The Imitation Game: How Encouraging Renegotiation Makes Good Borrowers Bad*

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Abstract

We show that commercial mortgage borrowers behave opportunistically in order to obtain principal reductions. To guide our empirical analysis, we develop a model in which lenders cannot perfectly observe borrowers' use values and renegotiation is costly. We then study the effects of a 2009 IRS rule change that reduces expected renegotiation costs. Borrowers with high private use values of the property are more likely to default following this regulation, particularly when expected servicer renegotiation capacity is high. Our results suggest substantial asymmetric information between borrowers and lenders, as well as adverse consequences of principal forgiveness.

Keywords: principal forgiveness, CMBS, asymmetric information, loan renegotiation.

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1 Introduction

The infrequency of principal modification in residential mortgages after sharp declines in real estate prices is puzzling.[1] While such modifications are preferable to a foreclosure for a particular loan, they may increase the risk of borrowers on other loans strategically defaulting in an attempt to extract similar modifications. For borrowers to be able to opportunistically default to the disadvantage of lenders, there must be substantial asymmetric information between borrowers and lenders such that financially healthy borrowers can imitate unhealthy ones–lenders must not be able to observe borrowers' true willingness and ability to pay.

In this paper, we provide evidence of substantial asymmetric information between borrowers and lenders even in commercial real estate (CRE) loans. In contrast to residential loans, where a borrower's ability to pay is difficult for the servicer to observe and to define conceptually, the cash flows on a commercial property are generally observable to both the servicer and the econometrician. We document this asymmetric information by focusing on the impact of principal writedowns on borrower behavior in commercial mortgage-backed securities (CMBS). Principal writedowns (also known as discounted payoffs, or DPOs hereafter) are a type of loan modification in which the special servicer accepts repayment of an amount less than the current unpaid principal balance on the loan. We ask whether a DPO induces other borrowers to behave opportunistically in anticipation of receiving the same type of principal writedown.[2]

[1] Adelino, Gerardi, and Willen (2013) find that the vast majority of seriously delinquent residential mortgages received no concessionary modification whatsoever with principal reduction being exceptionally rare. Ghent (2011) finds that principal reduction was similarly rare during the Great Depression.

[2] Anecdotal evidence suggest the CMBS industry is aware of strategic behavior on the part of CMBS borrowers. For example, consider the following excerpt from the prospectus for the deal BANK 2018-BNK15 in which the issuer discloses to investors the behavior of sponsors of certain loans in the pool:

> With respect to the Harvard Park Mortgage Loan (3.1%), three properties owned by the related sponsors have been subject to discounted payoffs since 2011. In November 2011, Basin Street Properties, which is owned by the related sponsors, placed its Petaluma Garage Retail property into a strategic default, and negotiated a discounted payoff of $4,500,000 on the $7,275,000 loan. In September 2014, Basin Street Properties negotiated a discounted payoff of $1,500,000 on a $6,160,000 mezzanine loan and repurchased at auction a $16,000,000 loan secured by its park Center Tower property. In June 2015, Basin Street Properties negotiated a discounted payoff of $15,000,000 on the $23,274,042 outstanding loan on its Cal Center property.

We begin by presenting a principal-agent model of negotiation between a borrower and a lender/special servicer that captures the key institutional features of the CMBS market, including regulation. Borrowers vary in their private use value of the property, and lenders cannot observe whether that value is high or low. High private use value types ("high types" hereafter) are willing to pay the full amount of their existing loan balance, whereas low private use value types ("low types" hereafter) would rather default than pay the full amount. Borrowers can request a transfer into special servicing and try to negotiate a DPO, a decision that depends on their expected payoff. The special servicer can choose to either grant the DPO request or instead initiate a foreclosure. Because the borrower does not know with certainty which strategy the servicer will choose, the expected payoff of bargaining is increasing in the likelihood that the servicer is willing to do a DPO. Additionally, the expected payoff is decreasing in the reputational and legal costs of requesting a transfer. These costs exist because a loan cannot arbitrarily be transferred into special servicing. Rather, IRS tax laws stipulate that loans can only be renegotiated when doing so will resolve current, or imminent, financial distress and default.

We assume high types incur a greater cost of transfer into special servicing than low types, because borrowers must demonstrate or convince the lender they are close to financial distress. For high types to do this, they may have to incur costs such as hiding or manipulating financial information to make it appear as though they are distressed. In addition, they may deliberately miss debt service payments, thus incurring reputational and monetary costs associated with financial distress, such as a higher cost of future credit and legal expenses. Therefore, while it is optimal for low types to default on their loans, defaults for high types result in costs that are otherwise avoidable.

The key empirical implication of the model is that high type borrowers are more likely to request a transfer and DPO if the expected cost of doing so decreases, conditional on the level of expected capacity of servicers to negotiate DPOs. In the second part of the paper we

According to the prospectus, the borrower Basin Street Properties placed a loan into "strategic default" and was able to negotiate a substantial DPO.

take this prediction to the data. We use a 2009 IRS tax rule change as a source of exogenous variation in the cost of requesting a transfer. This rule change allows CMBS loans to be transferred into special servicing and subsequently modified without ever becoming distressed or close to default. Therefore, it reduces the cost to high type borrowers of bargaining for a DPO.[3]

In our primary empirical analysis, we show that a loan is more likely to be transferred into special servicing following this rule change. Additionally, in the post-rule change time period, a loan is incrementally more likely to be transferred when the special servicer has recently negotiated a DPO on a *different* loan. The latter result is consistent with higher expected servicer capacity increasing the benefit to requesting a transfer when the cost of doing so is low.

We further show that loans that are transferred following the rule change are more likely to experience a full payoff of the loan balance, and this effect is also increasing in the measure of special servicer capacity. In addition, loans transferred following a DPO on a different loan in the post-rule change period are likely to never become 60+ days delinquent. Taken together, these results are consistent with high types (those willing to pay their entire loan balance) being more likely to transfer, given that full payoff and/or lack of serious delinquency ex-post should be positively correlated with ex-ante borrower quality.

Overall, our results show that a reduction in the cost of renegotiation incentivizes borrowers to opportunistically seek transfers, especially when they perceive servicers to be willing to bargain. These results are important as, to our knowledge, they are the first evidence of the impact of principal writedowns on commercial real estate borrower behavior, indicating that information asymmetries between borrowers and lenders that impede otherwise efficient debt renegotation are likely important for residential mortgages and other debt markets as well.

Our paper relates to literature on the potential for strategic responses to loan modifica-

[3]Transfers and modifications prior to default were still allowed prior to the rule change, but in practice loans were only transferred 1-3 months prior to default.

tions. Both Mayer, Morrison, Piskorski, and Gupta (2014) and Agarwal, Amromin, Ben-David, Chomsisengphet, Piskorski, and Seru (2017) empirically examine whether strategic default occurs in residential mortgages in response to modifications. The former finds that non-distressed borrowers are more likely to default when principal reductions are offered to distressed borrowers. In contrast, the latter finds no evidence that principal reductions induce strategic defaults. A broader literature on residential mortgage defaults attempts to disentangle liquidity-motivated defaults from those motivated by "strategic" reasons.[4] An earlier theoretical literature (see Riddiough and Wyatt, 1994; Wang, Young, and Zhou, 2002) raised the possibility of asymmetric information as a barrier to mortgage renegotiation but did not provide empirical evidence. Our model differs from these models as we posit that the asymmetric information is about the borrower's use value rather than default costs.

In contemporaneous work, Dinc and Yönder (2022) provide evidence of strategic default by commercial mortgage borrowers that complements ours. They show that many defaulting commercial mortgage borrowers continue to make payments on other obligations, indicating that they are not financially distressed in the sense that they lack the cash flow needed to make payments. Rather than looking at current cash flows, our evidence of strategic default is based on the fact that some borrowers with a high present value of retaining control of an asset imitate those with a low value in an attempt to obtain a modification. In another contemporaneous paper, Glancy, Kurtzman, and Loewenstein (2022) build on the insight of Black, Krainer, and Nichols (2020) to study the differences in modification propensity between bank and CMBS loans and how these differences affect ex-ante loan terms and the sorting of borrowers between lender types. Related to our work, they show that bank borrowers strategically default more often than CMBS borrowers, and that easing modification frictions reduces overall welfare for CMBS borrowers. Unlike their paper, we focus within the CMBS market on different borrower types, and our interest is in the impact

[4]See, for example, Foote, Gerardi, and Willen (2008), Elul, Souleles, Chomsisengphet, Glennon, and Hunt (2010), Adelino, Gerardi, and Willen (2013), Guiso, Sapienza, and Zingales (2013), Maturana (2017), Ganong and Noel (2020), Cespedes, Parra, and Sialm (2021), and Low (2021).

that asymmetric information has on borrower behavior when renegotiation costs are low.

Finally, our paper is related to the corporate finance literature that examines corporate and sovereign debt renegotiation, including Hackbarth, Hennessy, and Leland (2007), Bolton and Jeanne (2007), Davydenko and Strebulaev (2007), Valta (2016), Antill and Grenadier (2019), and Campello, Ladvika, and Matta (2019). Our model is stylized to capture the specific regulatory and institutional framework of the CMBS market such that we can use it to guide our empirical analysis.

In the context of this existing literature, our paper is important because we show that asymmetric information plays an important role in debt restructuring. Our finding that high-value borrowers are able to imitate bad borrowers is important because this has the potential to constrain lenders' ability to modify distressed loans efficiently. Although we study the CRE market specifically, our results speak to the potential impact of principal forgiveness in residential mortgages as well. Given that residential mortgage servicers have significantly less ability to assess borrowers' ability to pay, the fact that we see evidence of imitation in CRE suggests it is likely that such behavior would be present in residential real estate as well.

Additionally, our results speak broadly to the unintended consequences of regulation designed to encourage loan renegotiation. This is particularly important in light of recent real estate market turmoil and the response of regulators. In April 2020, in response to anticipated distress due to the COVID-19 pandemic, the IRS issued a rule that further expands the scope for CRE loan forbearance and modifications prior to default.[5] This rule directly parallels the rule we exploit in our empirical analysis. Although these types of policies, which are designed to encourage proactive renegotiation, may allow efficient pre-default resolution of certain loans, they may also encourage borrowers who otherwise would perform to use the additional renegogiation flexibility to extract concessions from servicers.

The remainder of the paper proceeds as follows. Section 2 discusses the institutional

[5]See `https://www.irs.gov/irb/2020-26_IRB` for more information on IRS Revenue Procedure 2020-26.

details, Section 3 presents a model of DPO negotiation, Section 4 describes the data and methodology, Section 5 presents the results, and Section 6 concludes.

2 Institutional Overview

When securitized commercial mortgages become distressed, they are transferred to a special servicer. The special servicer is responsible for working the loan out and/or initiating foreclosure. The servicer has many workout options available, including modifications such as term or interest rate changes, or DPOs. Although the borrower and special servicer can engage in discussions about modifications prior to a transfer or default (see Internal Revenue Service (2009) Section 3.11), the actual workout process can only begin after the loan has been transferred by the master servicer into special servicing. Once transferred, the borrower can engage directly with the special servicer and begin modifications or other renegotiations. Thus, the transfer event is the most significant event with respect to renegotiating the terms of the loan.

Transfers and subsequent loan renegotiation can have important consequences for the securitization vehicle used to pool mortgage loans and sell MBS bonds to investors. Real estate mortgage investment conduits (REMICs) are used in both residential and commercial MBS to pool loans and sell bonds to investors. REMICs themselves are exempt from federal taxes, and only the income earned by investors in the MBS is subject to federal tax. The tax-exempt status of the REMIC rests in part on whether it adheres to rules governing the types of mortgages it can hold. So long as the REMIC holds "qualifying mortgages" it remains tax-exempt, but it may lose this status if a non-trivial portion of the mortgage pool loses qualifying status. One reason a loan my lose its qualifying status is if it is modified, because significant modifications may be treated as an exchange of the original loan for a new (modified) loan. Because REMICs are prohibited from purchasing new mortgages or exchanging mortgages currently in the pool for others, a modification that constitutes an

exchange or new purchase would threaten the REMIC tax exemption.

2.1 The IRS rule change

The barriers to loan modification that the REMIC tax rules created became a significant issue in 2007 as financial crisis-related mortgage distress increased. In response and in order to allow for more efficient distressed loan resolution, the IRS, beginning in December 2007, issued a series of Revenue Procedures that provided safe harbor provisions for *residential* MBS REMICS. These procedures stated that significant loan modifications would not trigger an IRS challenge of the tax-exempt status of REMICS, provided the loans met certain criteria.[6]

For securitized commercial real estate loans, these barriers were removed in September of 2009. Prior to September 2009, modifications did not nullify a loan's qualifying status, and hence did not threaten the REMIC tax status, so long as the modification was made either (1) after the loan had actually defaulted or (2) when default was "reasonably foreseeable." The "reasonably foreseeable" criterion was usually interpreted narrowly such that only defaults expected within, e.g., 2-3 months qualified.[7] Thus, prior to the rule change, a loan could only be transferred to special servicing and subsequently modified if it had experienced a default event or if a default was imminent. Note that although transfer to special servicing itself would not threaten the tax status of the REMIC, transfer is a necessary condition for loan modification. Hence, transfers were in effect limited to cases in which the subsequent modifications would have been acceptable under the REMIC tax rules.

The definition of a default depends on the loan documents and the CMBS deal's Pooling and Servicing Agreement (PSA), but a standard definition is 60+ days delinquent, which means the loan has missed more than two monthly payments. Therefore, prior to the rule

[6]These Revenue Procedures include Rev. Proc. 2007-72, Rev. Proc. 2008-28, and Rev. Proc. 2008-47. See Beeman (2009) for a discussion.

[7]See, e.g., `https://www.seyfarth.com/news-insights/irs-announces-new-remic-rules.html` or `https://www.ballardspahr.com/alertspublications/legalalerts/2009-10-16_newirsguidanceoncommercial` for legal industry commentary on the reasonably foreseeable standard.

change a transfer and modification could take place after the loan became 60+ days delinquent, or if there was a reasonably foreseeable likelihood of it doing so within a few months.

In September 2009, in response to increasing levels of distress in the CMBS market, the IRS issued Revenue Procedure 2009-45 (Internal Revenue Service, 2009). Among other things, this rule significantly relaxed the criterion that required either an actual or reasonably foreseeable default in order for a loan to be modified without negative tax consequences. Section 5 of the Procedure states that "This revenue procedure applies to a modification...if...:"

> Based on all the facts and circumstances, the holder or servicer reasonably believes that there is a significant risk of default of the pre-modification loan upon maturity of the loan or at an earlier date. This reasonable belief must be based on a diligent contemporaneous determination of that risk, which may take into account credible written factual representations made by the issuer of the loan if the holder or servicer neither knows nor has reason to know that such representations are false. In a determination of the significance of the risk of a default, one relevant factor is how far in the future the possible default may be. There is no maximum period, however, after which default is per se not foreseeable. For example, in appropriate circumstances, a holder or servicer may reasonably believe that there is a significant risk of default even though the foreseen default is more than one year in the future. Similarly, although past performance is another relevant factor for assessing default risk, in appropriate circumstances, a holder or servicer may reasonably believe that there is a significant risk of default even if the loan is performing.

In particular the procedure allows a transfer and modification so long as the servicer believes there is risk of default at some point in the future, but it does not specify a definite time frame. Additionally, the procedure provides for the determination of default based on borrower representations.

The motivation for the rule change was primarily to allow term extensions without trig-

gering a change in tax status during the unusual credit market prevailing during the 2008-2009 financial crisis; see, for example, Globe Street (2009) and NYSBA (2008). Because most CMBS loans feature balloon payments, the borrower is usually forced to refinance the property at the end of the loan term. Absent any major change in the property's ability to generate cash flows, refinancing a CMBS loan is usually routine, but the extraordinary conditions during the financial crisis made refinancing difficult. On the other hand, if the property's cash flows had changed significantly such that delinquency was imminent, the existing REMIC rules already permitted modification.

Given the longer history of the modern residential MBS market, the REMIC rules in place prior to 2009 were designed with residential mortgages in mind, and did not necessarily foresee the need for common modifications of commercial mortgages (see pp. 2-3 of NYSBA, 2008). Unlike commercial mortgages, the vast majority of residential mortgages are fully amortizing, which meant that a term extension would not be necessary for a borrower who was otherwise capable of making payments. As such, the existing regulatory framework had not foreseen the need to allow term extensions to prevent a default. In addition to term extensions, the rulemaking discussion also refers to the possibility of allowing modifications that change the recourse status of the loan (NYSBA, 2008). A change in recourse status had not been previously covered because, in contrast to commercial mortgages where recourse provisions are negotiated on a case by case basis, state law largely determines the recourse status of residential mortgages.

Importantly for our analysis, nothing in the rule change is intended to change the outcomes for low type borrowers. The existing REMIC rules already permitted modifications for borrowers experiencing financial distress (i.e., borrowers with a low use value of the property). Rather, the goal of the rule change is merely to keep borrowers that want to stay in the property from defaulting due to an inability to obtain a new loan. Despite this, the language of the rule change was sufficiently broad to allow the borrower to request a DPO, or another type of modification, instead of a term extension.

2.2 Outcomes of borrower-lender renegotiation

Once loans are transferred into special servicing, the borrower and lender negotiate over a variety of potential resolutions. For our purposes, these resolutions can be grouped into three types. The first type is a loan modification, which can take the form of temporary interest rate reductions, maturity date extensions, amortization changes, forbearance, or a combination of these. Modifications allow the borrower to retain control of the property, but they do not result in any principal reduction. The second type is a DPO, which involve writing off some of the outstanding principal. The third type is a foreclosure, which we consider to include any resolution type in which the borrower surrenders control of the property. This can include actual foreclosure, short sale, or deed in lieu of foreclosure.

From among this set of post-transfer resolution possibilities, we focus on DPOs for two reasons. First, unlike a modification, a DPO provides an immediate and permanent principal reduction. Second, unlike a foreclosure, a DPO allows the borrower to retain the property. Thus, DPOs are a potentially high-payoff concession that both permanently modifies the loan terms and allows borrowers to retain control of the property.

The potential for favorable outcomes like a DPO gives rise to the potential for financially healthy borrowers to imitate distressed borrowers if they believe there is a chance they can obtain one. The incentive of borrowers to do so will depend on (1) their expectation about receiving a DPO and (2) their expected cost to obtaining a transfer. The expected cost will depend in part on the presence of regulations, such as Revenue Procedure 2009-45, that govern when and under what circumstances loans can be transferred without jeopardizing the REMIC tax status. In the following section, we formalize this intuition in a model of renegotiation between the borrower and lender/special servicer.

3 Model of DPO negotiation

Motivated by the discussion in the Section 2, we develop a principal-agent model of DPO negotiations between a lender (principal, she) and a borrower (agent, he). We assume that both parties are risk-neutral and maximize their expected payoffs. The borrower has a non-recourse mortgage of M dollars secured by a property with a market value of P. If the lender forecloses on the property, she will recover F dollars, with $F < P$ due to various administrative costs and inefficiencies associated with a foreclosure.

The borrower privately values the property at u dollars. The investor-specific valuation u can differ from the market value P due to a number of factors. For example, the current owner's entrepreneurial skills and priorities may differ from those of potential buyers. (P is sometimes referred to as the market value of the property, while u is the investment value.) Unlike P, M, and F which are publicly known, u is the borrower's private information.

The timeline of the negotiation is as follows. At time $t = 0$, the borrower with private value u decides whether to request a DPO. At time $t = 1$, upon receiving a DPO request, the lender chooses between a foreclosure and a DPO D, with $D < M$. If the lender and the borrower agree on the DPO, the lender gets paid D instead of F, the mortgage is terminated, and the borrower will extract utility u from owning the property. If the lender proceeds with a foreclosure, the borrower is given the final opportunity to repay the entire loan M and retain the property at time $t = 2$. If the borrower does not pay M, he loses the property and the lender recovers F on the loan.

We assume that the lender can commit to a negotiation strategy, which allows her to make credible take it or leave it offers to the borrower. In practice, this commitment is possible since lenders play a repeated game by negotiating loans with multiple borrowers. On the other hand, the DPO negotiation is a one-shot game for the borrower. As a result, the borrower lacks a commitment mechanism and chooses a subgame perfect strategy over the course of the negotiation.

3.1 DPO negotiation with complete information

We start our analysis of DPO negotiations with a benchmark case in which the lender knows the borrower's value u. While the equilibrium with complete information is straightforward, it highlights tensions between the lender and the borrower that will remain relevant in a setting with incomplete information.

If $u \leq F$, it is optimal for the lender to proceed with a foreclosure, since the borrower will not pay more than F to retain the property. If $F < u < M$, it is optimal for the lender to offer the borrower DPO $D = u$, where u is the maximum amount the borrower is willing to pay to retain the property. When $u \geq M$, proceeding with a foreclosure is optimal again. In this case, however, the borrower will agree to repay the entire loan amount M in order to avoid losing the property. We summarize our observations in the following proposition.

Proposition 1 *If a borrower whose value u is known to the lender requests a DPO, the subsequent negotiation between the borrower and the lender results in the following equilibrium outcomes*

(i) When $u \leq F$, the DPO negotiation ends in a foreclosure, with the lender's payoff of F, the borrower's payoff of 0.

(ii) When $F < u < M$, the DPO negotiation ends in a DPO $D = u$, with the lender's payoff of u, the borrower's payoff of 0.

(iii) When $u \geq M$, the DPO negotiation starts with a foreclosure procedure and ends in a full payout, with the lender's payoff of M and the borrower's payoff of $u - M$.

We will refer to borrowers with $u \geq M$ as high type borrowers (borrowers that place a high private value on retaining and operating the property), and borrowers with $u < M$ as low type borrowers (borrowers that place little value on retaining and operating the property). Part (iii) of Proposition 1 says that when the lender knows she is dealing with a high-value borrower, she will not agree on a DPO. Thus, in order for a high type to successfully negotiate a DPO, he has to imitate a low type. High types can be seen as "good" borrowers, since they

are willing to pay the entire loan amount, unlike "bad" low types who are going to default on their loans. However, as Proposition 1 indicates, the possibility of obtaining a DPO may incentivize good borrowers to behave as bad borrowers.

3.2 DPO negotiation with asymmetric information

We now consider a setting in which the lender negotiates a DPO with a borrower without knowing his private value u. The lender believes that the private value u of a borrower of a distressed loan is distributed according to the cumulative distribution function $\Phi(u)$ and the probability density function $\phi(u)$.

If the lender decides to proceed with a foreclosure, a borrower with $u \geq M$ will agree to pay M to retain the property. However, a borrower with $u < M$ will refuse to pay M, resulting in the lender's payoff of F. Thus, the lender's expected payoff L^F from pursuing a foreclosure is given by

$$L^F = F\Phi(M) + M(1 - \Phi(M)).$$

If the lender decides to proceed with DPO D, a borrower with $u \geq D$ will agree to pay D to retain the property. On the other hand, a borrower with $u < D$ will refuse to pay D, resulting in a foreclosure outcome with a payoff F to the lender. Thus, the lender's expected payoff $L(D)$ from pursuing DPO D is given by

$$L(D) = F\Phi(D) + D(1 - \Phi(D)).$$

Let D^* denote the DPO that maximizes the lender's payoff

$$D^* = \arg\max_{D \leq M} \{F\Phi(D) + D(1 - \Phi(D))\}.$$

We note that when $D = M$, the DPO is equivalent to a foreclosure, i.e., $L(M) = L^F$. Thus, the lender chooses a DPO over a foreclosure if and only if $D^* < M$. Let $L'(D)$ denote

the derivative of $L(D)$ with respect to D:

$$L'(D) = -(D - F)\phi(D) + 1 - \Phi(D). \tag{1}$$

Then, $L'(M) < 0$ is a sufficient condition for a DPO being preferred over a foreclosure. Indeed, when $L'(M) < 0$, a small reduction in mortgage repayment would increase the lender's expected payoff. Plugging $D = M$ into equation (1) yields Proposition 2.

Proposition 2 *If*

$$(M - F)\phi(M) > 1 - \Phi(M), \tag{2}$$

then the lender strictly prefers a DPO over a foreclosure, when the borrower's private value is not observable.

To interpret equation (2), assume that the lender offers the borrower a small discount on loan repayment, i.e., $D = M - \varepsilon$, for some small $\varepsilon > 0$. This will reduce the lenders payoff by ε with probability $1 - \Phi(M)$, which is the probability that $u > M$ and the borrower is willing to pay M to avoid a foreclosure. On the other hand, the DPO increases the lender's payoff by $M - \varepsilon - F$ with probability $\phi(M)\varepsilon$. Indeed, $\phi(M)\varepsilon$ is the probability that $u \in [M - \varepsilon, M]$, i.e., $\phi(M)\varepsilon$ is the probability that the borrower would switch from accepting a foreclosure to paying $M - \varepsilon$. Thus, the lender is better off with the DPO if

$$(M - \varepsilon - F)\phi(M)\varepsilon > (1 - \Phi(M))\varepsilon. \tag{3}$$

In the limit $\varepsilon \to 0$, equation (3) becomes (2).

We note that equation (2) is a sufficient condition for a DPO to be the preferred solution. Even if equation (2) does not hold, the lender may prefer a DPO over a foreclosure depending on the model parameters. To focus on the interesting case, from now on, we assume that M, F, and $\Phi(u)$ are such that the lender strictly prefers a DPO over a foreclosure, i.e., $D^* < M$.

3.3 DPO request decisions

At time zero, a strategic borrower decides whether to request a DPO. Due to various legal and reputational considerations, the borrower must pay a cost $c(u, R)$ to request a DPO. We assume that $c(u, R)$ is a continuously differentiable function of the borrower's private value u and the level of regulation and, for $u \geq M$, $c(u, R)$ is strictly increasing and convex in u. In addition, $c(u, R)$ is increasing in R,i.e., a higher R corresponds to a level of regulation that makes DPO procedures more costly for borrowers.

There are several reasons why requesting a DPO is costly for the borrower. First, for high types, it requires costly effort to hide or manipulate financial information in order to make it appear as though financial distress is imminent. For example, the higher the private use value, the greater the difficulty a borrower will have concealing cash flows, as compared to a borrower who is truly close to distress and lacking cash flows to pay the mortgage. Second, there are reputational costs associated with default such as a higher cost of future credit. Furthermore, default by the borrower may encourage existing tenants to default on their lease obligations, and make it more difficult to attract new tenants.

We normalize $c(u, R) = 0$ for $u < M$, since a low type is about to lose the property to a foreclosure anyway, and requesting a DPO does not create additional legal or reputational problems. Therefore, $c(u, R)$ represents the incremental cost associated with requesting a DPO for high types.

The lender has limited capacity to process DPO requests due to a limited number of employees with skills required to do DPOs. Because mortgage delinquency tends to be low for long periods of time and then surges, lenders may not be able to rapidly train enough skilled employees to accommodate peak demand to process every DPO request.[8] We model the limit to lender capacity as introducing uncertainty in whether the lender will process

[8]See Holden, Kelly, McManus, Scharlemann, Singer, and Worth (2012), Agarwal, Amromin, Ben-David, Chomsisengphet, Piskorski, and Seru (2017), Calem, Jagtiani, and Maingi (2021), Aiello (forthcoming), and Kim, Lee, Scharlemann, and Vickery (2021) for evidence on and discussion of limits in mortgage servicer capacity.

the DPO request. In particular, the lender starts negotiating a DPO with probability δ, and with probability $(1-\delta)$ the lender proceeds with a foreclosure. Hence, the borrower's expected payoff $B^{DPO}(u)$ conditional on a DPO request is given by

$$B^{DPO}(u) = \begin{cases} 0, \quad if \quad u \leq D^* \\ \delta(u - D^*), \quad if \quad D^* < u < M \\ \delta(u - D^*) + (1-\delta)(u - M) - c(u, R), \quad if \quad u \geq M. \end{cases}$$

If the borrower does not request a DPO, he will either pay M or lose the property to foreclosure, resulting in the following payoff

$$B^{N}(u) = \begin{cases} 0, \quad if \quad u < M \\ u - M, \quad if \quad u \geq M. \end{cases}$$

The net gains associated with a DPO request are given by

$$\Delta B^{DPO}(u) \equiv B^{DPO}(u) - B^{N}(u) = \begin{cases} 0, \quad if \quad u \leq D^* \\ \delta(u - D^*), \quad if \quad D^* < u < M \\ \delta(M - D^*) - c(u, R), \quad if \quad u \geq M. \end{cases} \tag{4}$$

A borrower with $u \leq D^*$ has nothing to gain or lose by requesting a DPO, since he loses his property to a foreclosure in any case. A borrower with $D^* < u < M$ gains from a DPO by paying less than his private use value. A high type borrower, i.e., $u > M$, benefits from a DPO by paying less than the full loan amount M that he would be paying otherwise. However, this borrower is paying the additional cost $c(u, R)$ while requesting a DPO. The next proposition characterizes conditions under which a high type decides to request a DPO.

Proposition 3 *There is a threshold $\bar{u}(\delta, R) > M$ such that it is optimal for borrowers with $u \leq \bar{u}(\delta, R)$ to request DPOs, and for borrowers with $u > \bar{u}(\delta, R)$ to pay M without requesting a DPO. The threshold $\bar{u}(\delta, R)$ is increasing in δ, and decreasing in R.*

Proof *A borrower with private value $\bar{u}$ is indifferent between requesting a DPO and paying M. According to equation (4), $\bar{u}$ must solve the following equation*

$$\delta(M - D^*) - c(\bar{u}, R) = 0.$$

Because $c(u, R)$ is continuous, strictly increasing and a convex function of u and $c(M, R) = 0$, there exists a unique solution $\bar{u}$ to the above equation and it must be greater than M.

According to the implicit function theorem, we have

$$\begin{aligned} \frac{\partial \bar{u}}{\partial \delta} &= \frac{M - D^*}{\frac{\partial c(\bar{u},R)}{\partial \bar{u}}} > 0, \\ \frac{\partial \bar{u}}{\partial R} &= -\frac{\frac{\partial c(\bar{u},R)}{\partial R}}{\frac{\partial c(\bar{u},R)}{\partial \bar{u}}} < 0. \end{aligned}$$

The inequalities follow from the fact that $c(u, R)$ is increasing in both u and R. Thus, $\bar{u}(\delta, R)$ is increasing in δ, and decreasing in R. Q.E.D.

Proposition 3 says that a lender with a higher DPO capacity δ will receive more DPO requests due to the inflow of high types. In particular, the mass of high types with $u \in (M, \bar{u}(\delta, R))$ who request DPOs is increasing in δ. Intuitively, because of the costs associated with DPO requests, high types pursue DPOs only if they have a high enough chance δ to succeed.

Similarly, Proposition 3 says that relaxing regulations, i.e., lowering R, will prompt more high types to request DPOs due to lower costs of DPO requests. As a direct consequence, we have Corollary 1 that says that relaxing regulations also increases the probability that a DPO request ends up in a full payoff of the mortgage principal.

Corollary 1 *Conditional on a DPO request, the probability of a full payoff decreases in R.*

Proof *Let X denote the number of DPO requests from low-value borrowers. Since there is*

no additional cost for those borrowers to request a DPO (see equation (4)), X does not depend on R. Let $\theta(u)$ denote the density of high-value borrowers. According to Proposition 3, the number Y of DPO requests coming from high-value borrowers is a function of $\bar{u}(\delta, R)$ and is given by

$$Y(\bar{u}(\delta, R)) = \int_{M}^{\bar{u}(\delta,R)} \theta(u)du.$$

Low types never repay the loan in full, while high types who requested DPOs fully repay their loan with probability $(1-\delta)$. Thus, the probability of a full payoff conditional on a DPO request equals

$$\pi(R) \equiv \frac{(1-\delta)Y(\bar{u}(\delta, R))}{X + Y(\bar{u}(\delta, R))}.$$

Differentiating $\pi(R)$ yields

$$\pi'(R) \equiv \frac{(1-\delta)X\theta(\bar{u}(\delta, R))\frac{\partial \bar{u}(\delta,R)}{\partial R}}{\left(X + Y(\bar{u}(\delta, R))\right)^2} < 0,$$

where the inequality follows from the fact that $\frac{\partial \bar{u}(\delta,R)}{\partial R} < 0$. Q.E.D.

3.4 Empirical implications

Proposition 3 states that as R decreases, the number of DPO requests will increase because more high types will request DPOs. Corollary 1 states that as R decreases, a DPO request is more likely to lead to full repayment of the loan. These results imply a number of testable hypotheses, including several related to Revenue Procedure 2009-45, which significantly relaxed conditions necessary for any type of loan renegotiation, including DPOs. This rule change corresponds to a reduction in R in the model. Prior to the rule change, borrowers had to default on their loans (or be very close to default) in order for DPO negotiations to take place. After September 2009, Revenue Procedure 2009-45 allows borrowers to negotiate DPOs while being current on their loans. Consistent with the model assumptions, the new rule primarily benefits high types. Indeed, it is optimal for low types to default on their

loans in any case, since $u < M$ for them. On the other hand, defaults for high types result in reputational and legal costs that are otherwise avoidable.

Because CMBS loan transfer from the master servicer to the special servicer is a necessary condition for a DPO negotiation, we proxy for DPO requests in the data using transfers. As a result, we have the following hypothesis.

Hypothesis 1: Following the regulatory change in September 2009,

(a) CMBS loans are more likely to be transferred into special servicing, and

(b) transferred loans are more likely to fully pay off ex-post.

Proposition 3 also implies that more borrowers with high private use values will request DPOs when a lender has a higher DPO capacity δ, which yields the following additional hypothesis.

Hypothesis 2: Following the regulatory change in September 2009, CMBS loans are more likely to be transferred into special servicing when servicer DPO capacity is perceived to be high.

4 Data and Empirical Methodology

To test the main implications of the model, we use data on private-label CMBS loans originated between January 2002 and September 2009 from Trepp. We use 2002 as the starting point because the average (and median) loan in the sample has a maturity date of roughly 10 years, which means that the average loan has more than two years remaining to maturity at the time Revenue Procedure 2009-45 goes into effect. This reduces the likelihood that any relation between DPOs and transfers in the time period immediately surrounding the rule change is confounded by borrower behavior that is driven by the need to refinance imminently-maturing loans, since the average loan is more than two years from requiring

refinancing.[9] Furthermore, we use September 2009 as the end point to focus only on loans originated before Revenue Procedure 2009-45 goes into effect. This ensures that our results are not confounded by the possibility that new borrowers issuing loans in the post-rule change period are inherently more opportunistic. Thus, we are able to focus on the change in existing borrower behavior pre- and post-rule change.

For this set of loans, we measure transfers and other time-varying loan characteristics during the September 2003-September 2015 period. This gives us a balanced number of months on either side of the rule change (which occurred in September 2009) and allows us to observe sufficient performance data for loans originated in September 2009.[10]

4.1 Main variable construction

In the model, high types request a DPO based on the levels of δ and R. In practice, such a DPO request is formally made once the borrower's loan has been transferred from the master servicer to the special servicer. Transfers are readily observable in the Trepp data, whereas DPO requests (or requests for any other type of workout) subsequent to transfer are not. However, because transfer is a necessary condition for a DPO request to occur, we proxy for DPO requests using transfers.

We identify transfers using Trepp's field for transfer dates. For loans that are transferred into special servicing, the transfer date field indicates the month in which the transfer occurs, and this field is missing for loans that are never transferred. Using this field, we define our main dependent, $transfer_{i,s,t}$, as an indicator that is equal to 1 if loan i serviced by special servicer s is transferred in month t. For loans that experience a transfer at some point in the sample, this variable is set to 0 in months prior to transfer and missing in months

[9] To further address concerns that any observed relation between DPOs and transfers is mechanically driven by loans approaching repayment and borrowers acting in response to the need for imminent refinancing, we include in all our regressions a control for the age of the loan, as well as origination time and current time fixed effects.

[10] In Appendix A we show that our results are robust to an alternative time period. For our analysis of outcomes following transfer, we extend the loan performance data to December 2017. This is because post-transfer outcomes such as default or full payoff may take time to occur, and we wish to ensure that loans originated in 2008 and 2009 have sufficient time to experience default or full payoff.

following the transfer. For loans that never experience a transfer, this variable is always set to 0. Hence, the dependent variable only takes a value of 1 in months in which a loan is transferred.

The model implies that higher special servicer DPO capacity δ will increase the propensity for high types to request a DPO after a reduction in R. Although a servicer's true DPO capacity is unobservable to the borrower (and the econometrician), we assume it is correlated with whether a servicer has recently negotiated a DPO. From a borrower's perspective, if their servicer negotiated a DPO for a different loan in the past few months, then the servicer's capacity for DPOs is likely to be high at that point in time. Therefore, we use the DPOs we observe in the data to construct a proxy for servicer DPO capacity.

In order to construct our DPO variable, we first identify DPOs by combining Trepp's workout and prepayment code fields. For each loan that is in special servicing Trepp provides a workout code. The workout code can change during the duration of special servicing based on the strategy the special servicer is pursuing. For example, a servicer may initially pursue a modification strategy but then switch to a foreclosure strategy after six months. Additionally, Trepp lists prepayment codes for loans that either voluntarily prepay or are liquidated after a default.

We first identify all loans that have a prepayment code that indicates a DPO. We then add to that set any loan without a prepayment code of DPO but for which the last workout code available at the time of liquidiation indicates a DPO.[11] Finally, we limit the set of DPOs to those for which the size of the discounted payoff relative to the size of the remaining

[11]We do not rely strictly on the workout code because we find it to be an inaccurate indicator of DPOs in particular. When we check the loans which Trepp codes as being in DPO against the actual delinquency commentary in Bloomberg we find a significant number of discrepancies. For example, we find a significant number of loans that Trepp codes as DPO but which the delinquency commentary indicates another workout strategy such as foreclosure or modification or note sale. Similarly, we find a number of loans that Trepp codes as not being in DPO but for which the delinquency commentary indicates there is a DPO being pursued. Although we have not checked every serviced loan in Trepp we have found that a number of these discrepancies occur when the loan is being "dual-tracked" in two different workout procedures. In these instances the delinquency commentary will indicate that a loan is being dual-tracked in, e.g., a foreclosure and a DPO. This indicates that the servicer is considering both options, but it is not clear whether either option is actually favored by the servicer.

balance is greater than 0, but less than 80%. In Appendix A we show that our results are qualitatively unchanged if we do not use this restriction.

After identifying all the DPOs in our sample, we define our first main independent variable of interest as follows. For loan i serviced by special servicer s in month t, the variable $DPO[w]_{s,t}$ is equal to 1 if servicer s negotiated a DPO on a different loan (any loan besides i) in a window of time w prior to month t, and 0 otherwise. When this indicator is equal to 1, the borrower for loan i expects servicer s to have high DPO capacity given s negotiated a DPO for another loan in the near past. In our analysis, we use various windows of time, including $[t-7, t-10]$ months, $[t-6, t-9]$ months, $[t-5, t-8]$ months, and $[t-4, t-7]$ months.

We define this variable at a lag since borrowers may not respond immediately to DPOs they observe. It takes time for a given borrower to learn about DPOs their special servicer negotiates with other borrowers, and it also takes time for a borrower to determine whether there is a significant likelihood of receiving a similar favorable workout if they are transferred. Additionally, once a borrower decides to seek a transfer into special servicing, it may take time for the master servicer to actually agree to this. We further define this variable using a window of time to account for the fact that borrowers may base their decision on special servicing outcomes they observe over a period of time, rather than in a single month.

Finally, the model implies that regulations R that make DPOs costly will reduce the number of high types requesting DPOs. In our setting, Revenue Procedure 2009-45 generates a reduction in R. This change went into effect on September 15, 2009.[12] Therefore, we define the pre-regulation time period of September 2003-September 2009 as the time period in which R is high, and the post-regulation period as October 2009-September 2015 as the period in which R is low. Our second independent variable of interest, *Post*, is therefore equal to 0 between September 2003 and September 2009, and equal to 1 between October 2009 and

[12]The IRS made the change in tax law retroactive to January 1, 2008, in order to avoid jeopardizing the tax treatment of REMICs in which loans were modified prior to default in 2008 and the beginning of 2009. This retroactive application will not impact our results because we focus on the transfer event itself and not the tax treatment of REMICs.

September 2015.

4.2 Methodology

Our empirical methodology estimates the relation between transfers (DPO requests) and special servicer DPO capacity, conditional on a reduction in the regulatory cost of obtaining a transfer. We use the following baseline specification:

$$transfer_{i,s,t} = \beta_0 + \beta_1 DPO[w]_{s,t} + \beta_2 Post_t + \beta_3 Post_t \times DPO[w]_{s,t} + \beta_x Cont_{i,s,t} + \epsilon_{i,j,t} \quad (5)$$

where $transfer_{i,s,t}$, $DPO[w]_{s,t}$, and $Post_t$ are defined above, and controls include loan origination characteristics (LTV, coupon, occupancy rate, and debt service coverage ratio (DSCR)) and characteristics at the time of transfer (age, ratio of current unpaid balance to origination balance, LTV, occupancy rate, and DSCR). We include originator, origination month, deal type, and property type fixed effects in all specifications. Additionally, we include either special servicer and MSA-by-month fixed effects, or special servicer-by-MSA and month fixed effects. The servicer and MSA-by-month fixed effects are particularly important as they allow us to account for characteristics of the servicer and local economic conditions that are correlated with the propensity to grant DPOs and the likelihood of a transfer. Alternatively, using servicer-by-MSA and month fixed effects allows us to include the $Post_t$ variable in the regression and also accounts for MSA-specific strategies that servicers employ.

We place several restrictions on our estimation sample. In order to alleviate concerns that servicers who do DPOs are unobservably different from those that do not, and that those differences are correlated with our main independent or dependent variables, we restrict our sample to loans serviced by special servicers who negotiated at least one DPO prior to the REMIC rule change and who do at least one DPO following the rule change. Furthermore, in order to ensure our fixed effects are estimated with a sufficient amount of within-group

variation, we require the following: (1) each special servicer to service at least 10 deals in the sample period (for servicer fixed effects); (2) each MSA to have at least 100 loans per month for every month in the sample period (for MSA-by-month fixed effects), (3) each loan originator to originate at least 1,000 loans in the sample period (for originator fixed effects), and (4) each servicer to have at least 100 loans per MSA in the sample period (for special servicer-by-MSA fixed effects).[13]

As an example of the timing in equation 5, take the DPO and transfer visually represented by Figure 1. This loan is transferred in January 2008 such that $transfer_{i,s,t}$ is equal to 1 in January 2008. If we use a $[t-3, t-6]$ DPO window, then the variable $DPO[-3,-6]_{s,t}$ is equal to 1 if special servicer s negotiated a DPO for a different loan between July and October 2007, and 0 otherwise.

Proposition 3 states that high types will request a DPO when servicer capacity is high and the regulation-induced cost of a transfer is low. Ex-ante higher private use value should be positively correlated with ex-post better loan performance, so, as a result, Corollary 1 states that, conditional on receiving a transfer, the probability of a borrower fully paying off the loan increases as the regulatory cost decreases. Empirically, therefore, we expect that loans transferred in the post-rule change period should perform differently from other loans, all else equal.

To study loan performance we construct two additional transfer indicator variables. The first is based directly on corollary 1 and conditions $transfer$ on the amount the borrower ultimately pays off relative to the remaining principal balance at the time of transfer. We construct the amount paid off using several Trepp fields. First, we use the prepayment and

[13]For our main analysis we put an additional restriction on the DPO variable and the loan on the left-hand side in that we exclude all loans that receive DPOs from the set of transfers. This means that the set of loans for which transfer is equal to 1 never receive a DPO in subsequent workouts. Similarly, the loans we use to define the main independent variable do not also appear as loans with transfer equal to 1. We allow the deal in which loan i resides to experience a DPO on a different loan during the time window over which the DPO variable is measured. In other words, if loan i resides in deal d, then deal d can experience a DPO for a different loan during the time window $[w]$ preceding t. This implies that a borrower can either observe a DPO from the special servicer from another deal or from within the deal in which their loan resides. Our results do not change if we exclude DPOs from within the same deal.

workout strategy codes to identify loans for which there is either a "Full Payoff" or "Full Payoff at Maturity." Second, we add to this set of loans any loan for which the size of the payoff relative to the remaining unpaid principal balance is at least 95%. To do this, we use the Trepp field *curunschedprin* to define the amount of the payoff at the time the loan is resolved, and the field *disposedamount* to define the balance at the time of resolution payoff. We then define a variable *unschedsize* equal to the size of the payoff relative to the disposed amount. Finally, we consider a loan to have received a full payoff when *unschedsize* is greater than or equal to 95%.

After identifying loans that receive full payoffs, whether at or prior to maturity, we define a variable *Transfer (Full payoff)* equal to 1 if the loan is transferred and subsequently fully pays off, and 0 otherwise. Thus, this variable is equal to 0 for loans that transfer and do not fully pay off by December 2017, or loans that are in servicing but not yet resolved by December 2017, or loans that are never transferred at all.

In addition to loan payoff, we create a second proxy for ex-ante high valuation by focusing on whether loans default prior to, or after, transfer. We define an indicator variable *Transfer (No default)* equal to 1 if a loan is transferred and never defaults, and 0 otherwise. We define default as being more than 60+ days delinquent at least once between the time the loan is originated and December 2017. This variable is therefore equal to 1 when a loan is transferred but is never 60+ days past due at any point before or after the transfer occurs, and 0 when the loan is transferred but is 60+ days past due at some point (or when the loan is never transferred). This variable thus captures borrowers who are never technically distressed, yet still obtain a transfer into servicing. Thus, we consider a lack of default to be consistent with high ex-ante quality. Finally, we estimate equation 5 using these two variables as the dependent variables.

5 Results and Discussion

Table 1 defines our variables. Tables 2 and 3 summarize the data for our multivariate estimation at the loan and loan-month level.[14] As shown in Table 2, we have 22,929 loans in our sample, of which 21% are transferred into special servicing (*Transfer*) and 2.7% receive DPOs (*DPO indicator*). Table 2 also describes the origination characteristics of the loans in our sample. The average loan is securitized at an LTV of 67% and a coupon rate of 6%. Additionally, the average loan has an origination DSCR of 1.5 and an origination occupancy rate of 94%.

Table 3 shows that, at the loan-month level, our DPO variables of interest ($DPO[-4,-7]$, $DPO[-5,-8]$, $DPO[-6,-9]$, and $DPO[-7,-10]$) have means of roughly 75%. This indicates that, for the average loan, the special servicer negotiates a DPO for a different loan in a recent window of time 75% of the time. Put another way, the average loan sees the special servicer recently negotiate a DPO for a different borrower in 9 months of the year, and does not see a recent DPO in 3 months of the year.

Figure 2 illustrates time trends in both DPOs and transfers during our estimation sample period. The solid series is total transfers during each month in the sample period, and the dashed series is total DPOs each month. The red vertical line is placed at September 2009 when the rule change occurred. The figure shows a significant increase in transfers to the special servicer beginning in late 2008 at the onset of the financial crisis. DPOs are low until 2009, and there is a significant increase in DPOs beginning in 2010 and going through 2011 as loans that went into distress during the peak of the financial crisis conclude their workouts.

Table 4 documents variation in DPOs, transfers, and defaults by property type and special servicer. The table reports the percentage of loans (by count) of a given property

[14]Note that the composition of Table 3 is slightly different from that of Table 2. This is because we do not include the loans that receive DPOs in our sample of transferred loans for the multivariate analysis. (The DPO variable is used to define the independent variables, but loans that are DPOed do not appear on the left-hand side.) Because Table 2 summarizes all the loans, including those that receive DPOs, it contains a larger set of loans than is summarized in Table 3.

type or special servicer that receive discounted payoffs (column 2), are transferred into special servicing (column 3), or become 60+ days past due (column 4). The top panel shows that Hospitality and Office property types have the highest transfer percentage, whereas Industrial and Multifamily have lower percentages of loans that are transferred. Hospitality and Office types are also more likely to experience DPOs.

In terms of variation across special servicers, the bottom panel of Table 4 illustrates that loans serviced by LNR, Midland, and CWCapital experience the highest percentage of transfers and also negotiate the highest percentage of DPOs.[15]

Finally, Table 5 shows significant geographic variation in DPOs, transfers, and delinquencies. This table includes the top 30 MSAs by total loan count and reports the same set of statistics as Table 4. For Atlanta, Phoenix, Las Vegas, and Detroit, more than 3 in 10 loans are transferred during the sample period. In contrast, MSAs like Los Angeles, Portland, San Diego, and Seattle experience transfer rates of just over 10%. DPO rates are highest in Detroit, Las Vegas, and Orlando, and lowest in Los Angeles, San Diego, Boston, and Washington, DC.

Taken together, the results in Tables 4 and 5 illustrate significant variation across property types, special servicers, and geographic regions. In our main empirical analysis we account for this variation by including property types fixed effects, special servicer fixed effects, and MSA-by-time fixed effects.

5.1 The impact of DPOs on transfers

Table 6 shows results for estimating equation 5 using a linear probability model. We show the results for four windows: $[t-7, t-10]$, $[t-6, t-9]$, $[t-5, t-8]$, and $[t-4, t-7]$. Columns 1-4 include MSA-by-month and special servicer fixed effects, whereas columns 5-8 include special servicer-by-MSA and month fixed effects, plus an indicator for the *Post* period. All columns include origination loan characteristics (LTV, coupon, occupancy rate, DSCR), current loan

[15] Table 4 includes special servicers in the multivariate estimation sample. These must satisfy the data restrictions described in Section 4.2.

characteristics (age, ratio of current unpaid balance to origination balance, LTV, occupancy rate, and DSCR), and originator, origination month, property type, and deal type fixed effects.

Across specifications the interaction terms $Post \times DPO$ indicate the impact of DPOs is positive and significant following the REMIC rule change. This is consistent with our model and implies that a DPO by the special servicer increases the likelihood of a different loan being transferred *conditional* on a reduction in the cost of transfer. The MSA-by-month fixed effects in columns 1-4 account for unobserved changes in local economic conditions that may be correlated with DPO and transfer activity. Similarly, the MSA-by-servicer fixed effects in columns 5-8 account for unobserved correlation between MSA-specific strategies employed by the special servicer and transfers and DPOs. Although we cannot include $Post$ in columns 1-4 due to collinearity with the fixed effects, the $Post$ variable is positive and significant in columns 5-8, consistent with an increase in transfers following the peak of the financial crisis. The term DPO is negatively associated with the probability of transfer for some specifications; we provide a potential explanation for this in Section 5.2.

In terms of control variables, current LTV is not significantly associated with transfer likelihood, but both current occupancy and current DSCR are negatively associated with transfer, which is consistent with higher occupancy and higher DSCR being associated with lower distress risk. The negative coefficient on age indicates that older loans are less likely to be transferred, and the positive coefficient on $Balratio$ suggests that loans with a higher ratio of current balance to origination balance are more likely to be transferred. Both these results are consistent with a lower distress likelihood for loans that have amortized more of their initial balance.

Overall, the results in Table 6 are consistent with borrowers attempting to extract concessions from lenders using the transfer process. Borrowers observe a DPO by their special servicer and infer that servicing capacity is high, and when the cost of transfer is low, this increase in perceived capacity translates into a greater likelihood that borrowers are trans-

ferred.[16]

Although Table 6 suggests that transfers are more likely following a DPO on another loan by the special servicer, they do not speak to loan performance subsequent to transfer. Because Corollary 1 predicts that full payoffs increase following a reduction in the cost of being transferred, we expect loans that transfer following a DPO in the post-regulation period to perform differently than loans transferred following a DPO prior to the regulation. To analyze such differences in performance, in this section we estimate whether DPOs are associated with the variables *Transfer (Full payoff)* and *Transfer (No default)*.

Tables 7 and 8 report the results. In Table 7, the $Post \times DPO$ interactions are positive and significant in six of the eight specifications, suggesting that borrowers are more likely to fully pay off following a transfer in the post-regulation change period. Additionally, the variable *Post* is positive and significant in columns 5-8, which is consistent with the prediction from Corollary 1 that full payoffs increase following the regulation change. In terms of delinquency, Table 8 indicates that loans transferred following a DPO in the post-period are more likely to never experience 60+ day delinquency status (whether before or after transfer) than loans transferred following a DPO in the pre-period.

Taken together, these results are consistent with high types imitating low types in order to obtain a transfer into special servicing. This is because high type borrowers are those willing to pay the full loan amount ex-ante. Therefore, they should be less likely to experience serious delinquency and more likely to fully pay off the loan balance ex-post. In particular, if they fail to successfully negotiate DPOs, high type borrowers optimally decide to fully pay off their loans, while low type borrowers lose their properties to foreclosure.

5.2 Pre-rule change strategic delay

Figure 2 shows that transfers began to increase significantly in 2008 and were relatively level during 2009, whereas DPOs did not begin to increase significantly until 2009. Because the

[16]We provide evidence to support a parallel trends assumption in Appendix B.

rule change did not occur until September 2009, our pre-period encompasses both the pre-financial crisis period, in which there is relatively modest transfer activity, and the period during the beginning and peak of the crisis, in which the amount of transfer activity is significant.

To capture potentially interesting variation during the peak crisis period, we define a second time period variable called $Interim$ which is equal to 1 between January 2008 and September 2009, and 0 otherwise. This variable therefore captures the peak crisis time period. We then interact $Interim$ with our DPO variables and include both $Interim \times DPO$ and $Post \times DPO$ in our main regression.

Table 9 reports the results. The $Post \times DPO$ variables remain positive and significant for seven of the eight specifications, and consistent with an increase in transfers beginning in 2008, both the $Post$ and $Interim$ variables are positive in columns 5-8. Additionally, the $Interim \times DPO$ terms are consistently negative across specifications, whereas the main DPO variables lose significance in several specifications. This suggests that the negative coefficient on the uninteracted DPO variables in Table 6 is primarily driven by the January 2008-September 2009 time period. Prior to January 2008, DPOs have no significant impact on the likelihood of a transfer.

Taken together, the results in Table 9 suggest that borrowers do not react to DPOs by their special servicer vis-a-vis a transfer or delinquency prior to 2008. In contrast, DPOs actually have a negative impact on transfer likelihood between January 2008 and September 2009. This implies that the negative coefficient on DPO in previous tables is primarily driven by borrower actions during the interim time period.

The negative impact of DPOs during the January 2008-September 2009 time period may be due to borrowers anticipating the rule change, and hence delaying strategic behavior until after the reduction in the cost of renegotiation. This is plausible because the IRS was relaxing modification rules for residential MBS borrowers precisely during the interim time period. In December 2007 it issued Revenue Procedure 2007-72, and this was followed by

Revenue Procedure 2008-28 in June 2008 and Revenue Procedure 2008-47 in July 2008. All three Revenue Procedures granted to RMBS borrowers the same types of tax rule concessions that were eventually granted to CMBS borrowers. This successive relaxation of tax rules for RMBS loans makes it likely that CMBS borrowers anticipated similar relief. Thus, borrowers may have delayed transfer requests in the time period immediately preceding the rule change.

6 Conclusion

We provide evidence of significant asymmetric information between borrowers and lenders in commercial real estate. Consistent with our model in which borrowers with high private use values request DPOs when the expected cost is low, we show that, following an exogenous reduction in the cost of renegotiation, loans are more likely to be transferred into special servicing. This effect is stronger when the special servicer recently negotiated a DPO for a different loan, and loans transferred following the reduction in renegotiation cost are more likely to fully pay off and less likely to default. Our results are important as they are the first to detail the impact of principal writedowns on commercial borrower behavior. We are also the first paper to study the consequences of the 2009 REMIC rule change on borrower incentives.

Our findings are particularly salient in light of the REMIC safe harbor provisions granted in April 2020 in response to COVID-19-induced commercial real estate distress. Like the rule change we study, these provisions are designed to increase the ability of borrowers and servicers to engage prior to default. Although such provisions may allow efficient resolution of certain distressed loans, our results suggest that policies that allow for such preemptive renegotiation may also encourage borrowers who otherwise would perform to attempt to extract concessions from servicers.[17]

[17]Recent anecdotal examples of opportunism in CRE loans have occurred during the COVID-19 pandemic. For example, retailer The Gap was involved in litigation with some landlords and lenders over failure to pay rent for its stores. Gap contends that state government-mandated shutdowns void lease agreements, whereas landlords and properties owners such as Simon Property Group contend Gap has the ability to pay and is using the pandemic to

cease rent payments or terminate lease agreements. See https://www.bloomberg.com/news/articles/2020-08-05/simon-countersues-gap-over-107-million-in-lease-payments and https://www.nytimes.com/2020/06/05/business/economy/coronavirus-commercial-real-estate.html.

References

Adelino, M., K. Gerardi, and P. Willen (2013): "Why don't Lenders renegotiate more home mortgages? Redefaults, self-cures and securitization," Journal of Monetary Economics, 60, 835–853.

Agarwal, S., G. Amromin, I. Ben-David, S. Chomsisengphet, T. Piskorski, and A. Seru (2017): "Policy Intervention in Debt Renegotiation: Evidence from the Home Affordable Modification Program," Journal of Political Economy, 125, 654–712.

Aiello, D. J. (forthcoming): "Financially constrained mortgage servicers," Journal of Financial Economics.

Antill, S. and S. Grenadier (2019): "Optimal capital structure and bankruptcy choice: Dynamic bargaining versus liquidation," Journal of Financial Economics, 133, 198–224.

Beeman, E. R. (2009): "A Compendium of Financial Crisis Tax Guidance," Bank Accounting and Finance, 22, 3–13.

Black, L., J. Krainer, and J. Nichols (2020): "Safe Collateral, Arm's-Length Credit: Evidence from the Commercial Real Estate Market," Review of Financial Studies, 33, 5173–5211.

Bolton, P. and O. Jeanne (2007): "Structuring and Restructuring Sovereign Debt: The Role of a Bankruptcy Regime," Journal of Political Economy, 115, 901–924.

Calem, P., J. Jagtiani, and R. Q. Maingi (2021): "Redefault Risk in the Aftermath of the Mortgage Crisis: Why Did Modifications Improve More than Self-Cures?" Journal of Real Estate Research, 43, 145–180.

Campello, M., T. Ladvika, and R. Matta (2019): "Renegotiation Frictions and Financial Distress Resolution: Evidence from CDS Spreads," Review of Finance, 23, 513–556.

Cespedes, J., C. Parra, and C. Sialm (2021): "The Effect of Principal Reduction on Household Distress: Evidence from Mortgage Cramdown," Working paper.

Davydenko, S. and I. Strebulaev (2007): "Strategic Actions and Credit Spreads: An Empirical Investigation," Journal of Finance, 62, 2633–2671.

Dinc, S. and E. Yönder (2022): "Strategic Default and Renegotiation: Evidence from Commercial Real Estate Loans," Working paper.

Elul, R., N. Souleles, S. Chomsisengphet, D. Glennon, and R. Hunt (2010): "What "Triggers" Mortgage Default?" American Economic Review: Papers and Proceedings, 100, 490–494.

Foote, C., K. Gerardi, and P. Willen (2008): "Negative equity and foreclosure: Theory and evidence," Journal of Urban Economics, 64, 234–245.

Ganong, P. and P. Noel (2020): "Liquidity versus Wealth in Household Debt Obligations: Evidence from Housing Policy in the Great Recession," American Economic Review, 110, 3100–3138.

Ghent, A. C. (2011): "Securitization and Mortgage Renegotiation: Evidence from the Great Depression," The Review of Financial Studies, 24, 1814–1847.

Glancy, D., R. Kurtzman, and L. Loewenstein (2022): "Loan Modifications and the Commercial Real Estate Market," Working paper.

Globe Street (2009): "REMIC Modifications and their Impact," GlobeSt.com, September 20.

Guiso, L., P. Sapienza, and L. Zingales (2013): "The Determinants of Attitudes toward Strategic Default on Mortgages," Journal of Finance, 68, 1473–1515.

Hackbarth, D., C. Hennessy, and H. Leland (2007): "Can the Trade-off Theory Explain Debt Structure?" Review of Financial Studies, 20, 1389–1428.

Holden, S., A. Kelly, D. McManus, T. Scharlemann, R. Singer, and J. D. Worth (2012): "The HAMP NPV Model: Development and Early Performance," Real Estate Economics, 40, S32–S64.

Internal Revenue Service (2009): "Rev. Proc. 2009-45," Tech. rep., Internal Revenue Source.

Kim, Y. S., D. Lee, T. Scharlemann, and J. Vickery (2021): "Intermediation Frictions in Debt Relief: Evidence from CARES Act Forbearance," Tech. rep., Federal Reserve Board of Governors.

Low, D. (2021): "What Triggers Mortgage Default? New Evidence from Linked Administrative and Survey Data," Working paper.

Maturana, G. (2017): "When Are Modifications of Securitized Loans Beneficial to Investors?" Review of Financial Studies, 30, 3824–3857.

Mayer, C., E. Morrison, T. Piskorski, and A. Gupta (2014): "Mortgage Modification and Strategic Behavior: Evidence from a Legal Settlement with Countrywide," American Economic Review, 104, 2830–2857.

NYSBA (2008): "Report on Modifications to Commmercial Mortgage Loans Held by a Real Estate Mortgage Investment Conduit (REMIC)," Tech. Rep. 1151, New York State Bar Association.

Riddiough, T. J. and S. B. Wyatt (1994): "Wimp or Tough Guy: Sequential Default Risk and Signaling with Mortgages," Journal of Real Estate Finance and Economics, 9, 299–321.

Roberts, M. and T. Whited (2013): "Endogeneity in empirical corporate finance," Handbook of the Economics of Finance, 2, 493–572.

Valta, P. (2016): "Strategic Default, Debt Structure, and Stock Returns," Journal of Financial and Quantitative Analysis, 51, 197–229.

Wang, K., L. Young, and Y. Zhou (2002): "Nondiscriminating Foreclosure and Voluntary Liquidating Costs," The Review of Financial Studies, 15, 959–985.

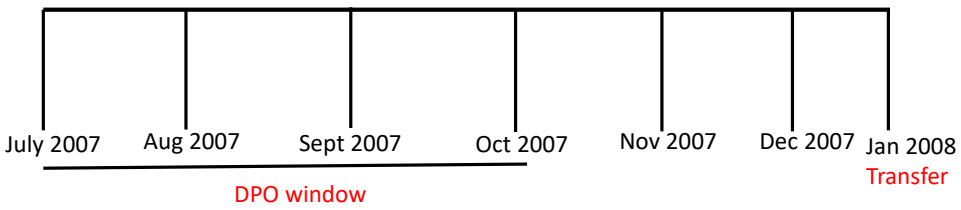

Figure 1: DPO-Transfer example

Notes: This figure illustrates the timing in our empirical specification when we use a DPO window of 3 months to 6 months prior to transfer.

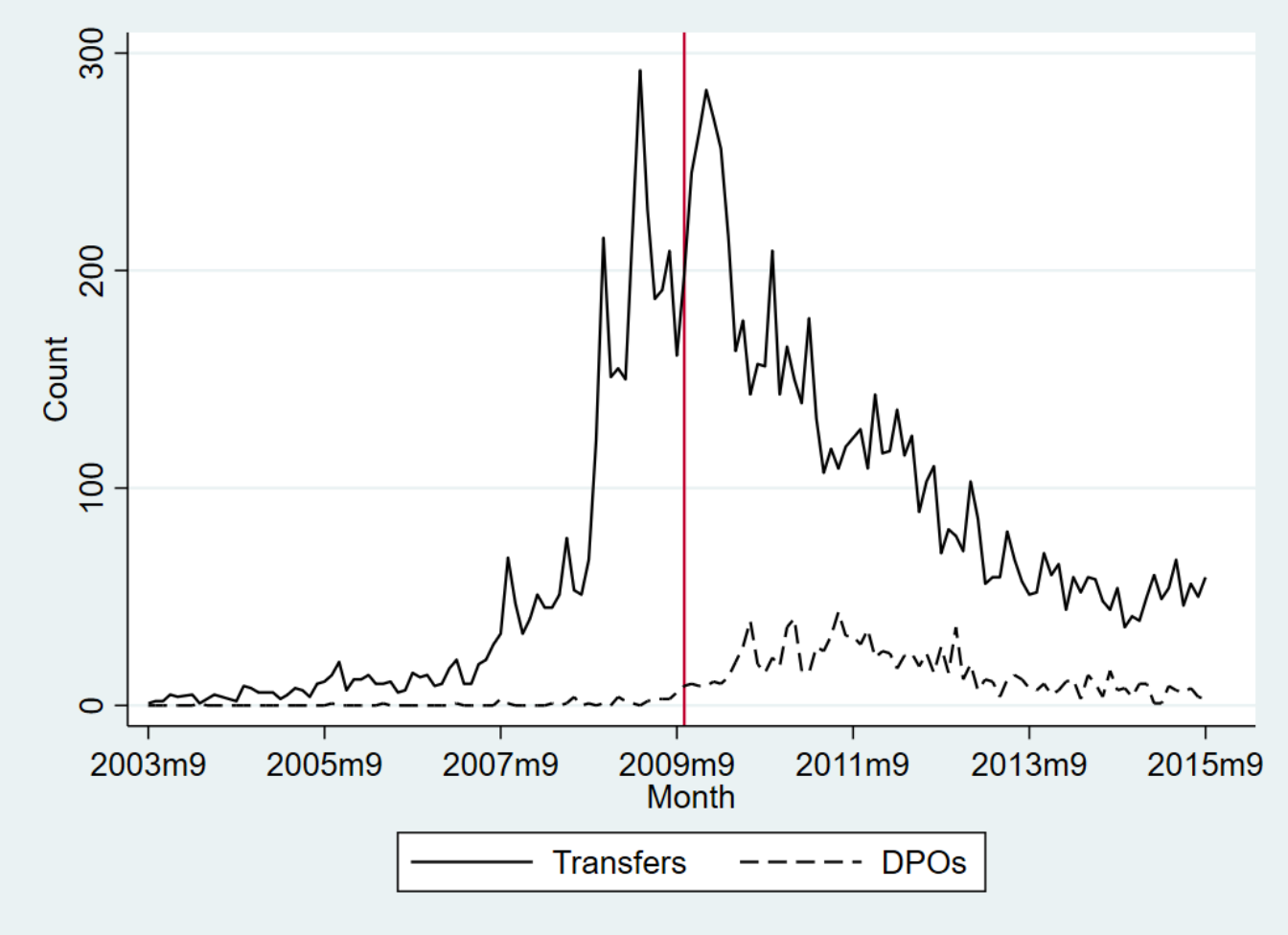

Figure 2: Transfers and DPOs over time

Notes: Data is from Trepp for nonagency CMBS deals originated from January 2002-September 2009, with performance measured from September 2003-September 2015. The vertical line is September 2009, the date of the IRS rule change.

Table 1: Variable definitions

Variable	**Definition**
DPO [-t,-t-n]	Indicator equal to 1 if loan special servicer negotiated a discounted payoff between t and t-n months prior
DPO Indicator	Indicator equal to 1 if DPO was negotiated in loan-month, 0 otherwise
Transfer	Indicator equal to 1 if loan was transferred into special servicing, missing in all months following transfer, and 0 otherwise
Transfer (Full payoff)	Indicator equal to 1 if loan was transferred into special servicing and received a full payoff, missing in all months following transfer, and 0 otherwise
Delinquent	Indicator equal to 1 if loan rolls straight from current to 60+ days past due, missing in all months following delinquency, and 0 otherwise
Post	Indicator equal to 1 for months between Oct 2009 and Sept 2013 and 0 for months between Sept 2005 and Sept 2009
Unschedsize	Size of payoff relative to the remaining unpaid principal balance at time of resolution
Orig LTV	Origination loan-to-value ratio
Orig coupon	Origination loan interest rate
Orig occ	Origination occupancy rate
Orig DSCR	Origination debt service coverage ratio
Age	Age of loan in months
Balratio	Unpaid principal balance divided by origination balance
Curr LTV	Current loan-to-value ratio
Curr occ	Current occupancy rate
Curr DSCR	Current debt service coverage ratio

Table 2: Summary statistics: loan level

variable	N	mean	p50	sd	min	max
Origination year	22,929	2005.2	2006	1.52	2002	2008
Orig LTV	22,762	64.98	70	15.97	10.6	82.9
Orig coupon	22,860	5.87	5.82	0.55	3.57	9.09
Orig occ	20,960	94.46	98	7.93	62.7	100
Orig DSCR	21,100	1.68	1.37	1.08	1.03	7.43
Transfer	22,776	0.21	0	0.41	0	1
Transfer (Full payoff)	22,776	0.07	0	0.26	0	1
Transfer (No delinquency)	22,776	0.05	0	0.21	0	1
Delinquent	22,929	0.17	0	0.38	0	1
DPO indicator	22,929	0.03	0	0.16	0	1

Notes: 1) Summary statistics at the loan level for the multivariate estimation sample. Data is from Trepp for CMBS deals originated from January 2002-September 2009, with performance measured from September 2003-September 2015. Full payoffs and delinquencies are measured as of December 2017. 2) All variables defined in Table 1. Variables are winsorized at the 1% level in each tail.

Table 3: Summary statistics: loan-month level (estimation sample)

variable	**N**	**mean**	**p50**	**sd**	**min**	**max**
Transfer	1,979,024	0.002	0	0.044	0	1
Transfer (Full payoff)	1,979,024	0.001	0	0.029	0	1
Transfer (No delinquency)	1,979,024	0.001	0	0.022	0	1
Post	1,979,024	0.528	1	0.499	0	1
DPO[-4,-7]	1,979,024	0.760	1	0.427	0	1
DPO[-5,-8]	1,979,024	0.754	1	0.431	0	1
DPO[-6,-9]	1,979,024	0.749	1	0.434	0	1
DPO[-7,-10]	1,979,024	0.744	1	0.436	0	1
Orig LTV	1,964,329	64.04	69.46	16.8	10.6	82.9
Orig coupon	1,973,768	5.85	5.8	0.54	3.57	8.8
Orig occ	1,800,441	94.77	98.3	7.68	62.7	100
Orig DSCR	1,833,355	1.74	1.38	1.19	1.03	7.43
Age	1,979,024	18.28	17	10.7	1	54
Balratio	1,977,510	0.94	0.96	0.08	0	1
Curr LTV	1,978,535	63.89	69.4	17.22	9.9	188.08
Curr occ	1,958,280	92.84	96.69	10.05	49.73	100
Curr DSCR	1,978,320	1.58	1.41	0.71	0.31	4.57
Year	1,979,024	2009.6	2009	2.86	2003	2015
Origination year	1,979,024	2005	2005	1.518	2002	2008

Notes: 1) Summary statistics at the loan-month level for the multivariate estimation sample. Data is from Trepp for CMBS deals originated from January 2002-September 2009, with performance measured from September 2003-September 2015. Full payoffs and delinquencies are measured as of December 2017. 2) All variables defined in Table 1. Variables are winsorized at the 1% level in each tail.

Table 4: DPOs, transfers, and delinquencies by property type and servicer

	(1)	(2)	(3)
	% DPO	% transfer	% delinquent
Property type			
Hospitality	0.053	0.284	0.233
Industrial	0.027	0.187	0.144
Multifamily	0.027	0.175	0.145
Office	0.051	0.276	0.229
Other	0.023	0.126	0.101
Retail	0.041	0.213	0.179
Special servicer			
C-III Asset Management LLC	0.036	0.195	0.160
CWCapital Asset Management	0.038	0.209	0.180
KeyBank	0.019	0.173	0.122
LNR Partners	0.043	0.241	0.204
Midland	0.067	0.212	0.157
Torchlight Loan Services, LLC	0.034	0.172	0.131

Notes: 1) This table illustrates the proportion of loans that experience a DPO, transfer, or 60+ day delinquency, for the multivariate estimation sample. The top panel displays loan proportions by property type, and the bottom panel displays proportions by special servicer. Data is from Trepp for CMBS deals originated from January 2002-September 2009, with performance measured from September 2003-September 2015. Full payoffs and delinquencies are measured as of December 2017. 2) All variables defined in Table 1.

Table 5: DPOs, transfers, and delinquencies by Top 30 MSAs

	(1)	(2)	(3)		(4)	(5)	(6)
	% DPO	% transfer	% delinquent		% DPO	% transfer	% delinquent
NYC	0.026	0.145	0.115	Boston	0.030	0.154	0.126
Los Angeles	0.017	0.115	0.087	Seattle	0.009	0.111	0.077
DalFW	0.059	0.254	0.197	Denver	0.047	0.171	0.126
Houston	0.059	0.260	0.224	Baltimore	0.023	0.136	0.111
Chicago	0.030	0.219	0.182	Tampa	0.065	0.312	0.292
DC	0.025	0.168	0.125	Orlando	0.083	0.308	0.300
Atlanta	0.055	0.384	0.341	Minneapolis	0.015	0.205	0.190
Phoenix	0.060	0.362	0.319	Charlotte	0.042	0.232	0.178
Miami	0.035	0.228	0.200	Sacramento	0.054	0.295	0.233
San Diego	0.020	0.141	0.108	Norfolk	0.027	0.186	0.164
San Fran	0.009	0.115	0.081	Indianapolis	0.067	0.269	0.274
Phil	0.037	0.223	0.177	San Antonio	0.028	0.290	0.198
Inland	0.054	0.253	0.201	Portland	0.010	0.106	0.087
Las Vegas	0.088	0.458	0.411	Austin	0.020	0.205	0.151
Detroit	0.085	0.378	0.311	Columbus	0.065	0.258	0.274

Notes: 1) This table illustrates the proportion of loans that experience a DPO, transfer, or 60+ day delinquency by MSA, for the multivariate estimation sample. The top 30 MSAs by total loan count are included. Data is from Trepp for CMBS deals originated from January 2002-September 2009, with performance measured from September 2003-September 2015. Full payoffs and delinquencies are measured as of December 2017. 2) All variables defined in Table 1.

Table 6: Impact of DPOs on transfer likelihood

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Transfer							
DPO[-5,-8]	-0.000096				-0.00025**			
	(0.00012)				(0.00012)			
Post x DPO[-5,-8]	0.0012***				0.0014***			
	(0.00037)				(0.00034)			
DPO[-4,-7]		-0.000033				-0.00020*		
		(0.00012)				(0.00012)		
Post x DPO[-4,-7]		0.00066*				0.00091**		
		(0.00039)				(0.00036)		
DPO[-6,-9]			-0.00017				-0.00035***	
			(0.00012)				(0.00012)	
Post x DPO[-6,-9]			0.0019***				0.0021***	
			(0.00037)				(0.00035)	
DPO[-7,-10]				-0.00035***				-0.00048***
				(0.00012)				(0.00011)
Post x DPO[-7,-10]				0.0017***				0.0020***
				(0.00040)				(0.00037)
Post					0.039***	0.039***	0.038***	0.037***
					(0.0035)	(0.0036)	(0.0035)	(0.0035)
Orig LTV	0.000048***	0.000048***	0.000048***	0.000048***	0.000045***	0.000045***	0.000045***	0.000045***
	(0.000014)	(0.000014)	(0.000014)	(0.000014)	(0.000014)	(0.000014)	(0.000014)	(0.000014)
Orig coupon	0.00049***	0.00049***	0.00049***	0.00049***	0.00051***	0.00051***	0.00051***	0.00051***
	(0.00011)	(0.00011)	(0.00011)	(0.00011)	(0.00011)	(0.00011)	(0.00011)	(0.00011)
Orig occ	0.000097***	0.000097***	0.000097***	0.000097***	0.000098***	0.000098***	0.000098***	0.000098***
	(8.1e-06)	(8.1e-06)	(8.1e-06)	(8.1e-06)	(8.1e-06)	(8.1e-06)	(8.1e-06)	(8.1e-06)
Orig DSCR	0.00078***	0.00078***	0.00078***	0.00078***	0.00076***	0.00076***	0.00076***	0.00076***
	(0.000065)	(0.000065)	(0.000065)	(0.000065)	(0.000065)	(0.000065)	(0.000065)	(0.000065)
Age	-0.00075***	-0.00075***	-0.00075***	-0.00074***	-0.00080***	-0.00080***	-0.00079***	-0.00078***
	(0.000077)	(0.000077)	(0.000077)	(0.000078)	(0.000074)	(0.000074)	(0.000074)	(0.000074)
Balratio	0.0025***	0.0025***	0.0025***	0.0025***	0.0027***	0.0027***	0.0026***	0.0027***
	(0.00047)	(0.00047)	(0.00047)	(0.00047)	(0.00047)	(0.00047)	(0.00047)	(0.00047)
Curr LTV	1.9e-06	1.9e-06	1.9e-06	2.0e-06	2.0e-06	2.1e-06	2.0e-06	2.2e-06
	(0.000013)	(0.000013)	(0.000013)	(0.000013)	(0.000013)	(0.000013)	(0.000013)	(0.000013)
Curr occ	-0.00023***	-0.00023***	-0.00023***	-0.00023***	-0.00024***	-0.00024***	-0.00024***	-0.00024***
	(8.6e-06)	(8.6e-06)	(8.6e-06)	(8.6e-06)	(8.6e-06)	(8.6e-06)	(8.6e-06)	(8.6e-06)
Curr DSCR	-0.0012***	-0.0012***	-0.0012***	-0.0012***	-0.0012***	-0.0012***	-0.0012***	-0.0012***
	(0.000082)	(0.000082)	(0.000082)	(0.000083)	(0.000082)	(0.000082)	(0.000082)	(0.000082)
Observations	1,646,187	1,646,187	1,646,187	1,646,187	1,646,187	1,646,187	1,646,187	1,646,187
R^2	0.008	0.008	0.008	0.008	0.005	0.005	0.005	0.005
Orig Year-Month FE	Y	Y	Y	Y	Y	Y	Y	Y
Curr Year-Month FE	N	N	N	N	Y	Y	Y	Y
SS FE	Y	Y	Y	Y	N	N	N	N
PropType FE	Y	Y	Y	Y	Y	Y	Y	Y
DealType FE	Y	Y	Y	Y	Y	Y	Y	Y
Originator FE	Y	Y	Y	Y	Y	Y	Y	Y
MSA-Year-Month FE	Y	Y	Y	Y	N	N	N	N
MSA-SS FE	N	N	N	N	Y	Y	Y	Y
SE Clust by loan	Y	Y	Y	Y	Y	Y	Y	Y

Notes: 1) Results of estimating linear regressions of transfer likelihood on DPO measures and controls. The DPO variables are measured at the special servicer-month level and all other variables are at the loan-month level. 2) Data is from Trepp for CMBS deals originated from January 2002-September 2009, with performance measured from September 2003-September 2015. Full payoffs and delinquencies are measured as of December 2017. 3) All variables defined in Table 1. Variables are winsorized at the 1% level in each tail. 4). $***p < 0.01$, $**p < 0.05$, and $*p < 0.1$. Standard errors clustered at the loan level.

Table 7: DPOs and full payoff subsequent to transfer

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Transfer (Full payoff)							
DPO[-5,-8]	-0.000064				-0.00011			
	(0.000078)				(0.000076)			
Post x DPO[-5,-8]	0.00073***				0.00074***			
	(0.00028)				(0.00026)			
DPO[-4,-7]		-0.000021				-0.000059		
		(0.000079)				(0.000075)		
Post x DPO[-4,-7]		0.00028				0.00039		
		(0.00031)				(0.00029)		
DPO[-6,-9]			-0.00016**				-0.00021***	
			(0.000079)				(0.000078)	
Post x DPO[-6,-9]			0.0011***				0.00099***	
			(0.00025)				(0.00023)	
DPO[-7,-10]				-0.00029***				-0.00031***
				(0.000075)				(0.000075)
Post x DPO[-7,-10]				0.0012***				0.0010***
				(0.00025)				(0.00024)
Post					0.0074***	0.0078***	0.0072***	0.0068***
					(0.0024)	(0.0024)	(0.0024)	(0.0024)
Observations	1,646,187	1,646,187	1,646,187	1,646,187	1,646,187	1,646,187	1,646,187	1,646,187
R^2	0.005	0.005	0.005	0.005	0.001	0.001	0.001	0.001
Loan controls	Y	Y	Y	Y	Y	Y	Y	Y
Orig Year-Month FE	Y	Y	Y	Y	Y	Y	Y	Y
Curr Year-Month FE	N	N	N	N	Y	Y	Y	Y
SS FE	Y	Y	Y	Y	N	N	N	N
PropType FE	Y	Y	Y	Y	Y	Y	Y	Y
DealType FE	Y	Y	Y	Y	Y	Y	Y	Y
Originator FE	Y	Y	Y	Y	Y	Y	Y	Y
MSA-Year-Month FE	Y	Y	Y	Y	N	N	N	N
MSA-SS FE	N	N	N	N	Y	Y	Y	Y
SE Clust by loan	Y	Y	Y	Y	Y	Y	Y	Y

Notes: 1) Results of estimating linear regressions of transfer likelihood on DPO measures and controls. The dependent variable is equal to 1 if the loan was transferred and realized a full payoff ex-post, and 0 otherwise. The DPO variables are measured at the special servicer-month level and all other variables are at the loan-month level. 2) Data is from Trepp for CMBS deals originated from January 2002-September 2009, with performance measured from September 2003-September 2015. Full payoffs are measured as of December 2017. 3) All variables defined in Table 1. Variables are winsorized at the 1% level in each tail. 4). $***p < 0.01$, $**p < 0.05$, and $*p < 0.1$. Standard errors clustered at the loan level.

Table 8: DPOs and no default transfers

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Transfer (No default)							
DPO[-5,-8]	-0.000097*				-0.00013***			
	(0.000052)				(0.000052)			
Post x DPO[-5,-8]	0.00079***				0.00093***			
	(0.00018)				(0.00017)			
DPO[-4,-7]		-7.5e-06				-0.000045		
		(0.000056)				(0.000054)		
Post x DPO[-4,-7]		0.00038*				0.00063***		
		(0.00021)				(0.00020)		
DPO[-6,-9]			-0.00015***				-0.00020***	
			(0.000055)				(0.000056)	
Post x DPO[-6,-9]			0.0010***				0.0011***	
			(0.00015)				(0.00014)	
DPO[-7,-10]				-0.00017***				-0.00021***
				(0.000055)				(0.000056)
Post x DPO[-7,-10]				0.00094***				0.0010***
				(0.00015)				(0.00015)
Post					0.000036	0.00029	-0.00010	-0.00032
					(0.0019)	(0.0019)	(0.0019)	(0.0019)
Observations	1,646,187	1,646,187	1,646,187	1,646,187	1,646,187	1,646,187	1,646,187	1,646,187
R^2	0.005	0.005	0.005	0.005	0.001	0.001	0.001	0.001
Loan controls	Y	Y	Y	Y	Y	Y	Y	Y
Orig Year-Month FE	Y	Y	Y	Y	Y	Y	Y	Y
Curr Year-Month FE	N	N	N	N	Y	Y	Y	Y
SS FE	Y	Y	Y	Y	N	N	N	N
PropType FE	Y	Y	Y	Y	Y	Y	Y	Y
DealType FE	Y	Y	Y	Y	Y	Y	Y	Y
Originator FE	Y	Y	Y	Y	Y	Y	Y	Y
MSA-Year-Month FE	Y	Y	Y	Y	N	N	N	N
MSA-SS FE	N	N	N	N	Y	Y	Y	Y
SE Clust by loan	Y	Y	Y	Y	Y	Y	Y	Y

Notes: 1) Results of estimating linear regressions of transfer likelihood on DPO measures and controls. The dependent variable is equal to 1 if the loan was transferred yet never defaults, either prior to or after transfer, and 0 otherwise. The DPO variables are measured at the special servicer-month level and all other variables are at the loan-month level. 2) Data is from Trepp for CMBS deals originated from January 2002-September 2009, with performance measured from September 2003-September 2015. Defaults are measured as of December 2017. 3) All variables defined in Table 1. Variables are winsorized at the 1% level in each tail. 4). $***p < 0.01$, $**p < 0.05$, and $*p < 0.1$. Standard errors clustered at the loan level.

Table 9: DPOs and transfers: heterogeneity in pre-regulation time period

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Transfer							
DPO[-5,-8]	0.00013				0.000022			
	(0.000088)				(0.000088)			
Post x DPO[-5,-8]	0.00095***				0.0011***			
	(0.00036)				(0.00034)			
Interim x DPO[-5,-8]	-0.00049**				-0.00059**			
	(0.00024)				(0.00023)			
DPO[-4,-7]		0.00020**				0.000063		
		(0.000091)				(0.000090)		
Post x DPO[-4,-7]		0.00040				0.00061*		
		(0.00038)				(0.00035)		
Interim x DPO[-4,-7]		-0.00053**				-0.00058**		
		(0.00025)				(0.00024)		
DPO[-6,-9]			0.000036				-0.000057	
			(0.000092)				(0.000089)	
Post x DPO[-6,-9]			0.0017***				0.0018***	
			(0.00037)				(0.00034)	
Interim x DPO[-6,-9]			-0.00043*				-0.00063***	
			(0.00023)				(0.00023)	
DPO[-7,-10]				-0.000048				-0.00012
				(0.000089)				(0.000085)
Post x DPO[-7,-10]				0.0014***				0.0016***
				(0.00039)				(0.00037)
Interim x DPO[-7,-10]				-0.00065***				-0.00076***
				(0.00023)				(0.00022)
Post					0.039***	0.039***	0.038***	0.038***
					(0.0035)	(0.0036)	(0.0035)	(0.0035)
Interim					0.021***	0.021***	0.021***	0.021***
					(0.0018)	(0.0018)	(0.0018)	(0.0018)
Observations	1,646,187	1,646,187	1,646,187	1,646,187	1,646,187	1,646,187	1,646,187	1,646,187
R^2	0.008	0.008	0.008	0.008	0.005	0.005	0.005	0.005
Loan characteristic ctrls	Y	Y	Y	Y	Y	Y	Y	Y
Orig Year-Month FE	Y	Y	Y	Y	Y	Y	Y	Y
Curr Year-Month FE	N	N	N	N	Y	Y	Y	Y
SS FE	Y	Y	Y	Y	N	N	N	N
PropType FE	Y	Y	Y	Y	Y	Y	Y	Y
DealType FE	Y	Y	Y	Y	Y	Y	Y	Y
Originator FE	Y	Y	Y	Y	Y	Y	Y	Y
MSA-Year-Month FE	Y	Y	Y	Y	N	N	N	N
MSA-SS FE	N	N	N	N	Y	Y	Y	Y
SE Clust by loan	Y	Y	Y	Y	Y	Y	Y	Y

Notes: 1) Results of estimating linear regressions of transfer likelihood on DPO measures and controls. The variable *Interim* is equal to 1 between January 2008 and September 2009, and 0 otherwise. The DPO variables are measured at the special servicer-month level and all other variables are at the loan-month level. 2) Data is from Trepp for CMBS deals originated from January 2002-September 2009, with performance measured from September 2003-September 2015. Full payoffs and delinquencies are measured as of December 2017. 3) All variables defined in Table 1. Variables are winsorized at the 1% level in each tail. 4). $***p < 0.01$, $**p < 0.05$, and $*p < 0.1$. Standard errors clustered at the loan level.

A Appendix: Robustness

In this section we show the results of sensitivity analyses that illustrate the robustness of our main results. First, we estimate our primary regressions using a tighter window of time surrounding the rule change. Specifically, we use loan performance from September 2005-September 2013, while still using loan originations from January 2002-September 2009. The results for the baseline specifications, reported in Table A1, show that there is no change if we instead using this more restricted loan performance sample.

Second, we consider a more relaxed definition of DPO that does not require the loan payoff to be greater than 0% but less than 80% of the remaining balance. In this analysis, we include all DPOs, regardless of size. The results for the baseline specifications are reported in Table A2 and show that expanding our definition of DPO does not alter the main findings.

Table A1: Robustness: 2005-2013 loan performance

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Transfer							
DPO[-5,-8]	-0.00024*				-0.00044***			
	(0.00014)				(0.00014)			
Post x DPO[-5,-8]	0.0015***				0.0017***			
	(0.00047)				(0.00043)			
DPO[-4,-7]		-0.00019				-0.00041***		
		(0.00014)				(0.00014)		
Post x DPO[-4,-7]		0.0010**				0.0011**		
		(0.00049)				(0.00045)		
DPO[-6,-9]			-0.00035**				-0.00058***	
			(0.00014)				(0.00014)	
Post x DPO[-6,-9]			0.0022***				0.0025***	
			(0.00046)				(0.00043)	
DPO[-7,-10]				-0.00053***				-0.00069***
				(0.00014)				(0.00013)
Post x DPO[-7,-10]				0.0020***				0.0023***
				(0.00047)				(0.00044)
Post					0.031***	0.032***	0.030***	0.030***
					(0.0032)	(0.0032)	(0.0032)	(0.0032)
Observations	1,338,248	1,338,248	1,338,248	1,338,248	1,338,248	1,338,248	1,338,248	1,338,248
R^2	0.008	0.008	0.008	0.008	0.005	0.005	0.005	0.005
Orig Year-Month FE	Y	Y	Y	Y	Y	Y	Y	Y
Curr Year-Month FE	N	N	N	N	Y	Y	Y	Y
SS FE	Y	Y	Y	Y	N	N	N	N
PropType FE	Y	Y	Y	Y	Y	Y	Y	Y
DealType FE	Y	Y	Y	Y	Y	Y	Y	Y
Originator FE	Y	Y	Y	Y	Y	Y	Y	Y
MSA-Year-Month FE	Y	Y	Y	Y	N	N	N	N
MSA-SS FE	N	N	N	N	Y	Y	Y	Y
SE Clust by loan	Y	Y	Y	Y	Y	Y	Y	Y

Notes: 1) Results of estimating linear regressions of transfer likelihood on DPO measures and controls. The DPO variables are measured at the special servicer-month level and all other variables are at the loan-month level. 2) Data is from Trepp for CMBS deals originated from January 2002-September 2009, with performance measured from September 2005-September 2013. Full payoffs and delinquencies are measured as of December 2017. 3) All variables defined in Table 1. Variables are winsorized at the 1% level in each tail. 4). $***p < 0.01$, $**p < 0.05$, and $*p < 0.1$. Standard errors clustered at the loan level.

Table A2: Robustness: alternative definition of DPO

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
					Transfer			
DPO[-5,-8]	-0.00016				-0.00036***			
	(0.00013)				(0.00013)			
Post x DPO[-5,-8]	0.0017***				0.0020***			
	(0.00051)				(0.00047)			
DPO[-4,-7]		-0.00015				-0.00037***		
		(0.00013)				(0.00013)		
Post x DPO[-4,-7]		0.0011**				0.0014***		
		(0.00052)				(0.00048)		
DPO[-6,-9]			-0.00033**				-0.00054***	
			(0.00014)				(0.00013)	
Post x DPO[-6,-9]			0.0023***				0.0025***	
			(0.00050)				(0.00046)	
DPO[-7,-10]				-0.00037***				-0.00058***
				(0.00013)				(0.00013)
Post x DPO[-7,-10]				0.0018***				0.0023***
				(0.00049)				(0.00046)
Post					0.037***	0.039***	0.037***	0.037***
					(0.0036)	(0.0036)	(0.0036)	(0.0036)
Observations	1,646,187	1,646,187	1,646,187	1,646,187	1,646,187	1,646,187	1,646,187	1,646,187
R^2	0.008	0.008	0.008	0.008	0.005	0.005	0.005	0.005
Orig Year-Month FE	Y	Y	Y	Y	Y	Y	Y	Y
Curr Year-Month FE	N	N	N	N	Y	Y	Y	Y
SS FE	Y	Y	Y	Y	N	N	N	N
PropType FE	Y	Y	Y	Y	Y	Y	Y	Y
DealType FE	Y	Y	Y	Y	Y	Y	Y	Y
Originator FE	Y	Y	Y	Y	Y	Y	Y	Y
MSA-Year-Month FE	Y	Y	Y	Y	N	N	N	N
MSA-SS FE	N	N	N	N	Y	Y	Y	Y
SE Clust by loan	Y	Y	Y	Y	Y	Y	Y	Y

Notes: 1) Results of estimating linear regressions of transfer likelihood on DPO measures and controls. The DPO variables are measured at the special servicer-month level and all other variables are at the loan-month level. There are no size restrictions on the DPO variables. 2) Data is from Trepp for CMBS deals originated from January 2002-September 2009, with performance measured from September 2003-September 2015. Full payoffs and delinquencies are measured as of December 2017. 3) All variables defined in Table 1. Variables are winsorized at the 1% level in each tail. 4). $***p < 0.01$, $**p < 0.05$, and $*p < 0.1$. Standard errors clustered at the loan level.

B Appendix: parallel trends analysis

In this section we provide evidence of parallel trends in transfer probability prior to the rule change. In our setting, the Revenue Procedure 2009-45 tax rule change is the treatment, the control group is the set of loans that transfer absent a DPO by the special servicer in a preceding time window, and the treatment group is the set of loans that transfer following a DPO in a preceding time window.

We wish to establish that the transfer probabilities for the control and treatment group would have experienced a similar trend absent Revenue Procedure 2009-45. Although a formal test of this is impossible, we can nevertheless examine the time trend in transfer probabilities between treatment and control groups before and after the rule change. Doing so can provide a better understanding of whether treatment and control groups were in fact behaving similarly prior to the rule change. If the treatment group did not experience a statically different probability of transfer compared to the control group in the months leading up to the rule change, then we can be reasonably confident in the parallel trends assumption.

To study the time trend in transfer probability, we follow the suggestion of Roberts and Whited (2013) and estimate a variation of equation 5 in which we interact $DPO[w]_{s,t}$ (which is equal to 1 when the loan is in the treatment group and 0 when the loan is in the control group) with indicators for each month in the sample period:

$$transfer_{i,s,t} = \beta_0 + \beta_1 DPO[w]_{s,t} + \sum_{t=Sept2003}^{Sept2015} \beta_m Month_t + \sum_{t=Sept2003}^{Sept2015} \beta_n Month_t \times DPO[w]_{s,t} + \beta_x Cont_{i,s,t} + \epsilon_{i,j,t} \quad \text{(B.1)}$$

In this equation, we replace $Post$ with $\sum_{t=Sept2003}^{Sept2015} Month_t$, which is a set of indicators for every month (we exclude September 2009 because that is the month in which the treatment occurs), and we replace $Post_t \times DPO[w]_{s,t}$ with $\sum_{t=Sept2003}^{Sept2015} Month_t \times DPO[w]_{s,t}$, which is each month indicator interacted with the DPO variable. We include the full set of loan

characteristics and fixed effects that are included in the specifications reported in columns 5-8 of Table 6.

The interaction term coefficients from estimating this equation using the variable $DPO[-5, -8]$ are reported in Table B1.[18] For brevity, we report the terms in 3-month intervals: September, December, March, and June. When coefficients could not be estimated due to collinearity, we denote them with "o." We also denote the month in which the rule change occurred with "X."

The results are consistent with no significant pre-trend in the treatment group relative to the control group. Column 2 shows that, prior to September 2009, the interaction terms are statistically insignificant, indicating the treatment group loans were not transferred at a different probability than control loans. In contrast, column 4 shows that, in the post-rule change period, loans were significantly more likely to transfer following a DPO 5 to 8 months prior. In other words, the treatment group experienced a significantly higher likelihood of transfer than the control group following the treatment.

Overall, these results are consistent with the two groups exhibiting parallel trends prior to the rule change, but significantly different outcomes following the rule change.

[18]The results are qualitatively unchanged if we use any of the other three DPO variables.

Table B1: Parallel trends analysis using $DPO[-5,-8]$

(1)	(2)	(3)	(4)
	Transfer		
Sep-03	-7.3e-06	Dec-09	0.0026
Dec-03	-0.0021	Mar-10	0.0032***
Mar-04	0.0016	Jun-10	0.0025***
Jun-04	-0.00024	Sep-10	-0.0017
Sep-04	0.00026	Dec-10	0.0039***
Dec-04	0.00043	Mar-11	0.0057***
Mar-05	-0.00041	Jun-11	0.0041***
Jun-05	0.00037	Sep-11	0.0050***
Sep-05	0.00040	Dec-11	0.0079***
Dec-05	-0.00046	Mar-12	0.0081***
Mar-06	-0.00050	Jun-12	0.0078***
Jun-06	-0.00054	Sep-12	0.0079***
Sep-06	-0.00040	Dec-12	0.0098***
Dec-06	-0.00037	Jan-13	0.011***
Mar-07	o	Feb-13	0.011***
Jun-07	o	Mar-13	0.0094***
Sep-07	-0.00023	Jun-13	0.00034
Dec-07	4.3e-06	Sep-13	0.00075
Mar-08	-0.0029**	Dec-13	0.0019*
Jun-08	-0.0012	Mar-14	0.014***
Sep-08	-0.0026*	Jun-14	0.013***
Dec-08	-0.0023*	Sep-14	0.0011
Mar-09	0.0049	Dec-14	0.00071
Jun-09	-0.00067	Mar-15	0.00082
Sep-09	X	Jun-15	0.00078
		Sep-15	-0.00062
Observations		1,646,187	
R^2		0.005	

Notes: 1) This table reports interaction term coefficients from estimating equation B.1. The controls and fixed effects include those that appear in columns 5-8 of Table 6. The DPO variable is measured at the special servicer-month level and all other variables are at the loan-month level. 2) Data is from Trepp for CMBS deals originated from January 2002-September 2009, with performance measured from September 2003-September 2015. 3) All variables defined in Table 1. Variables are winsorized at the 1% level in each tail. 4). $***p < 0.01$, $**p < 0.05$, and $*p < 0.1$. Standard errors clustered at the loan level.