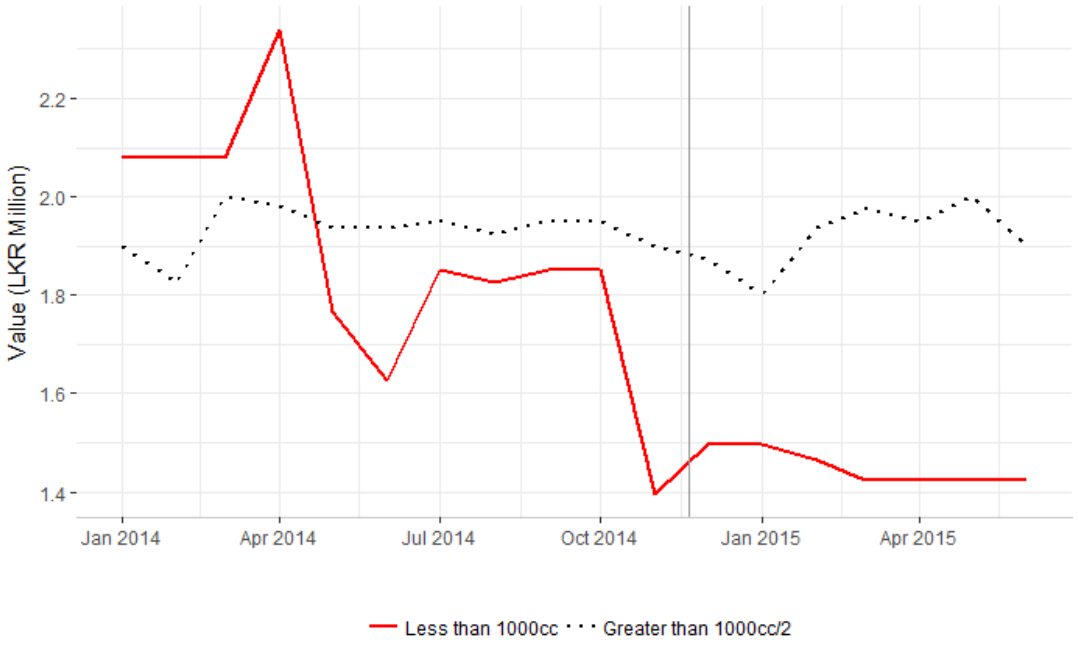


Figure 8: Effect of Tax Decrease on Value of Used Cars with Engine <1000cc

The figure shows the difference in the valuations between cars with engine <1000cc (treated) and cars with engine >1000cc (control) before and after each tax decrease. Y-axis represents the coefficient estimate β_m from the equation below, against months since each tax increase m. Panel A and Panle B plot the effect of November 2015 and April 2016 tax increases respectively. i,v,t and d represent borrower, model of the car, month of loan origination and district respectively.

$$log(valuation)_{ivtd} = \alpha_v + \alpha_{td} + \sum_m \beta_m \ Less\ than\ 1000cc_i \times m + \epsilon_{ivtd}$$

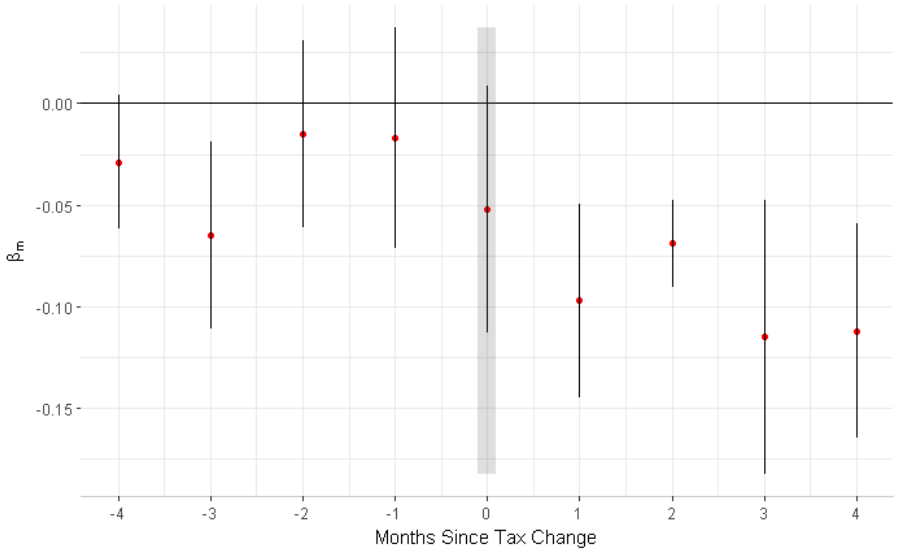


Figure 9: Effect of Tax Decrease on Default Rate of Cars with Engines <1000cc

The figure shows the difference in the default rates between cars with engine <1000cc (treated) and cars with engine >1000cc (control) before and after each tax decrease. Y-axis represents the coefficient estimate β_m from the equation below, against months since each tax increase m. Panel A and Panle B plot the effect of November 2015 and April 2016 tax increases respectively. i,t and d represent borrower, month of loan origination and district respectively.

$$Default_{itd} = \alpha_i + \alpha_{td} + \sum_m \beta_m \ Less\ than\ 1000cc_i \times m + \epsilon_{ivtd}$$

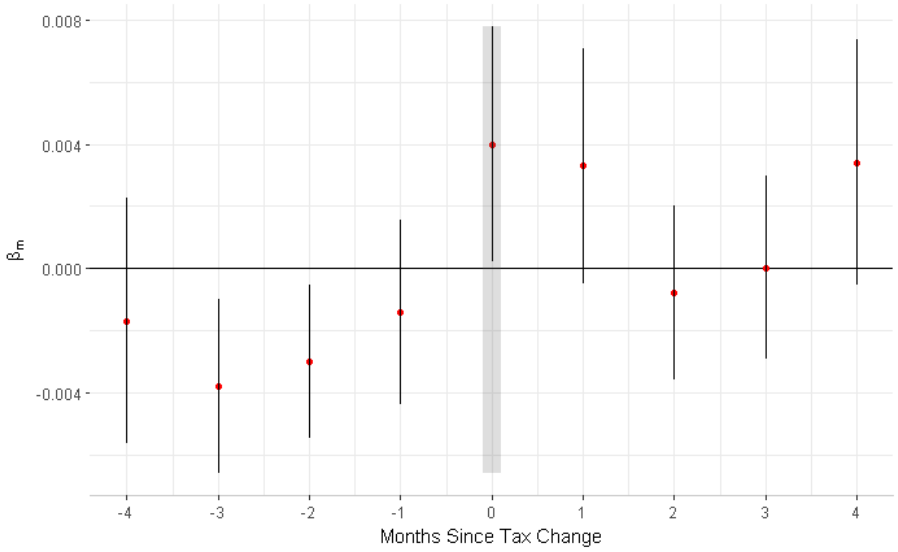


Figure 10: Effect of Down-Payment Changes on Monthly Default Rates

This figure plots the mean default rate for each vehicle type in each month over the period from August 2016 and April 2017. Down-payment changes were proposed in late November 2016 and implemented in mid January 2017. Down-payment requirement for cars, SUVs and vans were increased to 50% and for 3-wheelers to 75%. For buses and trucks the down-payment requirement was decreased to 10%.

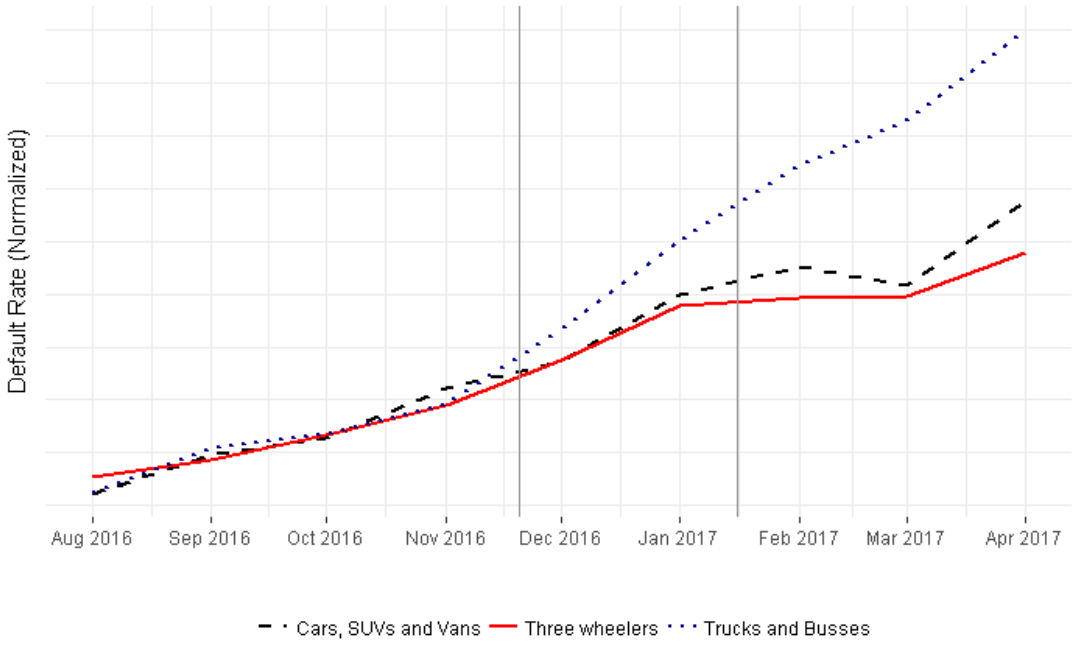


Table 1: Summary Statistics

This table shows sample means and standard deviations of key variables in different samples. First two columns provide summary statistics separately for treatment and control samples used in the first set of tests that use unanticipated tax increases for 3-wheelers as natural experiments. Third and forth columns provide summary statistics for cars with engines less than 1000cc and more than 1000cc respectively. Last four columns provide summary statistics for different vehicle types used in the second set of results which uses loan-to-value restriction changes as a natural experiment. Standard deviations are given in parenthesis.

	Tax Change Samples				Loan-to-value Restriction Sample			
	Three Wheelers *(Treatment)*	Other Vehicles *(Control)*	Cars with <1000cc engines *(Treatment)*	Cars with >1000cc engines *(Control)*	Cars, SUVs and Vans	Trucks and Buses	Motorbikes	Three Wheelers
N	29,224	9,025	1,451	880	17,673	3,098	5,491	37,254
Loan Year	2013.53	2013.44	2014.44	2014.19	2015.12	2015.17	2015.42	2015.06
	(0.77)	(0.86)	(0.88)	(0.84)	(0.69)	(0.73)	(0.66)	(0.67)
Loan Amount (LKR)	382,403	750,191	934,179	1,063,925	1,474,508	1,239,012	244,741	432,351
	(127,737)	(493,155)	(388,069)	(510,546)	(1,430,583)	(1,200,029)	(62,602)	(152,641)
Valuation (LKR)	419,294	1,030,202	1,300,993	1,646,840	2,290,953	1,950,972	248,730	473,238
	(95,637)	(666,554)	(495,619)	(552,988)	(2,077,911)	(1,555,818)	(62,623)	(116,372)
Loan-to-value (%)	75.38	74.06	64.99	60.66	63.68	61.45	71.47	73.72
	(20.74)	(51.51)	(30.46)	(26.89)	(54.44)	(39.08)	(12.95)	(20.17)
Interest Rate (%)	26.74	23.19	15.55	17.39	15.58	17.46	30.43	23.48
	(5.78)	(6.45)	(3.58)	(3.91)	(2.41)	(3.03)	(3.68)	(5.83)
Loan Term (months)	42.94	44.98	53.30	50.66	50.87	43.59	31.64	44.51
	(9.93)	(10.66)	(9.09)	(9.43)	(10.41)	(9.91)	(6.77)	(11.69)
Brand New	0.62	0.53	0.44	0.07	0.22	0.04	1.00	0.69
	(0.48)	(0.50)	(0.50)	(0.25)	(0.41)	(0.20)	(0.05)	(0.46)
Male	0.80	0.78	0.72	0.73	0.76	0.81	0.79	0.80
	(0.40)	(0.41)	(0.45)	(0.44)	(0.43)	(0.39)	(0.41)	(0.40)
Married	0.65	0.67	0.74	0.76	0.75	0.73	0.58	0.72
	(0.48)	(0.47)	(0.44)	(0.43)	(0.43)	(0.44)	(0.49)	(0.45)
Borrower Age	35.97	36.57	37.17	38.95	39.23	40.27	32.00	36.51
	(10.79)	(11.02)	(11.04)	(11.15)	(11.27)	(11.32)	(10.70)	(11.02)

Table 2: Effect of Tax Increase on 3-wheeler Default Rate

This table looks at the impact of November 2015 and April 2016 import tax increases for 3-wheelers on the default rate of 3-wheeler loans originated prior to tax increases. These tax increases increase the value of 3-wheelers already pledged as collateral. The dependent variable is a dummy variable that is equal to one if borrower i is not current in the time t and zero otherwise. The dummy variables *Dec 2015-Feb 2016* and *May 2016-Jul 2016* indicate if the loan-month observation is in the period after the respective tax increase. Dummy variable *3-wheeler* is equal to one if the vehicle type received the treatment (i.e. a 3-wheeler). All other types of vehicles are included as the control sample. Columns (1) and (3) report the estimation results of equation 2 and columns (2) and (4) include controls. Samples consist of loan-month observations three months before and after the tax increases. Standard errors are clustered at loan level and reported in parentheses below coefficient estimates. I use *,**, and *** to denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	Nov 2015 Tax Increase		Apr 2016 Tax Increase	
	(1)	(2)	(3)	(4)
Dec 2015-Feb 2016 × 3-wheeler	-0.003***	-0.004***		
	(0.001)	(0.001)		
May 2016-Jul 2016 × 3-wheeler			-0.004**	-0.005***
			(0.002)	(0.002)
Loan Age^2	-0.00002***	-0.00005***	0.000	-0.00003***
	(0.000)	(0.000)	(0.000)	(0.000)
Time to Maturity		0.0002**		0.0001
		(0.000)		(0.000)
Loan-to-value		-0.00001		0.0001*
		(0.000)		(0.000)
Interest Rate		0.002***		0.002***
		(0.000)		(0.001)
Married		0.004***		-0.0005
		(0.001)		(0.002)
Male		-0.004**		-0.009***
		(0.002)		(0.002)
Borrower Age		-0.0004***		-0.0003***
		(0.000)		(0.000)
Valuation		0.000		0.000
		0.000		0.000
Brand New		-0.012***		-0.009*
		(0.003)		(0.005)
Other Deposits		-0.003		-0.004
		(0.003)		(0.006)
Loan FE	✓	✗	✓	✗
District × Month FE	✓	✓	✓	✓
Origination Month FE	✗	✓	✗	✓
Vehicle Type FE	✗	✓	✗	✓
Observations	301,454	301,454	201,781	201,781
Adjusted R^2	0.787	0.022	0.814	0.018

Table 3: Effect of Tax Increase on 3-wheeler Default Rate - Matched Difference-in-Difference

This table looks at the impact of November 2015 and April 2016 import tax increases for 3-wheelers on the default rate of 3-wheeler loans originated prior to tax increases. These tax increases increase the value of 3-wheelers already pledged as collateral. The dependent variable is a dummy variable that is equal to one if borrower i is not current in the time t and zero otherwise. The dummy variables *Dec 2015-Feb 2016* and *May 2016-Jul 2016* indicate if the loan-month observation is in the period after the respective tax increase. Dummy variable *3-wheeler* is equal to one if the vehicle type received the treatment (i.e. a 3-wheeler). Samples were constructed by matching using borrower characteristics, district and loan origination month using propensity score matching method. Columns (1) and (3) use only motorbikes as the control sample. Columns (2) and (4) use mini-trucks as the control sample. Samples consist of loan-month observations three months before and after the tax increases. Standard errors are clustered at loan level and reported in parentheses below coefficient estimates. I use *,**, and *** to denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	Nov 2015 Tax Increase		Apr 2016 Tax Increase	
Control Sample	Motorbikes	Mini-Trucks	Motorbikes	Mini-Trucks
	(1)	(2)	(3)	(4)
Dec 2015 - Feb 2016 × 3-wheeler	-0.004***	-0.006***		
	(0.002)	(0.002)		
May 2016 - Jul 2016 × 3-wheeler			-0.008***	-0.003***
			(0.002)	(0.001)
Loan Age^2	-0.00002**	-0.00003***	-0.00004***	-0.00002***
	(0.000)	(0.000)	(0.000)	(0.000)
Loan FE	✓	✓	✓	✓
District × Month FE	✓	✓	✓	✓
Observations	98,904	102,703	100,930	95,094
Adjusted R^2	0.8	0.808	0.752	0.791

Table 4: Effect of Tax Increase on Self-Cure Rate

Panel A of this table compares the self-cure rates of 3-wheelers and other vehicles before and after November 2015 and April 2016 import tax increases for 3-wheelers. Loan i is defined as a self-cure in time t if the loan is current in time t conditional on loan being in default at time *t-1*. Last row of Panel A reports the difference-in-difference estimate for each tax increase. Panel B reports the percentage of borrowers who redefaulted anytime after tax increase conditional on self-curing in the month after tax increase.

Panel A: Self-Cure Rate

	Nov 2015 Tax Increase		April 2016 Tax Increase	
	t=Nov-15	t=Dec-15	t=Apr-16	t=May-16
3-wheelers	4.86%	36.87%	9.79%	19.84%
Other Vehicles	6.17%	25.88%	8.26%	10.17%
Difference-in-difference	12.30%		8.14%	

Panel B: Redefault Rate

	Nov 2015 Tax Increase	April 2016 Tax Increase
3-wheelers	0.27%	0.00%
Other Vehicles	16.94%	7.45%

Table 5: Effect of Tax Increase on Small Car Default Rate

This table looks at the impact of November 2014 import tax reduction on the default rate of car loans originated prior to tax reduction. Cars with engine capacity less than 1000cc were affected by the tax change and value of such cars pledged as collateral bore the tax rate decreases following the tax decrease. The dependent variable is a dummy variable that is equal to one if borrower i is not current in the time t and zero otherwise. The dummy variable *Dec 2014-Feb 2015* indicates if the loan-month observation is in the period after the tax reduction. Dummy variable *<1000cc* is equal to one if the vehicle type received the treatment (i.e. a car with engine less than 1000cc). Cars with engines greater than 1000cc are included as the control sample. Columns (1) reports the estimation results of equation 2 and columns (2) includes controls. Samples consist of loan-month observations three months before and after the tax increases. Standard errors are clustered at loan level and reported in parentheses below coefficient estimates. I use *,**, and *** to denote statistical significance at the 10%, 5%, and 1% levels, respectively..

	(1)	(2)
Dec 2014 - Feb 2015 × <1000cc	0.004*	0.006***
	(0.002)	(0.002)
Loan Age^2	0.000	-0.00001
	(0.002)	(0.000)
<1000cc		-0.009*
		(0.005)
Loan-to-value		0.007**
		(0.004)
Interest Rate		0.002*
		(0.001)
Married		0.001
		(0.004)
Male		-0.002
		(0.004)
Borrower Age		-0.0002
		(0.000)
Valuation		0.000
		0.000
Other deposits		-0.002
		(0.003)
Loan FE	✓	✗
District × Month FE	✓	✓
Origination Month FE	✗	✓
Observations	14,097	14,097
Adjusted R^2	0.792	0.093

Table 6: Effect of Maximum Loan-to-Value Ratio Changes on Used Vehicle Values

This table looks at the impact of changes to maximum loan-to-value ratio on values of used vehicles. Maximum loan-to-value ratio for new trucks and buses was increased after January 2017 and maximum loan-to-value ratio for cars, SUVs, vans and 3-wheelers was decreased. This table reports the estimation results of the equation below. i,v,t and d represent borrower, model of the vehicle, month of origination and district respectively. Standard errors are clustered at loan level and reported in parentheses below coefficient estimates. I use *,**, and *** to denote statistical significance at the 10%, 5%, and 1% levels, respectively.

$$log(valuation)_{ivtd} = \alpha_v + \alpha_{td} + \beta Jan\ 2017\text{ - }Jun\ 2017_i \times Vehicle\ Type + \epsilon_{ivtd}$$

	(1)
Jan 2017 - Jun 2017 × Cars, SUVs and Vans	-0.040
	(0.024)
Jan 2017 - Jun 2017 × Trucks and Buses	-0.200***
	(0.011)
Model FE	✓
Manufacturing Year	✓
District × Month FE	✓
Observations	21,379
Adjusted R^2	0.729

Table 7: Effect of Maximum Loan-to-Value Ratio Changes on Default

This table looks at the impact of changes to maximum loan-to-value ratio on default. Maximum loan-to-value ratio for new trucks, buses and motorbikes was increased after January 2017 and this reduces the value of those types of vehicles already pledged as collateral. Maximum loan-to-value ratio for cars, SUVs, vans and 3-wheelers was decreased and this increases the value of those vehicles already pledged as collateral. This table reports the estimation results of equation 4. The dependent variable is a dummy variable that is equal to one if borrower i is not current in the time t and zero otherwise. The dummy variables *Feb 2017-Apr2017* and *Dec 2016 - Jan 2017* indicates whether the observation is in post-implementation period or post-announcement(and pre-implementation) period respectively. Dummy variables *Trucks and Buses*,*Cars, SUVs and Vans* and *Motorbike* indicate the type of the vehicle. Samples consist of loan-month observations from September 2016 to April 2017. Loan-to-value ratio changes were announced in late November 2016 and implemented in late January 2017. Standard errors are clustered at loan level and reported in parentheses below coefficient estimates. I use *,**, and *** to denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)
Feb 2017 - Apr 2017 × Trucks and Buses	0.005**	0.005***
	(0.002)	(0.002)
Feb 2017 - Apr 2017 × Motorbike	0.004**	0.003**
	(0.002)	(0.002)
Feb 2017 - Apr 2017 × Cars, SUVs and Vans	-0.001	-0.001*
	(0.001)	(0.001)
Dec 2016 - Jan 2017 × Trucks and Buses	0.0004	0.001
	(0.001)	(0.001)
Dec 2016 - Jan 2017 × Motorbike	0.001	0.0005
	(0.001)	(0.001)
Dec 2016 - Jan 2017 × Cars, SUVs and Vans	0.000	0.000
	(0.001)	(0.000)
Loan Age^2	0.000	0.000
	(0.000)	(0.000)
Loan-to-Value		0.003***
		(0.001)
Interest Rate		0.001***
		(0.000)
Married		0.00002
		(0.001)
Male		-0.001
		(0.001)
Borrower Age		-0.0002***
		(0.000)
Valuation		-0.000***
		0.000
Brand New		-0.001
		(0.001)
Loan FE	✓	✗
Month × District FE	✓	✓
Vehicle Type FE	✗	✓
Origination Month FE	✗	✓
Observations	394,767	394,767
Adjusted R^2	0.729	0.009

Table 8: Placebo Test: Effect of Tax Increase on 3-wheeler Default Rate

This table simulates the 3-wheeler tax increases in April 2015 and estimates equation 2. The dependent variable is a dummy variable that is equal to one if borrower i is not current in the time t and zero otherwise. The dummy variable *May 2015-Jul 2015* takes value one if the loan-month observation is in this period. Dummy variables *3-wheeler* indicates if the collateral is a 3-wheeler. Samples consist of loan-month observations from February 2015 to July 2015. Standard errors are clustered at loan level and reported in parentheses below coefficient estimates. I use *,**, and *** to denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)
May 2015 - Jul 2015 × 3-wheeler	0.001	0.001
	(0.001)	(0.001)
Loan Age^2	-0.0001***	-0.0001***
	(0.000)	(0.000)
Time to Maturity		0.0001**
		(0.000)
Loan-to-Value		0.0004***
		(0.000)
Interest Rate		0.002***
		(0.000)
Married		0.012***
		(0.001)
Male		-0.004**
		(0.002)
Borrower Age		-0.0004***
		(0.000)
Valuation		0.000
		0.000
Brand New		-0.014***
		(0.003)
Other Deposits		-0.001
		(0.001)
Loan FE	✓	✗
Month × District FE	✓	✓
Vehicle Type FE	✗	✓
Origination Month FE	✗	✓
Observations	298,910	298,910
Adjusted R^2	0.802	0.028

Table 9: Placebo Test: Effect of Maximum Loan-to-Value Ratio Changes on Default

This table simulates the maximum loan-to-value ratio changes in August 2016 and reports the estimation results of equation 4. The dependent variable is a dummy variable that is equal to one if borrower i is not current in the time t and zero otherwise. The dummy variables *Sep 2016-Nov 2016* indicates whether the observation is after the simulated maximum loan-to-value changes in August 2016. Dummy variables *Trucks and Buses*, *Cars, SUVs and Vans* and *Motorbike* indicate the type of the vehicle. Samples consist of loan-month observations from May 2016 to November 2016. Standard errors are clustered at loan level and reported in parentheses below coefficient estimates. I use *,**, and *** to denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)
Sep 2016 - Nov 2016 × Trucks and Buses	0.002	0.001
	(0.001)	(0.001)
Sep 2016 - Nov 2016 × Motorbike	0.000	0.0005
	(0.001)	(0.001)
Sep 2016 - Nov 2016 × Cars, SUVs and Vans	0.000	0.000
	(0.001)	(0.001)
Loan Age^2	-0.00001***	-0.00001*
	(0.000)	(0.000)
Loan-to-Value		-0.00000**
		0.000
Interest Rate		0.001***
		(0.000)
Married		-0.001
		(0.001)
Male		-0.001*
		(0.001)
Borrower Age		-0.0001***
		(0.000)
Valuation		-0.000***
		0.000
Brand New		0.000
		(0.001)
Loan FE	✓	✗
Month × District FE	✓	✓
Vehicle Type FE	✗	✓
Origination Month FE	✗	✓
Observations	317,356	317,356
Adjusted R^2	0.677	0.008

Table 10: Effect of Tax Increase on 3-wheeler Prepayment Rate

This table looks at the impact of November 2015 and April 2016 import tax increases for 3-wheelers on the prepayment rate of 3-wheeler loans originated prior to tax increases. These tax increases increase the value of 3-wheelers already pledged as collateral. The dependent variable is a dummy variable that is equal to one if borrower i prepaid the loan in the time t and zero otherwise. The dummy variables *Dec 2015-Feb 2016* and *May 2016-Jul 2016* indicate if the loan-month observation is in the period after the respective tax increase. Dummy variable *3-wheeler* is equal to one if the vehicle type received the treatment (i.e. a 3-wheeler). All other types of vehicles are included as the control sample. Samples consist of loan-month observations three months before and after the tax increases. Standard errors are clustered at loan level and reported in parentheses below coefficient estimates. I use *,**, and *** to denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	November 2015 Tax Increase	April 2016 Tax Increase
	(1)	(2)
Dec 2015-Feb 2016 × 3-wheeler	0.0004	
	(0.000)	
May 2016-Jul 2016 × 3-wheeler		0.0001
		(0.000)
Loan Age^2	0.000	0.000
	(0.000)	(0.000)
Loan FE	✓	✓
District × Month FE	✓	✓
Observations	272,579	198,833
Adjusted R^2	0.647	0.953

Table 11: Effect of Tax Increase on 3-wheeler Default Rate by Origination Year

This table looks at the impact of November 2015 and April 2016 import tax increases for 3-wheelers on the default rate of 3-wheeler loans originated prior to tax increases. I divide my sample in to two subgroups based on the whether the loans were originated between July 2013 and December 2014, between January 2012 and June 2013 or before January 2012. The dependent variable is a dummy variable that is equal to one if borrower i prepaid the loan in the time t and zero otherwise. The dummy variables *Dec 2015-Feb 2016* and *May 2016-Jul 2016* indicate if the loan-month observation is in the period after the respective tax increase. Dummy variable *3-wheeler* is equal to one if the vehicle type received the treatment (i.e. a 3-wheeler). All other types of vehicles are included as the control sample. Samples consist of loan-month observations three months before and after the tax increases. Standard errors are clustered at loan level and reported in parentheses below coefficient estimates. I use *,**, and *** to denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	November 2015 Tax Increase			April 2016 Tax Increase		
	Jul 13-Dec 14	Jan 12-Jun 13	<Jan 12	Jul 13-Dec 14	Jan 12-Jun 13	<Jan 12
	(1)	(2)	(3)	(4)	(5)	(6)
Dec 2015-Feb 2016 × 3-wheeler	-0.014***	-0.01	0.001			
	(0.004)	(0.006)	(0.001)			
May 2016-Jul 2016 × 3-wheeler				-0.009**	-0.004	-0.003
				(0.004)	(0.004)	(0.003)
Loan Age^2	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Loan FE	✓	✓	✓	✓	✓	✓
District × Month FE	✓	✓	✓	✓	✓	✓
Observations	51,610	29,452	220,390	70,185	43,935	86,742
Adjusted R^2	0.767	0.804	0.736	0.815	0.816	0.770