Strategic Mortgage Default:
The Effect of Neighborhood Factors

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Abstract

This paper studies strategic default—the willingness of a borrower to walk away from a mortgage when the value of the home falls below the unpaid principal balance despite an ability to pay. This study differs from the literature in two fundamental ways: first, we use unique data assets describing the household's equity position and capacity to carry the debt in addition to credit performance to identify strategic defaulters accurately. Secondly, we address externalities from local foreclosures and other strategic defaults and find that the incidence of strategic default is sensitive to the presence of other nearby strategic defaulters. These results have significant implications for foreclosure and loss mitigation policies employed by servicers and investors.

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Introduction

The subprime crisis resulted from a speculative bubble in the housing market that began to burst in the United States in 2006 and caused ripple effects across the globe in the form of financial failures, including the failure of Freddie Mac and Fannie Mae, and a global credit crunch. The house price declines that coincided with the bursting of the bubble are unprecedented. According to the CoreLogic House Price index, home prices nationally declined by more than 30 percent following the June 2006 peak. Declines in selected states, including California, Nevada, Arizona, and Florida have been far greater.

The dramatic declines in house prices have led to a significant portion of mortgagees with homes that are markedly lower in value than the remaining mortgage balance. A recent industry report[1] on negative equity indicates that, as of the end of the first quarter of 2012, more than 11.4 million U.S. mortgages—23.7 percent of all mortgaged properties were in negative-equity positions, meaning the borrower's mortgage debt exceeded the value of the home. The distribution of negative equity is concentrated in five states: Nevada, Florida, Arizona, Georgia, and Michigan. These top five states combined have a negative equity share of 44.5 percent, while the remaining states have a combined average negative-equity share of 15.9 percent.

The high proportion of borrowers with negative equity led to a rapid increase in foreclosures, compounded by the rapid rise in the unemployment rate from 4.7% in December 2007 to 7.2% by December 2008 and 10.2% by October 2009 and the 8.8 million nonfarm payroll jobs that were lost during the recession. The high unemployment and

dismal housing market performance have persisted a full 3.5 years past the end of the recession.

A recent report on foreclosure activity[2] indicates that sales of homes that were in some stage of foreclosure or real estate-owned (REO; a.k.a. bank-owned) accounted for 23 percent of all U.S. residential sales during the second quarter of 2012. Foreclosure sales accounted for 43 percent of all residential sales in both Georgia and Nevada in the second quarter, the two highest percentages among the states despite decreasing foreclosure- related sales activity in both states. California foreclosure-related sales in the second quarter decreased 10 percent from a year ago, but still accounted for 40 percent of all residential sales in the state—the third highest percentage of any state.

In response to the crisis, President Obama announced the Homeowner Affordability and Stability Plan on February 18, 2009 to help up to 7 to 9 million families restructure or refinance their mortgages so to avoid foreclosure. As part of this plan, on March 4, 2009, the Treasury Department announced a national loan modification program aimed at helping 3 to 4 million at-risk homeowners. Under the Home Owner Affordable Modification program (HAMP), a loan servicer uses a uniform modification process to address a borrower's inability to pay and to provide a borrower with sustainable monthly payments.[3]

A less well known federal program is the U.S. Department of Housing and Urban Development's Neighborhood Stabilization Program which was authorized by the Housing and Economic Recovery Act of 2008 and has awarded $4 billion in grants to state and local governments to reduce the social costs associated with foreclosed properties. A second version of this was included in the American Recovery and Reinvestment Act of 2009 and

included an additional $2 billion in funding. These grants are predicated on the belief that foreclosure in general and vacancies in particular can generate significant social costs in the form of increased municipal expenses and reductions in the value of nearby properties.

Despite these enormous public policy initiatives, delinquencies, defaults and foreclosures have remained stubbornly commonplace. Moreover, primary concerns with HAMP loan modifications include the seemingly high rate of re-default on modified loans and a lack of focus on 'strategic default' – the willingness of a borrower to walk away from a mortgage when the value of the home falls below the unpaid principal balance despite an ability to pay. Within six months, over half of all modified loans were 30 days or more delinquent and over a third were 60 days or more delinquent (OCC and OTS 2009).

Additional pressure is being applied to expand existing government programs and industry leaders have called for additional programs "where there is principal reduction for borrowers with negative equity in their home" as opposed to just an interest rate reduction.[4] Moreover, the Federal Housing Finance Agency Office of Inspector General issued a report in October 2012 that argued that the FHFA has an opportunity to provide Freddie Mac and Fannie Mae guidance about effectively pursuing and collecting deficiencies from targeted groups of borrowers who may possess the ability to repay (i.e., strategic defaulters).[5]

In Bradley, et al. (2012), we brought unique data assets to the problem of accurately measuring strategic default. After briefly summarizing this research, this article focuses on whether foreclosures and strategic defaults are contagious. Our specific hypothesis is that a neighborhood that has experienced a high percentage of foreclosures is a less desirable place to live and thus increases the likelihood of default even among those borrowers that

can still afford to make their mortgage payments. The roots of this hypothesis are agent-based models, especially the work of Thomas Schelling (1971, 1978) and his colleagues. However, unlike Schelling's interest in the persistence of segregation in housing markets, the catalyst for the undesirability of a neighborhood today stems from a high proportion of foreclosed properties. A simple model is presented in the Appendix that provides more structure to our hypothesis. In short, the argument is rather simple: as the foreclosure rate increases, a contagion effect takes over and the higher proportion of foreclosures itself becomes a 'trigger', with no other borrower specific event needed to induce loan default. Additionally, we examine if strategic default itself is contagious.

Understanding the determinants of mortgage default and how default is exercised is important for the development of models to aid in underwriting and the specification of normative pricing models for mortgages and mortgage-backed securities. Additionally, understanding the determinants of default is important for public policy where taxpayer money has been focused on reducing foreclosures by offering loan modifications to homeowners.

Previous Studies of Strategic Default

A number of studies examine 'strategic default'. However, existing studies of strategic default ignore important necessary conditions for it to occur, namely negative equity position and a lack of capacity to carry all debts, as evidenced most importantly by income or wealth capacity and related triggers. We leverage unique data to overcome these deficiencies and discover that strategic default, though important, is not nearly as prevalent as others have suggested. Moreover, as will become evident, we think each of these studies

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is limited by a failure to address the problem of externalities faced by borrowers and banks. All real estate is local, and a clear understanding of the dynamics occurring within neighborhoods is critical to developing a solution to the problem.

Foster and Van Order (1984) were the first to apply option theory formally to the field of mortgage default. Using data on FHA 203(b) default rates from 1960 through 1978, the authors estimate loan-to-value ratios over time and use this information to create a number of variables that represent the percentage of loans with negative equity for each year in the study period. These equity variables are included in the regression model in current and lagged form. Overall, the option-based model of default works remarkably well: It explains over 90 percent of the variance using just the equity variables. The significance of the lagged equity terms indicates that the default option is not exercised immediately. Given a borrower with negative net equity, Foster and Van Order contend that an event such as a divorce or loss of employment might be needed to 'trigger' a default, although no empirical support is provided for this contention. Ultimately, Foster and Van Order attribute the imperfect exercise of the option to the importance of transactions costs.

The role of transactions and other costs in the default decision has been the subject of a number of other studies. For instance, Kau, Keenan, and Kim (1994) develop an inter-temporal optimization model of the default decision and argue that a borrower defaults not when the value of the equity falls below the unpaid principal or the present value of the payments, but when it falls below the value of the mortgage to the borrower. Using simulation analysis, the authors find support that the value of the house must fall by substantially more than the value of the mortgage's termination option at the point of zero

equity before it is in fact rational for a borrower to default. The authors conclude that the amounts involved could be mistaken for transaction costs when in reality transactions costs play little or no role in the default decision.

Experian-Oliver Wyman (2009) use credit-bureau data to study strategic defaulters. In particular, a borrower's credit performance is analyzed on all credit obligations before and after serious mortgage default (60 DPD). Individuals who remain current on the non-mortgage trade and roll straight from current to 180+ DPD on the mortgage trade are defined as strategic defaulters. The underlying presumptions are that the behavior is driven by underwater homes and not by income distress. However, the study controls for neither of these circumstances: there is no measure of negative equity; there is no ability to differentiate borrowers who stopped paying their mortgage because of an inability to continue to pay all of their obligations from borrowers who have suffered no deterioration in income. Moreover, some of the recommendations, e.g., that strategic defaulters should not be given a loan modification, conflict with basic option theory.

Das (2009) models the problem of strategic default and recommends a two-phased approach: first, determine if a loan should be modified or given another treatment; and, second, for those that should be modified, rely to a much greater extent on loan write-downs. These results are consistent with those of Kau et al. (1992, 1995). Obviously, if a borrower only cares about their equity position, then the only way to prevent him from exercising the default option is to take him 'out of the money', that is, lower the loan amount. Reducing the interest rate will have *no* effect on such borrowers.

Adelino, Gerardi and Willen (forthcoming) examine redefault risk among nonperforming

mortgage loans and use a theoretical model to show that the possibility that a borrower will

still redefault despite costly negotiation on a modification, and self-cure risk, the possibility

that a seriously delinquent borrower will become current without negotiation, make

negotiation unattractive to investors. They provide a very simple explanation for this

behavior; namely, lenders expect to recover more from foreclosure than from a modified

loan. They do point out, however, that while the model shows why investors may not want

to perform modifications it does not necessarily imply that modifications may not be

socially optimal. Large financial incentives to investors or even to borrowers to continue

payment could mitigate this problem.

Guiso, Sapeinza, and Zingales (2013) examine the strategic default hypothesis, but mostly

with survey data. They report that the willingness to default increases nonlinearly with the

proportion of foreclosures in the same ZIP code and that roughly 25 percent of existing

defaults are strategic. Moreover, the authors report no household with the ability to pay

defaults if the equity shortfall is less than 10 percent of the value of the house. Yet, 17

percent of households would default, even if they can afford to pay their mortgage, when

the equity shortfall reaches 50 percent of the value of the house.

Wilkinson-Ryan (2011) uses experimental methods to examine strategic default and

specifically examines social and contextual triggers that reframe foreclosure as a contract

option rather than a moral violation. Using a sequence of experiments, Wilkinson-Ryan

finds that the likelihood of strategic default increases for banks that have been bailed out,

that are perceived as acting greedy (e.g., large subprime presence), that have sold servicing

rights to another party, and for homes located in neighborhoods where the foreclosure rate is high.

Seiler, et al. (2012) conducted a survey of mortgagees to examine why some decide to strategically default while others do not. They find that realized shame and guilt are consistent with ex ante expectations. However, the financial backlash experienced by strategic defaulters is less than anticipated, causing strategic defaulters not to regret their actions. Empirically, they find key strategic default drivers include the homeowner's expectation of future real estate price movements, frustration with the lender, moral evaluation of the decision to strategically default, loan knowledge, political ideology, gender, income and age.

Goldstein, et al. (2011) use a large sample of U.S. mortgages observed over the 2005-2009 period, and find that foreclosures are contagious. After controlling for major factors known to influence a borrower's decision to default, including borrower and loan characteristics, local demographic and economic conditions, and changes in property values, the likelihood of a mortgage default increases by as much as 24 percent with a one standard deviation increase in the foreclosure rate of the borrower's surrounding ZIP code.

The authors claim that contagion is most prevalent among strategic defaulters: borrowers who are underwater on their mortgage but are not likely to be financially distressed. Unfortunately, the authors use rather crude tools to measure strategic default such as broad stratification criteria that include FICO (at origination), property value, and per capita income in the ZIP code. Finally, the authors do not have data on the presence of junior liens, so they cannot compute the combined LTV for loans in the sample. Frame (2010)

provides a critical review of the literature seeking to estimate foreclosure externalities. As a group, the papers are consistent with the existence of social costs related to foreclosure activity as reflected in the prices of nearby homes.

The empirical evidence relating to foreclosure effects on nearby property sales prices suggests a discount, with such discounts dissipating quickly the farther away the foreclosed property is from the sale in space and time. All of the papers reviewed, however, focus only on the effect that foreclosures may have on nearby prices. None address the impact that foreclosures may have on behavior, including default, of nearby borrowers.

Seiler, Lane, and Harrison (forthcoming) examine the herding behavior of individuals in the context of their willingness to strategically default on a mortgage based on the (falsely) observed behavior of those around them. They conduct experiments with feedback to participants and find that homeowners are easily persuaded to follow the herd and adopt a strategic default proclivity consistent with that of their peers.

Research Methodology

Before heading into an empirical examination of strategic default and possible contagion effects, it's necessary to place this behavior in the context of other work that investigates the determinants of mortgage default and how default is exercised. Figure 1 is a heuristic tool that will help us accomplish this task.

[Figure 1 here]

As discussed in Section II, an extensive literature focuses on the determinants of mortgage default and on the idea that a mortgage can be viewed as a collection of financial options. One of the central tenets of this theory is that default is similar to a put option where the borrower has the right to sell the house to the lender at the face value of the mortgage when the value of the house falls below the unpaid principal balance on the mortgage. In practice, all borrowers in area B, those with negative equity, are treated as though they will default. Under the extended view of the pure option theory, not all borrowers in B default, as some elect to preserve their ability to default at some future time (alternatively, maintain their rights to the shelter services of the home and any future asset appreciation), which also has value. It is typically believed that borrowers with loan-to-value ratios as high as 110 percent might elect to remain current so as to afford themselves the option of defaulting in the future.

Under the 'trigger' theory, trigger defaulters come from area *TD*, of Figure 1, that is, from the pool of borrowers with negative equity who have suffered a 'life event' such as job loss, divorce, serious illness or death. Furthermore, even some borrowers with near negative equity (such as those in area DD, "distress defaulters"), might elect to default because transactions costs might eliminate their small equity positions and their financial distress is such that they lack the capacity to carry the monthly obligation even for a short time.

The strategic default literature instead begins with the pool of borrowers that have defaulted and asks which proportion of these borrowers defaulted despite having the ability to make payments. Again, for heuristic purposes, denote this set of borrowers as defined by the union of areas DD, TD, and SD in Figure 1. The strategic default literature attempts to

identify the proportion of borrowers in area SD relative to the total number of borrowers that have defaulted. Unfortunately, existing studies ignore some of the necessary conditions for strategic default. For example, existing studies use the absence of default on any other credit obligation as evidence that the borrower could afford to pay. However, when faced with a negative income shock that requires a choice about which debts to pay, a borrower may elect to pay all obligations except the mortgage. Such a decision may be perfectly rational since the mortgage is typically the largest debt payment and the borrower may continue to reside in the home for quite some time even after payments are missed. Without controlling for income shocks, such behavior would be classified incorrectly as strategic when it is not.

Conditioned on default, identifying which borrowers defaulted strategically from those that did not is a straightforward qualitative dependent variable problem that we model using a logistic framework.

Data

We created a panel data set that combines CoreLogic loan-level data contributed by large mortgage servicers and CoreLogic local market data with credit and income data provided by Equifax. CoreLogic servicing consortium data comprise over 43 million mortgages, representing 88 percent coverage of active prime and subprime loans, including 100 percent of all Government Sponsored Enterprise loans. In addition to the GSE data, CoreLogic maintains a servicing feed from eight of the top ten mortgage lenders/servicers in the country.

Equifax's Consumer Information Solutions maintains credit bureau records on consumers submitted by financial institutions describing account balances, limits, and payment history. As of September 2013, Equifax had information on 47.9 million first lien mortgages and the borrowers and co-borrowers on those accounts.[6]

Equifax's Workforce Solutions maintains active payroll and employment information on 54 million workers in its *The Work Number*® (TWN) database, the nation's largest central source of consolidated employment information collected from more than 7,000 employers nationwide. The EFX TWN database reports only actual payroll data, not modeled, surveyed or aggregated information. The individual is the unit of observation and the worker's employment and income data are used to gauge whether they have suffered a significant negative income shock before defaulting on their mortgageWhile EFX TWN data is ideal because it is actual payroll information, the sample of matched records is limited, particularly when there are multiple borrowers on the mortgage loan, and it does not cover self-employed borrowers. For an alternative view with greater coverage we looked to a measure of modeled household income, Equifax's IXI Services' Income360, to assess income shocks and find results very similar to those that rely on EFX TWN database. The Income360 measure estimates household income from assets and wages. The estimates are produced twice a year, based on June 30th and December 31st snapshots of approximately $11 trillion in direct measured financial assets supplied by the Equifax IXI network member financial institutions in addition to surveyed household wage and salary income. Income360 measures a more permanent or smoothed income rather than transitory income at the micro-neighborhood level.[7]

We anonymously merged Equifax's credit and income data to the CoreLogic records. Key fields for the study included:

Loan characteristics from CoreLogic:

- Origination date

- Original and current LTV

- Original and current loan balance on first and second liens

- Loan product

- Loan purpose

- Interest rate and reset information

- Occupancy status at origination

- loan status

- Origination and Current property values (current values marked-to-market using

- CoreLogic's House Price Index)

Local market information from CoreLogic:

- Neighborhood foreclosure rate calculated as the ratio of the cumulative

  foreclosure cases in the past 12 months over the average loan count in the past

  12 months, where the loan count is the total number of outstanding first-lien

  loans within the ZIP code. The ending point for the past 12 months period is

  two months prior to a loan going 60 DPD for the first time.

Credit-bureau information from Equifax:

- # of times of borrowers were 30+ days past due (DPD) on non-mortgage trades

  in the past **12** months at month t

- # of times of 30+DPD on mortgage trades in the past **12** months at month t

- Average balances of 30+ DPD on non-mortgage trades in the past **12** months

- # of times of 30+DPD on non-mortgage trades in the past **6** months at month t

- # of times of 30+ DPD on mortgage trades in the past **6** months at month t

- Average balances of 30+ DPD on non-mortgage trades in the past **6** months at month t

- Origination and updated Vantage Scores

Income information from Equifax:

- Employment status at month t (*TWN*)

- Individual income at month t (*TWN*)

- Household income (IXI Income360) measured as most recent observation prior to borrower becoming 60 DPD on the mortgage account)

The population of interest is loans that rolled to 60 days past due for the 1st time during the June 2008 to June 2011 interval. Each loan was tracked for 6 months to determine if it rolled straight to 180 DPD or worse. Since strategic default is defined as a loan that rolls straight from current to 180 DPD, we also captured loan performance status for the two months prior to each loan rolling to 60 DPD for the first time.[8] The initial data pull from CoreLogic's database prior to data cleaning and exclusions included 1.7 million loans. After applying cleaning and exclusion rules and merging with Equifax credit data and IXI Income360 data the sample contained 845,659 records (hereafter called the EFX IXI sample) and once merged with Equifax TWN employment records, the sample contained 135,025 observations (hereafter called the EFX TWN sample).[9]

[Table 1 here]

In an effort to identify strategic defaulters – borrowers that walk away from a mortgage despite an ability to pay – we extend the work of Experian-Oliver Wyman (2009) and others by also ensuring that the borrower had negative equity at the time of default and that the borrower was not income constrained. First, like Experian-Oliver Wyman (2009), we identify strategic defaulters as borrowers that were current on their non-mortgage debt all the time, but went straight from current to 180+ DPD without any curing in between.

In other words, borrowers are not treated as strategic defaulters if they made full or partial payments on the mortgage at any point after their missed payments or if they went delinquent on any other tradeline during the observation period. These borrowers are considered to be distressed borrowers due to an inability to make payments. For both the EFX IXI sample and the EFX TWN sample, the share of defaulted loans that meet the Experian- Oliver Wyman strategic default definition is 21 percent. Second, for true strategic default, there must be negative equity at the time the borrowers become delinquent. No one with any equity in their home would ever walk away from the mortgage. Hence, being underwater is a necessary condition for strategic default. Unlike many previous studies, we consider all liens on the property to determine the equity position. We are able to determine if the borrower has negative equity by applying the CoreLogic repeated-sale housing price index to each property to calculate the current value and hence the current loan-to-value ratio. In the EFX IXI sample, 15.5 percent of the original defaulter sample is now classified as a potentially strategic defaulter. In the EFX TWN sample, the share is 16.6 percent.

Finally, we consider whether borrowers experience income shocks by directly examining changes in income. A borrower that has suffered an income shock may be forced to choose between their debt obligations given limited resources. Such a borrower may elect to go delinquent on the mortgage account but not on other payments. We assume that all borrowers originally had sufficient capacity to carry the mortgage debt, so loss of income will create financial distress. The challenge is in defining what constitutes an income shock. For the EFX TWN sample we investigate three definitions: (1) no income shock; (2) and income shock of 10 percent or less; or (3) an income shock of 20 percent or less. The equivalent definitions in the EFX IXI Sample are (1) no change in average micro-neighborhood income; an income loss of 2 percent or less; and (3) an income loss of 8 percent or less. These definitions create a strategic default share range of 7.7 percent to 14.6 percent.

Strategic default is a real problem with identifiable characteristics. However, our findings suggest that while strategic default is a material problem that should be considered in loss mitigation, underwriting and pricing models, it is far less important than some have suggested. Indeed, our findings are in line with the 9 to 13 percent range reported by Barclay's Capital and far below the 35 percent reported by the University of Chicago's Booth School of Business.

For the rest of the study we consider those strategic defaulters who have experienced a 20 percent (8 percent for the EFX IXI sample) or smaller reduction in monthly income as it is the broadest. Summary statistics for the EFX TWN sample are provided in Table 2.

[Table 2 here]

In Table 3 we show some simple cross tabs by loan characteristics. The incidence of strategic default increases as the loan goes deeper into negative equity: 15 percent of loans with CLTVs between 100 and 110 percent are strategic defaulters while 33 percent of loans with CLTVs in excess of 160 percent are. Similarly those who had a refreshed Vantage credit score in the deeply subprime range of 500 to 680 have a strategic default rate of 4 percent while those with super prime scores, those above 800, have a 32 percent rate. Finally, proximity to other defaulters is very strongly correlated with strategic default.

If fewer than 0.5 percent of mortgagees in a ZIP Code have entered into foreclosure during the last year, the incidence of strategic default is just 5 percent. However, if more than 4 percent of a borrower's ZIP Code neighbors have gone into foreclosure, the rate jumps to 22 percent.When a borrower defaults on his mortgage and the home goes through the foreclosure and REO disposition processes, this action affects the well-being of surrounding homeowners. To the extent that the proportion of foreclosures in a market remains low, the externality is likely to be modest. However, additional foreclosures in a market impact the tax base, the quality of local schools, and crime. Since a home is not just a financial transaction for a borrower, but also a way of generating consumption services, and since foreclosures affect these consumption services, a higher proportion of foreclosures likely affect a borrower's willingness to continue to pay his mortgage, even if he has the ability to do so. When such circumstances exist, actions taken by individuals in their own best interest, may lead to social outcomes that are undesirable, consistent with the theory presented in the Appendix. In the next section we focus our attention on this proximity correlation.

[Table 3 here]

Regression Results for Strategic Default and Contagion

Our basic empirical model is a logistic model of strategic default:

Prob(Strategic Default | 60 DPD) = f(borrower attributes, loan attributes, economic factors; *local foreclosure rate, local strategic default rate*)

To test the proximity externality theory, we regressed the strategic default indicator on local measures of the foreclosure rate, while controlling for key credit risk characteristics. The focus of the analysis is whether a neighborhood that has experienced a higher percentage of foreclosures increases the likelihood of default even among borrowers that can still afford to make their mortgage payments. Similar to Goldstein, et al. (2011) we contend that mortgage defaults are contagious if they directly increase the likelihood of default of a mortgage on a nearby property, all else held constant and we interpret a positive and significant impact of the area foreclosure rate and area strategic default rate on the probability of default as contagion.

Strategic default is the same as previously defined. The foreclosure rate data include foreclosure information from the CoreLogic MarketTrends dataset and cover most of the ZIP codes in the nation. We chose the 12-month cumulative foreclosure rate as the relevant measure since the number of foreclosure cases in one month within one ZIP code is very small and fluctuate widely from month to month. To reduce the chance of getting a spurious result, the foreclosure rate is calculated as the ratio of the cumulative foreclosure cases in the past 12 months over the average loan count in the past 12 months.

The strategic default term entered as a regressor is the cumulative ZIP-Code level strategic default rate over the preceding 12 months for the neighborhood at the month that each strategic default loan was last "current" and then started straight rolling to 180+ DPD. The results are reported in Tables 4 and 5. Model 1 displays the regression output with neighborhood foreclosure rate as an explanatory variable but without the neighborhood strategic default rate as the base case; Model 2 adds the local area strategic default rate. All of the coefficients have the expected signs with statistical significance at the 5 percent level or better.

[Tables 4 and 5 here]

As can be seen, strategic defaulters are more likely to be borrowers who obtained a mortgage with limited or no income or asset documentation than those with full documentation. One argument is that limited/no documentation borrowers are more confident that servicers will not have much information about their assets and hence be unlikely to pursue any action against them. Hence, borrowers who took out limited/no documentation loans are more likely to strategic default.

Credit-worthy borrowers are more likely to default strategically. We find that, everything else constant, a 50-point jump in the Vantage Score at the time of default is associated with a 5 percentage point increase in the probability of strategic default.

Strategic default tends to increase as a loan ages initially, peaks around month 36, and then declines – a reflection of the natural life-cycle of homeownership. Older loans will have the advantage of accumulated amortization creating a greater equity buffer and greater

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borrower loyalty to the local area. Newer loans tend to have weaker equity positions and will be more vulnerable to price declines, particularly if the home was purchased or equity was extracted during the peak of the home-price bubble.

Underwater borrowers who default sometimes face recourse risk. The threat of recourse option would be expected to reduce the incentives to strategic default. Legal scholars (e.g., White (2009)), however, point out that lenders rarely exercise the recourse options, even in states that allow recourse. On the other hand, Ghent and Kudlyak (2009) provide evidence that recourse laws affect the probability of default. Even though lenders rarely pursue the recourse option, the tax liability from forgiven recourse debt may have discouraged default. Our empirical results shows, after controlling for other risks, the existence of the recourse option lowers the probability of strategic default significantly.

Borrowers with higher loan balances are more likely to be strategic defaulters, since a larger loan balance provides a greater incentive for borrowers to walk away from their mortgage if the higher dollar amount of loss can be eliminated by defaulting.

Negative externality from neighborhood foreclosures is confirmed in the regression output. Borrowers in the community with a high foreclosure rate are more likely to walk away from the mortgages, consistent with numerous studies in the literature (see Frame, 2010).

One question often being raised in the media since the financial crisis is whether moral aversion to default had decayed over time and led to more strategic default. With more borrowers learning about other borrowers strategically defaulting on their mortgages, the cultural environment may have shifted to make strategic default less stigmatizing and, thus,

led to more strategic defaulters. Shiller (2010) argued that over time, strategic defaults are

contagious and are likely to grow:

> *"Strategic default on mortgages will grow substantially over the next year,*
>
> *among prime borrowers, and become identified as a serious problem. The*
>
> *sense that 'everyone is doing it' is already growing, and will continue to*
>
> *grow, to the detriment of mortgage holders. It will grow because of a*
>
> *building backlash against the financial sector, growing populist rhetoric and*
>
> *a declining sense of community with the business world. Some people will*
>
> *take another look at their mortgage contract, and note that nowhere did they*
>
> *swear on the bible that they would repay."*

To test this hypothesis, we add the ZIP Code-Level neighborhood strategic default rate into

the model. The results are presented under Model 2 in Table 4.

Both the ZIP Code-level foreclosure and strategic default rates are important determinants

of strategic default, consistent with our theoretical model. That the first term is significant

is also consistent with some prior research (e.g., Goldstein et al. (2011)) and in our context

suggests that a higher local rate of foreclosure leads to the types of externalities discussed in

the literature, enticing some borrowers who still have the ability to continue to make their

mortgage payments to stop doing so. In this context, a higher rate of foreclosures acts as a

'trigger' event.

That the strategic default term is also statistically significant indicates that, even after

controlling for area foreclosure rate, the likelihood that you may know someone who has

strategically defaulted independently increases the likelihood of strategic default. As such our results reaffirm the findings of survey (e.g., Guiso, Sapienza, and Zingales (2013)) and experimental studies (e.g., Wilkinson-Ryan (2011)) that suggest that strategic default itself is contagious.

As a robustness check on our regression results, we repeated the regressions using the Equifax IXI sample. As stated earlier, unlike Equifax TWN data measuring individual incomes, Income360 provides a smoothed or permanent income measurement at micro-neighborhood level. Using Income360 data, we are able to get an increased number of matches on our original CoreLogic loan data-Equifax credit data merged sample. In Table 5 Model 1 and Model 2 are the same specifications as those used for the EFX TWN sample. Both the neighborhood foreclosure and strategic default rates are statistically and economically significant after controlling for all other risks.

Conclusions and Policy Implications

Results of our analysis suggest that local market conditions, as measured by the foreclosure rate and the local rate of strategic default, do affect borrowers' willingness to stop paying their mortgage, even though they have the ability to do so. In particular, the 12-month cumulative foreclosure rate measured at the ZIP-code level and the local rate of strategic default are statistically significant and economically important determinants of strategic default across a wide array of model specifications indicating contagion.

These findings are consistent with our simple game-theory model and point to the need to expand the types of modifications and other public policy alternatives currently being

offered troubled borrowers to address the externality problem resulting from foreclosure, especially for borrowers in areas where the foreclosure rate may become or already is high.

There are likely many policy alternatives that may meet this need. For example, The U.S. Department of Housing and Urban Development's Neighborhood Stabilization Program might be extended; the emphasis on pursuing deficiency judgments might be helpful in deterring borrowers from pursuing this option; and behavioral economic approaches might be applied to increase the borrower's stigma from strategic default.

It is clear that while strategic default is less of a problem than some researchers have claimed, it's still a significant issue and failure to address this problem and the externalities they cause is likely to lead to additional disruption within communities in the form of the unnecessary failure of a large number of local neighborhoods. For perspective, there were 48.6 million first liens outstanding in November 2012 and the 60- DPD rate was 0.82 percent, meaning there were 400,000 at that stage of delinquency. Using the most conservative measure of strategic default, 31,000 of these defaults were strategic – able to pay but choosing not to do so. Using the broadest definition, 58,000 defaults per month are strategic. Knowing that where these are concentrated will indicate where they are likely to continue to happen at high rates in the future.

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Appendix

This appendix provides a simple model to provide more structure to our hypothesis that foreclosures and strategic defaults are contagious. If this hypothesis is correct it has major implications including, net credit loss modeling, reserve setting, stress testing, costing/pricing, and determination of capital adequacy. It may also lead to contagion effects across asset classes in addition to the feedback effects on local house prices.

A Simple One-Period Model

A non-cooperative lending game is offered as a way of motivating the econometric analysis that appears in the body of the paper. The model begins as a simple extension the work of Riddiough and Wyatt (1994) who posit a two-player game between a borrower and a lender. The borrower can choose one of two actions: pay the mortgage or default. For borrowers who elect to default, the lender then chooses to either modify the loan or proceed to foreclosure. The authors demonstrate that it is generally in the interest of both players to reach negotiated modified loan terms.[10]

To be specific, Figure A1 presents the game tree. Player H is the borrower and player L, the lender. After observing the value of the property value at time T, the borrower can choose one of two pure strategies: payment according to the loan terms non-default, N, or default, D. If the borrower decides to pay, her payoff is the value of the property, P_T, less the loan balance Q_T, and the periodic loan payment, M. If the borrower pays, the lender receives $Q_T + M$.

[Figure A1 here]

The borrower may elect instead to default, D. If no negotiated foreclosure strategy is agreed upon, the respective payoffs are $-C_H$, the cost of foreclosure to the borrower, with the lender receiving $P_T - C_L$, the value of the property less the lender's cost of foreclosure C_L.

Riddiough and Wyatt demonstrate that it is in the interest of both the borrower and lender to reach a settlement as long as the following condition is satisfied;

$$-C_H < P_T - (Q_T + M) \leq C_L, \tag{1}$$

with designated payoffs denoted by B_H and B_L, respectively.

A Simple One-Period Model With Externalities

An extension of the Riddiough and Wyatt (1994) model includes two borrowers, B^1 and B^2, and two lenders, L^A and L^B. Furthermore, externalities exist such that the decision to default by one player decreases the cost of default to the other player. Such externalities can be in a number of forms, but always seem to be in the direction of decreasing the cost of default. For example, Capone and Metz (2003) discuss how empty houses and depressed sale prices for foreclosed properties have feedback effects on the market and that abandonment and blight can destroy neighborhoods.

Guiso, Sapeinza, and Zingales (2013) point towards a reduced psychological cost of default when those around you have elected to default too. Finally, a large number of foreclosures

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would decrease the value of the consumption services consistent with arguments made by

Cutts and Merrill (2008).

In the extended game, the two borrowers decide first whether they want to pay the mortgage

or default and the lenders then decide whether to modify or foreclose. The payoff matrix

following the first move of the game is represented in Figure A2.

[Figure A2 here]

Under these conditions the settlement condition for each player and her bank now become:

$$-C_{H,i}^* < P_{H,i}^T - \left(Q_{H,i}^T + M_i\right) \leq C_{L,j} \tag{2}$$

where, $i = 1,2$ indicates borrowers 1 and 2, $J = A, B$ denotes lenders A and B.

Since $-C_{H,i_{H,i}}^* < P_{H,i}^T {}_{\overline{H,i}} \left(Q_{H,i}^T + M_i\right) \leq C_{L,j}$ for each borrower because of the externalities, a

comparison of (1) and (2) yields two points worth noting: First, borrowers who are aware of

the externality problem that results from foreclosure are more likely default in the first

place; and (2) if a bargaining solution is obtained between any borrower and her bank, such

a modification is less likely to be sufficient to prevent redefault compared to that in (1),

unless the bank explicitly recognizes and accounts for the lower cost of foreclosure faced by

the borrower, which is unlikely. Failure to appropriately address the externality problem

attributable to foreclosures leads to an outcome that is not socially optimal.

The behavior of lenders is also affected by the externality problem. Acting on its own, a

bank willing to provide a loan modification to a borrower may find that it has not been

successful in keeping the borrower in the home unless other banks provide relief to

similarly situated borrowers in the same neighborhood. As such, each bank is reluctant to

provide relief without the assurance that other banks will do so too.

Figure 1: Universe of Borrowers – Identifying Distressed and Strategic Defaulters

A — Borrowers who have had a life event

DD TD SD

B — Borrowers with negative equity

Borrowers with capacity and equity
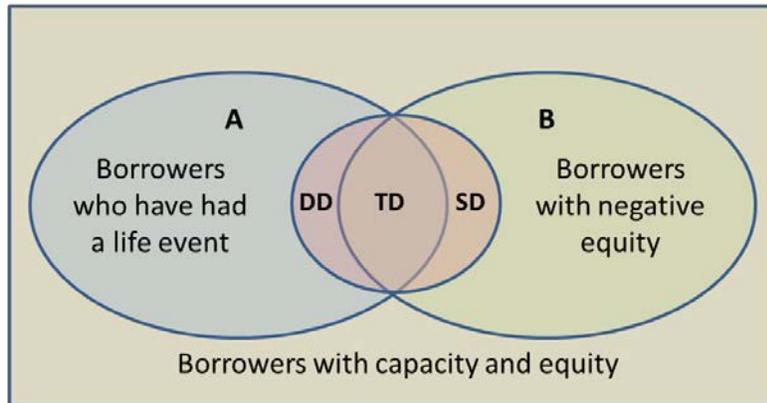
Figure A1: Tree Representation of Riddiough and Wyatt (1994) Game
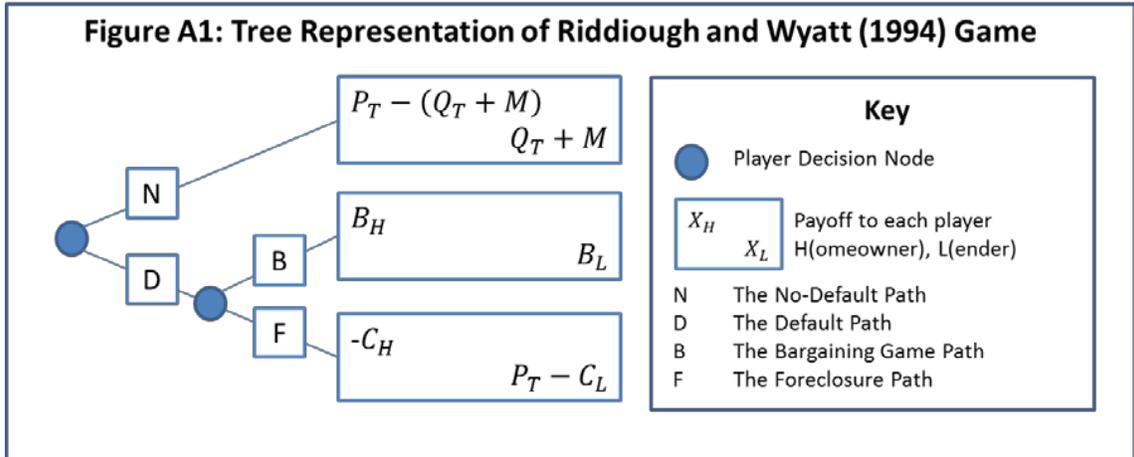
Figure A2: Tree Representation of Riddiough and Wyatt (1994) Game with 2 Borrowers and 2 Lenders

Borrower 1

	Borrower 1	
Borrower 2	$\begin{aligned} P_{T,1} - (Q_{T,1} + M_1) \\ P_{T,2} - (Q_{T,2} + M_2) \end{aligned}$	$\begin{aligned} -C_{H,1} \\ P_{T,2} - (Q_{T,2} + M_2) \end{aligned}$
	$\begin{aligned} P_{T,1} - (Q_{T,1} + M_1) \\ -C_{H,2} \end{aligned}$	$\begin{aligned} -C_{H,1}{}^* \\ -C_{H,2}{}^* \end{aligned}$

Key

$\begin{aligned} X_{H,1} \\ X_{H,2} \end{aligned}$ Payoff to each borrower (H), 1 and 2

Table 1: Measuring Strategic Default Incidence

Group	I.	II.	III.	IV.a.	IV.b.	IV.c.
Definition of Default	Simple Default	Experian-Oliver Wyman Strategic Default	CoreLogic-Equifax Strategic Default on Negative Equity	CoreLogic-Equifax Strategic Default on Negative Equity & Capacity	CoreLogic-Equifax Strategic Default on Negative Equity & Capacity	CoreLogic-Equifax Strategic Default on Negative Equity & Capacity
	Loan went first-time 60+ DPD between June 2008 & March 2011	Group I. members that went straight to 180+ DPD while staying current on all non-mortgage tradelines	Group II. members whose total mortgage debt exceeds the value of the property (CLTV > 100%)	Group III. members that experienced no loss of income over 6 months prior to first default.	Group III. members that experienced loss of income ≤10% over 6 months prior to first default.	Group III. members that experienced loss of income ≤ 20% over 6 months prior to first default.
EFX TWN						
Number	135,025	28,499	22,347	12,956	18,857	19,653
% of Simple Defaulters who strategically defaulted	–	21.1%	16.6%	9.6%	14.0%	14.6%
EFX IXI						
Number	845,659	177,395	131,068	65,220	72,793	92,654
% of Simple Defaulters who strategically defaulted	–	21.0%	15.5%	7.7%	8.6%	11.0%

Table 2: Summary of Statistics – EFX TWN Sample with 20% threshold for income shocks					
		# obs	Mean	Median	STD
All Borrowers	Updated CLTV	135,025	116.12	108.20	44.89
	Refreshed Vantage Score (observed 2 months prior to first reaching 60 DPD)	135,025	693	681	110
	Foreclosure Rate	135,022	3.23%	2.26%	3.05%
Experian-OliverWyman Strategic Default	Updated CLTV	28,499	135.65	125.76	53.97
	Refreshed Vantage Score (observed 2 months prior to first reaching 60 DPD)	28,499	777	775	102
	Foreclosure Rate	28,499	3.83%	2.96%	3.25%
CoreLogic – Equifax Strategic Default (10% threshold)	Updated CLTV	18,857	148.94	136.89	53.30
	Refreshed Vantage Score (observed 2 months prior to first reaching 60 DPD)	18,857	783	782	100
	Foreclosure Rate	18,857	4.20%	3.39%	3.28%
CoreLogic – Equifax Strategic Default (20% threshold)	Updated CLTV	19,653	148.87	136.88	53.14
	Refreshed Vantage Score (observed 2 months prior to first reaching 60 DPD)	19,653	783	783	99
	Foreclosure Rate	19,653	4.19%	3.38%	3.28%

Table 3: Strategic Default by Key Drivers (EFX TWN Sample with 20% threshold for income shocks)

Updated CLTV	Strategic Default Rate	Refresh Vantage Score	Strategic Default Rate	Property State	Strategic Default Rate	Foreclosure Rate	Strategic Default Rate
[0,100]	0	[500,680]	4%	NV	32%	[0%,0.5%)	5%
(100,110]	15%	[681,720]	13%	AZ	26%	[0.5%,1.0%)	6%
(110,120]	19%	[721,760]	20%	CA	25%	[1.0%,2.0%)	10%
(120,130]	23%	[761,800]	27%	FL	18%	[2.0%,4.0%)	17%
(130,140]	25%	[801,840]	32%	MI	16%	4.0% +	22%
(140,150]	28%	[841,880]	35%	ID	13%		
(150,160]	31%	[881,920]	38%	OR	13%		
160+	33%	920+	38%	WA	12%		

Table 4: EFX TWN Sample: Important Factors that Determine Strategic Default – Logistic Regression Output

	Model 1		Model 2	
	Coefficient	Avg. Marginal Effect	Coefficient	Avg. Marginal Effect
Intercept	-7.883		-7.684	
Full Documentation	-0.1649	-0.016	-0.1517	-0.016
Dummy for Missing Documentation	-0.4487	-0.045	-0.4538	-0.048
Refreshed Vantage Score (2 months prior to first-time 60 days past due; range 501-990)	0.0074	0.001	0.0071	0.001
Neighborhood Foreclosure Rate (2 months prior to first-time 60 days past due)	3.0800	0.306	2.4439	0.260
Loan Age	0.0214	1.025	0.0226	0.002
Loan Age, squared	-0.00032	1.000	-0.00033	-0.00004
(MTM_LTV-100)* (MTM_LTV>100)	0.0104	0.001	0.0101	0.001
State_AZ	0.5830	0.058	0.4992	0.053
State_FL	0.6874	0.068	0.6608	0.070
State_MI	0.8294	0.082	0.8073	0.086
State_NV	1.0169	0.101	0.9383	0.100
State_CA	0.4001	0.040	0.2917	0.031
Dummy for Recourse States	-0.4185	-0.042	-0.4300	-0.046
Current Mortgage Bal (in $1000s)	0.000471	0.00005	0.000509	0.00005
Neighborhood Strategic Default Rate (2 months prior to first-time 60 days past due)	N/A	N/A	0.317	0.034
Number of Loans	135,022		112,075	
Number of Strategic Defaults	19,653		17,510	
c-stat	0.826		0.816	

Dependent variable captures the log odds of strategic default, defined as borrowers rolling straight from current to 180+DPD on mortgage, but remaining current on all other tradelines, with "underwater" property and without experiencing negative income shocks. All coefficients are statistically significant at 5% level. Data Period: June 2008 – March 2011. Following Ghent and Kudlyak (2009), we define the following 10 states as non-recourse states: Alaska, Arizona, California, Iowa, Minnesota, Montana, North Carolina (purchase mortgages), North Dakota, Oregon, Washington, and Wisconsin. Income shock equal to a loss of income of 20% or less as measured from Equifax's *The Work Number* payroll records. Average marginal effect is estimated by first computing the marginal effect of logistic function at each observation and then calculating the sample average of individual marginal effects.

Table 5: EFX IXI Sample: Important Factors that Determine Strategic Default – Logistic Regression Output

	Model 1		Model 2	
	Coefficient	Avg. Marginal Effect	Coefficient	Avg. Marginal Effect
Intercept	-8.066		-7.885	
Full Documentation	-0.151	-0.013	-0.154	-0.013
Dummy for Missing Documentation	-0.315	-0.026	-0.325	-0.028
Refreshed Vantage Score (2 months prior to first-time 60 days past due; range 501-990)	0.007	0.001	0.007	0.001
Neighborhood Foreclosure Rate (2 months prior to first-time 60 days past due)	3.721	0.311	3.045	0.266
Loan Age	0.033	1.036	0.032	0.003
Loan Age, squared	-0.00044	1.000	-0.00043	-0.00003
(MTM_LTV-100)* (MTM_LTV>100)	0.010	0.001	0.009	0.001
State_AZ	0.485	0.041	0.428	0.037
State_FL	0.506	0.042	0.489	0.043
State_MI	0.797	0.067	0.762	0.066
State_NV	0.851	0.071	0.786	0.069
State_CA	0.308	0.026	0.246	0.021
Dummy for Recourse States	-0.302	-0.025	-0.297	-0.026
Current Mortgage Bal ($000)	0.00024	0.00002	0.00021	0.00002
Neighborhood Strategic Default Rate (2 months prior to first-time 60 days past due)	N/A	N/A	0.606	0.053
Number of Loans	841,642		767,181	
Number of Strategic Defaults	92,654		88,264	
c-stat	0.807		0.802	

Dependent variable captures the log odds of strategic default, defined as borrowers rolling straight from current to 180+DPD on mortgage, but remaining current on all other tradelines, with "underwater" property and without experiencing negative income shocks. All coefficients are statistically significant at 1% level. Data Period: June 2008 – March 2011. Following Ghent and Kudlyak (2009), we define the following 10 states as non-recourse states: Alaska, Arizona, California, Iowa, Minnesota, Montana, North Carolina (purchase mortgages), North Dakota, Oregon, Washington, and Wisconsin. Income shock equal to a loss of household income of 8% or less as measured from Equifax's IXI Income360 measure of income. Average marginal effect is estimated by first computing the marginal effect of logistic function at each observation and then calculating the sample average of individual marginal effects.

Endnotes

[1] CoreLogic, Negative Equity Report, July 12, 2012.

[2] See www.realtytrac.com .

[3] Details of the Home Affordable Modification Program are provided at www.financialstability.gov . To assist loan servicers implement the HAMP, the Treasury Department issued a directive covering: HAMP eligibility, underwriting procedures, the modification process, reporting requirements, fees and compensation, and compliance. For example, to be eligible for a HAMP, the loan servicer must verify a host of criteria including that, the mortgage is a first lien mortgage loan secured by a one- to four-unit property, the mortgage is delinquent or default is reasonably foreseeable, the borrower documents a financial hardship and represents that (s)he does not have sufficient liquid assets to make the monthly mortgage payments, and that the borrower has a monthly mortgage payment ratio greater than 31 percent.

[4] For example, see the comments of Sanjiv Das of CitiMortgage, Wall Street Journal, November 24, 2009.

[5] See the Federal Housing Finance Agency Office of Inspector General Audit Report: AUD-2013-001, issued on October 17, 2012.

[6] Combined with consumers who do not have active mortgage tradelines, Equifax's credit records cover approximately 240 million consumers.

[7] The micro-neighborhood level is the ZIP+4 Code area if there are at least 7 households within it; otherwise it is a combination of economically-similar, nearby ZIP+4 Code areas with at least 7 households in the combined area. In general, Equifax's IXI micro-neighborhoods have 7-12 households in them. Because the IXI Income360 measure is not derived from an individual or household's actual financial information it cannot be used in any credit decision that would trigger an adverse action reason code under the Fair Credit Reporting Act. The Work Number data can be used by financial institutions in credit granting/denying decisions under the FCRA.

[8] Our definition of strategic default is identical to that used by Experian-Oliver Wyman (2009). Loans that roll straight from current to 180+DPD or Foreclosure or REO are strategic defaults. Any loan that made at least one payment during the tracking period is not a strategic default. We do not have short-sale status so loans resolved via short sale are not counted as strategic defaults if they occur during the tracking period, but as payoffs. If the short sale occurs at the end of the tracking period or later, they are counted as strategic defaults. Since less than 70 bps of the loans payoff for any reason during the tracking period, the potential slippage is very little

[9] The considerable drop off in available observations that results from merging the data files (1.7 million, down to 800k, down to 135k) is attributable to the following cleaning rules and exclusions followed by the reduction in loan counts in parentheses: Loans not specified as owner-occupied (187k); non-conventional loans (346k); non-single-family residences [1-unit] (312k); non-purchase/refinance loans (16k); second lien loans (3,800); loans originated in 2010 or 2011 (2,700); loans with an origination date later than observation date (1 loan); loans missing credit-bureau information during the observation period (40k+); loans with a current balance of zero (94); loans with a Vantage Score outside of the valid range of 500-990 (29k); and, finally loans entering 60+DPD within the first 6 months of origination [early payment defaults] (4,300). These rules and exclusions yield about 707,000 loans without any valid EFX TWN Income information. Restricting our analysis only to loans with valid EFX TWN information leaves a pool of 135,025 loans. For the Income 360 sample, there were about 974 loans without valid Income360 information, leaving a valid sample of 845,659. Finally, we conducted a comparison of the non-matched and matched EFX TWN samples (707,608 and 135,025, respectively,) to determine if the match leads to any material biases. Using the Experian-Oliver Wyman definition, the proportion of strategic defaulters is essentially the same between the TWN-matched and the TWN-non-matched samples, with a p-value of 78.8 percent. For the CoreLogic-Equifax definition, the TWN-matched sample has a slightly higher proportion of strategic defaults (16.55%) compared to the non-matched sample (15.39%), which, if anything, suggests that even our estimates of strategic default may be slightly high, reinforcing our view that strategic defaults are not as widespread as others have declared.

[10] Cutts and Green (2005) and Cutts and Merrill (2008) indicate that this is also the view that has long been held by the mortgage industry. In particular, Freddie Mac and Fannie Mae have long rewarded servicers for successfully negotiating deed-in-lieu transfers and loan modifications.