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Losing Public Health Insurance: TennCare Disenrollment and Personal Financial Distress

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Abstract: A primary goal of health insurance is smoothing the financial risk associated with health shocks. We estimate the effect of exposure to health-insurance reform on individual-level financial well-being. Using a plausibly exogenous shock to health insurance status resulting from a sudden disenrollment from Tennessee's Medicaid program in 2005, we find that the reform resulted in a 2.78 point decline in credit risk score for an individual in the median county in Tennessee. This study is the first examining the impact of losing any form of public assistance on personal financial well-being, and our results inform ongoing discussions around Medicaid reform.

JEL classification: D14, H75, I13

Key words: Medicaid, public assistance, household finance, debt, bankruptcy

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I. Introduction

Personal health care costs in the United States can change suddenly with a new diagnosis or accident, in many cases leading to financially catastrophic shocks for households that can persist for several years. Hospitalization, for example, is associated with lower credit scores, less access to credit (as measured by credit limits), less borrowing activity, higher balances of debt in collections, and an increased rate of bankruptcy, with these negative outcomes persisting for at least four years after the hospital admission (Dobkin et al. 2018). Financial distress can be caused by less dramatic health events as well; various acute or chronic medical conditions are associated with increased likelihood of an individual entering bankruptcy.[1]

Health insurance status plays an important role in an individual's ability to weather the financial consequences of adverse health events. Doty et al. (2008) find that 29 percent of uninsured adults were contacted by a collection agency about an unpaid medical bill, as compared to 5 percent of insured adults. The uninsured with medical debt were also found to be more likely to spend down their savings and to report being unable to pay for necessities such as food, heat, or shelter due to their outstanding medical bills. Health insurance provides more than access to medical care; it serves as protection against the substantial financial risk associated with health shocks. Accurate measurement of these financial protection benefits is vital to any policy analysis involving government insurance programs and to the understanding of the health insurance sector in general.[2]

As individual financial data has become more readily available to researchers, a literature has emerged attempting to quantify the financial protection provided by health insurance. A

[1] See Zhu (2011) and Ramsey et al. (2013), among others.
[2] To put the size and importance of the health insurance sector into perspective, approximately 2.4 trillion dollars, or 13 percent of U.S. GDP, was spent via health insurers (both private and public) in 2015 (Martin et al. 2017).

common strategy for such measurement is to examine the effect of a public health insurance program on the out-of-pocket expenses of the newly insured. Several studies utilized the rollout of new programs for identification (Finkelstein and McKnight 2008; Engelhardt and Gruber 2011; Finkelstein et al. 2012; Baicker et al. 2013), while Barcellos and Jacobson (2015) took advantage of discontinuities in coverage around an eligibility cutoff. These studies show that the presence of insurance indeed lowers out-of-pocket spending, with the most recent of these studies showing that insurance coverage significantly reduces the likelihood of carrying medical debt, the need to borrow to pay bills, the need to use savings to pay bills, and the likelihood of being contacted by a collection agency.[3]

More recent studies utilized measures of individual financial well-being from third-party financial records, examining credit report data (Mazumder and Miller 2016; Hu et al. 2017; Blascak and Mikhed 2018; Miller et al. 2018; Brevoort et al. 2019) or publicly-reported bankruptcy filings (Gross and Notowidigdo 2011). These studies find that expansions in public health insurance programs decrease the frequency of bankruptcies, lower the amount of debt in collection, and improve credit scores, all of which are an improvement in household financial health.

This study adds to the above literature on an important new margin. The entire body of knowledge on this topic is based on the expansion of health insurance coverage to new populations. In contrast, we examine the impact of a sudden and large-scale Medicaid disenrollment, and, to our knowledge, are the first to study the impact of health insurance loss on personal finances. In fact, this study appears to be the first to examine the impact on personal financial well-being of losing any form of public assistance.

[3] Also relevant is work by Allen et al. (2018) which demonstrates that counties in California receiving early ACA Medicaid expansion utilized fewer payday loans; as well as work by Zewde et al. (2019) which demonstrates that counties expanding Medicaid under the ACA experienced fewer eviction filings.

A lack of information on the interplay between insurance loss and personal finance is an important gap in the literature. Health insurance is a complicated good and has several pathways through which it may impact financial well-being. Some of these pathways also suggest that the impact of losing health insurance on financial well-being may not simply be the inverse of gaining health insurance. As the first study on the impact of losing public insurance on personal finance, our study lays the groundwork for understanding if losing health insurance is symmetric to gaining.[4]

In this study, we consider the effect of the 2005 reform, in which approximately 170,000 individuals in Tennessee lost Medicaid eligibility, on their personal financial health. This analysis is particularly relevant for current policy considerations as the population affected by the Tennessee reform is similar to the population impacted by the recent Medicaid expansions under the Patient Protection and Affordable Care Act (ACA), the largest single health insurance expansion in decades (Garthwaite, Gross and Notowidigdo 2014). This makes evidence from the Tennessee reform plausibly more externally valid to a potential rollback of the ACA Medicaid expansion than evidence from the expansions resulting from the Massachusetts reform or the Oregon Medicaid Lottery. Further, if asymmetry is present, estimates from the Tennessee reform may be a better source of information for predicting the effect of a Medicaid expansion rollback than estimates from the ACA Medicaid expansion.[5] Such a rollback was contained in a recent U.S. House of Representatives' proposal titled the American Health Care Act (AHCA), and in multiple iterations of the U.S. Senate's follow-up proposal, the Better Care Reconciliation Act.

[4] It is important to note that this study is not capable of proving exact asymmetry, as we are not able to track the same population through the process of gaining and then losing health insurance. We are able to construct estimates from insurance loss that are comparable to similar estimate from gaining insurance, and to the extent that the populations are similar, draw meaningful comparisons.

[5] Or may be a vital additional source of information to be used in addition to evidence from the ACA expansion.

There have also been other recent state policy changes in which individuals lost Medicaid eligibility, such as Arkansas's Medicaid work requirements. (Sommers et al. 2019).

II. Policy Variation: TennCare's Creation and Eventual Reform

In the early 1990s, Tennessee offered traditional fee-for-service Medicaid to children and family members enrolled in other welfare programs.[6] During this time, the state experienced annual budget deficits of as much as $250 million, largely driven by increases in Medicaid spending. Additionally, a non-trivial part of Tennessee's Medicaid funding (around $400 million) was provided by a special tax on hospitals and nursing homes that was scheduled to end by the end of 1994. Then-Governor McWherter enacted a comprehensive restructuring of the Medicaid system in Tennessee with two goals in mind: control cost and expand eligibility.[7]

To control cost, all Tennessee Medicaid beneficiaries were enrolled in a managed care organization with the expectation that managed care would significantly reduce expenditures per beneficiary and generate savings that could in turn be used to fund expanded eligibility. There were three main expansions to the eligibility criteria: First, the income eligibility was expanded from 185% of the Federal Poverty Level (FPL) up to 400% of the FPL; second, the reform made childless adults eligible, a group that until that time had rarely been eligible for public health insurance in the U.S; and third, the expansion covered the "uninsurable," individuals who had been denied coverage in the private marketplace. These changes to the health care system in Tennessee and the substantial expansion in coverage became known as TennCare.[8]

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[6] In the absence of waivers, states were required to provide Medicaid to families receiving Aid to Families with Dependent Children (AFDC), individuals on Supplemental Security Income (SSI) and to pregnant women and infants living at up to 133% of the Federal Poverty Level (FPL) (Boben, 2000). In Tennessee, eligibility for AFDC was 43% of the FPL. Eligibility for SSI was 75% of the FPL. The threshold for medically needy was 25% of the FPL. Medicaid covered pregnant woman and infants with family incomes to 185% of the FPL, children ages 1 to 5 with incomes 133% of the FPL, and children born after September 30, 1983, to 100% of the FPL. (Wooldridge et al, 1996).

[7] For a more detailed timeline of TennCare's implementation, refer to Chang and Steinberg (2014).

[8] It is important to note that within TennCare, households with incomes below 100% of the FPL did not pay premiums. In contrast, households above 100% of the FPL did pay premiums to maintain coverage. "Premiums were adjusted

By the early 2000s Tennessee once again experienced growing budget deficits, this time driven by the rising cost of the TennCare program.[9] The state initiated a process of re-verification for TennCare enrollees in 2002 that initially resulted in loss of insurance for nearly 200,000 individuals who did not respond to the re-verification. However, a court case led to a grace period for insurance coverage, during which many who had lost insurance due to re-verification re-applied and re-qualified for benefits.

The most substantial and permanent change to TennCare was set into motion in November of 2004. At that time, Governor Bredesen of Tennessee announced in a press release that, in response to budget deficits, "as many as 430,000 enrollees…out of a total of 1.3 million…could lose health coverage" (Bredesen, 2004). Between August 2005 and June 2006, TennCare benefits were terminated for many enrollees. There were several margins on which TennCare was contracted; the most meaningful was the termination of eligibility for childless adults and the uninsurable. Garthwaite, Gross and Notowidigdo (2014) suggest that 90 percent of the individuals dropped from the TennCare program were childless adults. Roughly a third (29.3%) of the disenrolled were 55-64 years old and approximately 41% were aged 35 to 54. The disenrolled were slightly more female (58.2%) and predominantly white (75.9%). The disenrolled were not, in general, highly educated; just over half had only a high school diploma, and approximately a third were high school dropouts.

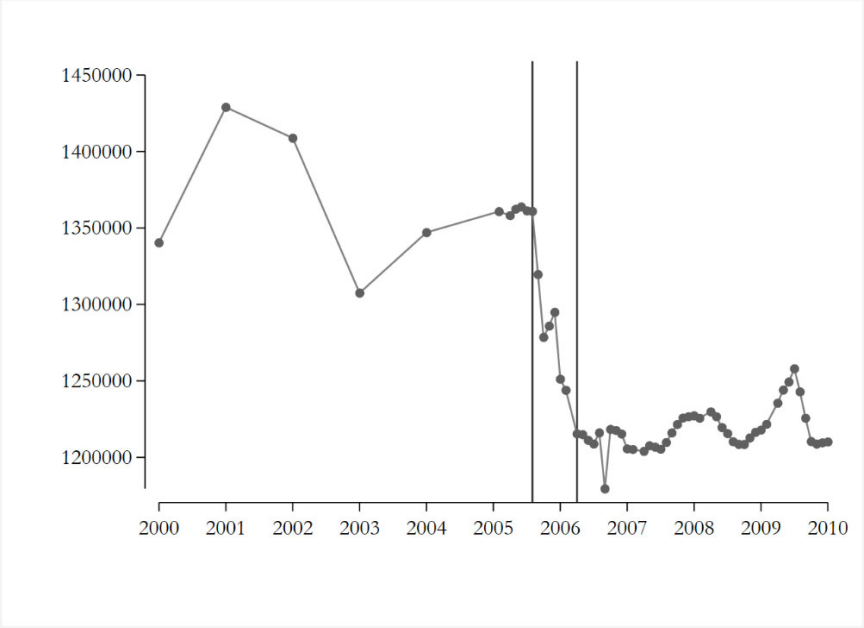
In Figure 1, we use administrative data from TennCare to show the change in enrollment due to the reform by plotting the number of people enrolled in TennCare over time. The steep drop

for income and family size. For those above 200% of the FPL, premiums were also adjusted by whether participants elect high-deductible or low-deductible payment plans." (Wooldridge et al, 1996).

[9] According to Chang and Steinberg (2014), TennCare faced a $342 million deficit in 2001.

in enrollment beginning in the middle of 2005 (August) that is visible in Figure 1 is our primary policy variation.[10] The reform was completely implemented by approximately May 2006.

Figure 1: TennCare Enrollment Levels 2000-2010



Notes: Vertical lines from left to right represent start of reform and completion of implementation. Source: *Tennessee Department of Health, Division of TennCare Administrative Records*

III. Loss of Health Insurance, Financial Well-Being, and Symmetry

There are several ways in which a loss of health insurance could impact financial outcomes, some of which potentially result in asymmetric effects of gaining versus losing insurance. In this section, we discuss potential pathways through which health insurance loss may impact financial well-being, as well as findings from the literature that provide insight into these pathways. For the purpose of this study, we interpret the findings of the analyses to come as the combination of any of these potentially offsetting effects, and as the population average of how these effects are distributed (potentially unequally) across Tennessee.

[10] Unfortunately, the Tennessee Department of Health only began keeping monthly records in 2005; before this the records were of annual enrollment counts only.

A. Health-Related Mechanisms: Repeated Expenses

Individuals with chronic conditions may require regular management through medication, medical devices or therapeutic services. These management activities represent a repeated medical expenditure that is more expensive to the consumer when not subsidized by health insurance. Hwang et al. (2001) use the Medical Expenditure Panel Survey (MEPS) to estimate annual out-of-pocket expenditures on chronic health conditions across different characteristics. They estimate that for Medicaid beneficiaries, costs range from $129 to $455 for individuals with one to more than three chronic health conditions. For uninsured individuals these costs range from $419 to $1,845.[11] This evidence indicates that managing chronic conditions imposes cost to individuals substantial enough to possibly result in delayed payment or lasting debt.

Additionally, analysis of the Oregon Medicaid Experiment (Baicker et al. 2013) reveals that individuals who are given Medicaid coverage are more likely to have a usual place of care, more likely to be diagnosed with diabetes and more likely to be using medication for diabetes. Having insurance, and thus a regular source of care and screening, may make individuals more likely to acquire repeated expenses through proper case management of chronic illness, expenses which become much less affordable if insurance is lost.[12]

In summary, beginning a new affordable repeated expense when insured, and then having the price of that expense greatly increased when insurance is lost, thus locking a person into high payments to maintain their health, is a potential source of asymmetry (suggesting effects on financial outcomes that are larger in magnitude from losing insurance compared to gaining

[11] These are national averages for people under 65 in 2017 dollars constructed from 1996 MEPS. The CDC has updated these estimates for people with at least 2 chronic health conditions; the average out of pocket is $2,174.99 for anyone with at least 2 chronic health conditions (https://www.cdc.gov/pcd/issues/2015/14_0388.htm).

[12] Individuals with insurance may also take worse care of themselves due to moral hazard. Tello-Trillo (2017) finds only weak evidence of this type of behavior from the TennCare reform.

coverage). However, individuals could also see larger financial benefits from gaining insurance than harms from losing insurance via repeated expenses if care can be delayed or stocked. Gaining insurance may allow an individual to relieve pent-up demand at relatively lower prices and losing insurance (if foreseen) could be partially mitigated through stockpiling care.[13]

B. Health-Related Mechanisms: One-Time Expenses

Individuals may also suffer large financial expenses due to negative health events requiring medical attention such as a visit to the Emergency Department (ED), a hospitalization, or a surgery. Such an event could result from known health conditions that deteriorate over time and need a major intervention or from an unforeseen health shock. It is important to note that the likelihood of the latter could be increased by reduced access to primary care in the absence of insurance coverage, as undiagnosed chronic illnesses are often discovered during major adverse events, such as discovering diabetes (a major risk factor for heart attack) during hospitalization for a heart attack (Oswald, Corcoran and Yudkin, 1984). Tarazi et al (2017) and Tello-Trillo (2017) provide evidence that the TennCare reform did, in fact, decrease access to care (due to cost) by approximately 4 percentage points, a 15 percent change from pre-reform levels. This decreased access could have led to increases in the prevalence of adverse health events due to the now-uninsured having an increased chance of an undetected chronic issue. For example, Maclean et al. (2018), find evidence of a post TennCare reform increase in mental health or substance abuse hospitalizations, which was attributed to a decline in proper case management when insurance was lost.

[13] We think that any effect through stockpiling was likely small in the context of the TennCare reform. Tello-Trillo (2017) found no evidence of additional utilization leading up to the reform (i.e. stockpiling care), likely due to uncertainty regarding who the reform would target (Bennet 2014).

As mentioned earlier, Dobkin et al. (2018) report serious financial consequences associated with hospitalization, and, pertinent to this study, the authors find these effects to be more pronounced for hospitalizations of patients without the protection of health insurance. In Tennessee specifically, Ghosh and Simon (2015) find an increase in the uninsured share of hospitalizations after the reform, while the total number of hospitalizations remained constant. Taken together, this suggests that TennCare reform would be expected to lead to increased financial strain from hospitalizations.

Other research on the TennCare reform suggests that ED visits may have been an additional contributor to financial strain. Although there is no strong evidence of an increase in the overall number of ED visits after the TennCare reform, Heavrin et al. (2011) estimate that the share of uninsured ED visits increased by 5.3%, and Tello-Trillo (2017) estimates that the share of self-paid ED admissions shifted from 13% to nearly 30%. In summary, loss of health insurance likely increased the magnitude of one-time health expenditures, as well as increased their frequency if those who lost insurance consumed less precautionary care.

C. Financial Mechanisms: Borrowing

Even in the absence of new health care expenses, public health insurance may still impact financial well-being through changes in borrowing behavior. Receiving health insurance is analogous to being given an asset – it has a cash value and can be considered an increase in that individual's income. If the income increase is seen as long lasting, then that individual may respond by consumption smoothing. Miller et al. (2018) found evidence of this behavior in the population of newly Medicaid-insured under the ACA expansion in Michigan, who greatly increased auto loan and credit card borrowing. Additionally, Blascak and Mikhed (2017) found that those impacted by the ACA dependent coverage mandate borrowed more on credit cards

following policy implementation. Health insurance has also been shown to decrease medical debt in collections and improve the interest rates offered to potential borrowers (Brevoort et al. 2019). This lowers the cost of borrowing for non-medical expenditures. If insurance is subsequently taken away, and these results reverse themselves, then affected individuals suffer an additional penalty: they have engaged in new, non-medical borrowing and now have the associated recurring payments. At the same time, these individuals have returned to their uninsured levels of medical-financial risk, where by revealed preference they would not want to be engaging in the aforementioned additional non-medical borrowing. In summary, losing insurance puts an individual in a less advantageous situation for borrowing, gaining and then losing insurance could cause individuals to become worse off then had they never became insured in the first place, suggesting asymmetric effects of losing insurance that are larger than when gaining coverage.

D. Financial Mechanisms: Strategic Bankruptcy

Gaining health insurance can significantly decrease bankruptcy risk. This is not just because individuals are now insured against large medical expenses that could cause bankruptcy. It is also a possibility that some of the uninsured population may intentionally choose to not save or hold assets because they are using bankruptcy protections as implicit health insurance (Mahoney, 2015, Gallagher et al., 2019). This suggests that individuals who lose public health insurance and believe that they have a high health expenditure risk may strategically engage in financially unhealthy behaviors (such as letting debt go past due), with the intention of taking advantage of bankruptcy protections in the case of an adverse health event.[14]

E. Financial Mechanisms: Employment

[14] Such behaviors could be dampened if the public insurance has asset tests, meaning that individuals with insurance could also be intentionally not saving to keep benefits, which would limit the change in behavior if those individuals lose public insurance and then want to use bankruptcy as implicit health insurance. However, TennCare did not have an asset test.

Garthwaite, Gross, and Notowidigdo (2014) show that TennCare reform increased employment among the likely disenrolled. Employment could provide access to health insurance and a steady income from employment could improve an individual's ability to weather adverse health and financial shocks, even without insurance. Garthwaite, Gross and Notowidigdo (2014) estimate a substantial implied annual wage increase between $1,830 and $4,900 for individuals initially at 75%-200% of the federal poverty line. Through this mechanism, financial outcomes could improve after loss of public insurance. However, it is also possible that the presence of health insurance allows for more stable employment, and improved financial stability, due to better health management. Therefore, insurance loss could also lead to both employment and financial instability (Dizioli and Pinhero 2016).

IV. Data

Our data come from two main sources: Tennessee's administrative Medicaid enrollment records (TennCare Records) and the Federal Reserve Bank of New York's Consumer Credit Panel/Equifax (CCP). We also use county-level unemployment rates obtained from the Bureau of Labor Statistics.

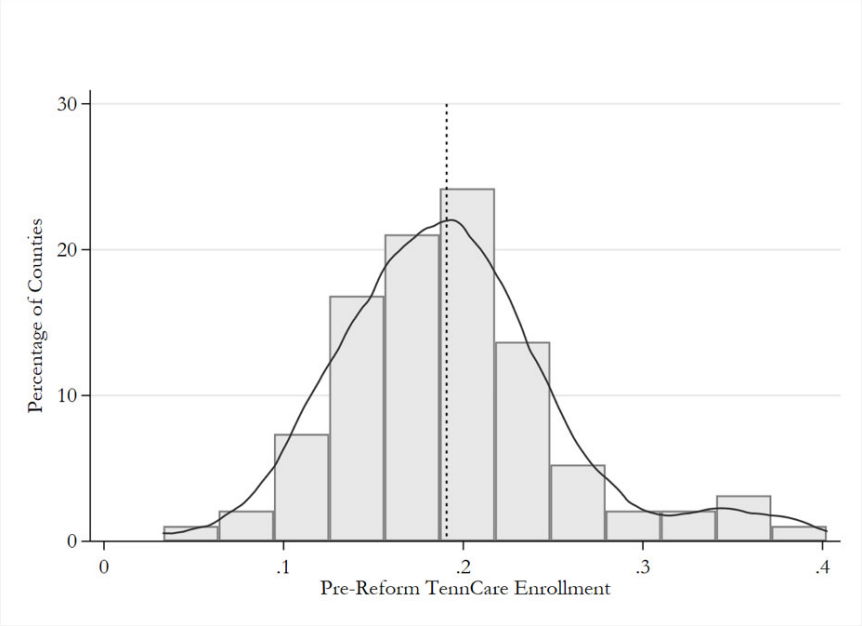
A. Tennessee Medicaid Records

In order to estimate the intensity of the reform across counties we use administrative data on the number of people enrolled in TennCare. These data, provided by the Tennessee Department of Health, Division of TennCare, include monthly counts of the number of people enrolled in TennCare since 2005, by county and age group. County population data from the Census are used to construct TennCare enrollment rates.

The primary measure of county-level exposure to the TennCare reform that we utilize is the rate of TennCare enrollment in a county before the reform began, which is calculated as the

average county enrollment rate over the first two quarters of 2005.This variable measures a county's capacity to disenroll. Pre-reform rates of enrollment are popular in dose response models measuring changes in health insurance policy because they mitigate concern that individual choice to enroll (or in our case individual propensity to be disenrolled) may be endogenous to the outcome measure and thus can serve as an "intent to treat" estimator.[15] This measure of policy exposure also allows our estimates to be more easily compared to the existing literature. Figure 2 plots the distribution of pre-reform enrollment across Tennessee. There is substantial variation in this measure: the median county had 19% of its adult population covered by TennCare, with county-level proportions ranging from 3.3% to 40%.

Figure 2. Variation in County-Level Pre-Reform TennCare Enrollment Rates



Notes: Vertical dashed line is median pre-reform TennCare enrollment, solid line is a kernel-density plot of pre-reform TennCare enrollment. Source: *Tennessee Department of Health, Division of TennCare Administrative Records*

[15] Examples include Medicare (Finklestein and McKnight 2008), the Massachusetts reform (Miller 2012; Mazumder and Miller 2016), the TennCare reform (Tello-Trillo 2017), and the ACA (Courtemanche, Marton and Yelowitz 2016; Courtemanche et al. 2017; Courtemanche, Friedson, Koller and Rees 2017; Courtemanche et al. 2018 among others). The insurance expansion analog of our estimation strategy has shown that pre-reform uninsurance rates are highly predictive of growth in insurance enrollment (Courtemanche, Marton and Yelowitz 2016; Courtemanche et al. 2017; Courtemanche, Friedson, Koller and Rees 2017).

B. Consumer Credit Panel

The CCP is a nationally representative 5-percent sample of individuals with Social Security Numbers and credit reports maintained by Equifax, along with members of their household. Individuals are observed in a quarterly panel starting in 1999 and continuing to the present (data are updated quarterly). New individuals are added to the panel over time to maintain its 5 percent ratio with the national population. The CCP data contain a wide array of measures of financial well-being that are available to credit rating companies as well as an individual's date of birth and geographic information at the census block level. No other demographic information about individuals is contained within the CCP. For a detailed description of the data and the methodology underlying its creation, see Lee and van der Klaauw (2010).

The following measures of individual financial well-being from the CCP are used as outcome measures. The first outcome of interest is the Equifax risk score, which is the Equifax analog to an individual's FICO credit score. The Equifax Risk Score, or the credit score, ranges from 280 to 850 and is a measure of an individual's probability of being severely delinquent (more than 90-days overdue, which is the point at which a creditor can initiate recovery through a collection agency) in the next 24 months, with higher values representing a better credit risk (i.e. lower risk of delinquency). The exact formula used to calculate the score is proprietary, but in general, it is a point-in-time calculation based on several measures in a consumer's credit report. We interpret this variable as a summary measure of an individual's general financial well-being.

We also examine the amount of total debt (in 2011 dollars), share of total debt, number of accounts and share of accounts that are severely delinquent. These outcomes are complicated

measures of financial health. A change in any one of these variables could represent a change in financial well-being but could also represent a change in other circumstances. For example, one must qualify for, and carry, debt in order to have debt or accounts past due, and higher-income individuals tend to carry more debt. Therefore, an increase in the total amount of delinquent debt could be due to increases in income and all debt balances (including delinquent debt), or it could be due to a general decline in financial well-being. Similarly, increases in the shares of debt and accounts that are delinquent could be due to worsening financial well-being but could also be due to improving well-being where an individual pays down debt and closes some accounts, leaving delinquent accounts to take on a larger share of total remaining debt or accounts. Therefore, a worsening of any single one of these measures of levels and shares of severely delinquent debt does not necessarily correspond with worsening individual financial well-being, but we consider increases in severe delinquency across several or all of these measures together to be stronger evidence of worsening in individual financial status. Finally, we also analyze two dichotomous outcome variables: one variable indicating that an individual has any debt that is severely delinquent and one variable indicating that an individual declared bankruptcy within the past 24 months.

C. Sampling Criteria

For the purposes of this study, we include individuals from the CCP between the first quarter (q1) of 2002 and the fourth quarter (q4) of 2007 that live in Tennessee during the pre-period portion of the sampling frame but may live anywhere in the United States during the post-period.[16] This restriction is to ensure that individuals in our data would have lived in Tennessee

[16] The time frame of the sample was chosen to end in 2007 so as to not contaminate these results with the impact of the Great Recession.

long enough to have been eligible for TennCare benefits.[17] Individuals are assigned a county's pre-reform TennCare enrollment rate based on their county of residence immediately before the reform (i.e. where that individual lived in the second quarter of 2005).

All individuals in the sample remain in the CCP during the sampling frame (that is, are not dropped due to death or discontinuance of their credit report) and do not have an incomplete credit profile for more than two quarters of the panel. We do this to avoid using individuals with frequently omitted values, which could be an indicator of financial irregularities due to fraud, but also to allow for some cases of missing data as Equifax will frequently not record a credit risk score in certain situations (such as immediately after a change of address).[18]

Furthermore, the sample is restricted to individuals that do not experience severe delinquency or bankruptcy prior to the beginning of the reform, as severe delinquency and bankruptcy are financial situations that greatly alter access to credit and interactions with financial institutions. Once an individual is severely delinquent or bankrupt, they likely react in a different manner to shocks to their financial well-being such as loss of insurance. We are particularly concerned about a "floor problem." Individuals who are already flagged with severe delinquency of 90 days past due on their credit reports may not have their credit worsen when impacted by the same events as individuals with good credit as they have already suffered such a penalty. Missing payments or other signs of financial distress may not count the same for these individuals if they are being scored by a different set of rules.

[17] We estimate our model with a binary variable for migration as the outcome variable and find null effects. These results are available upon request.

[18] Continuous residence in Tennessee prior to the TennCare reform also minimizes the likelihood that the Equifax data reflect fraudulent credit reports. In addition, our findings are not sensitive to requiring individuals to have a complete credit profile for the entire panel.

Another reason for these exclusions is that those in bankruptcy may be individuals with fundamentally different financial habits and risk of bad financial decision making from the general population. Musto (2004) demonstrates that on average, when bankruptcy flags are removed from credit reports due to statutory time limits, those individuals tend to be worse financial risks than individuals who are otherwise similar. Our exclusion of those with pre-reform bankruptcy also has the benefit of excluding individuals that were not able to smooth consumption in the pre-period, thus the impact of the loss of TennCare is not conflated with the lack of access to credit in the pre-period.[19]

Lastly, we want to avoid contamination of our results due to the strategic behavior around the Bankruptcy Abuse Prevention and Consumer Prevention Act (BAPCPA), which made it more difficult to obtain the most advantageous bankruptcies, and coincided with a large (and likely anticipatory) increase in bankruptcy filings ahead of its enactment in the second quarter of 2005 (Sánchez, 2014).

D. Summary Statistics

The means for our baseline sample consisting of financially healthy individuals ages 21-64 living in Tennessee during the pre-reform period, are reported in Column 1 of Table 1. The average exposure to the TennCare reform for this sample, measured by the pre-reform TennCare enrollment rate, is 15.4%. We also divide the sample up into quintiles based on the pre-reform TennCare enrollment rate. The means for these quintiles are reported in Columns 2-6. Note that in the first (lowest enrollment) quintile, the average individual lives in a county in which just over 9% of the population was enrolled in TennCare prior to the reform. This proportion rises

[19] Though we exclude individuals with bankruptcy or severe delinquency from our main analyses, we show results separately for this group in Section VII.

monotonically through the quintiles reaching 23% in the fifth quintile with the greatest pre-reform TennCare enrollment.

Our measures of financial health include the Equifax Risk Score, levels and shares of balances and accounts that are severely delinquent, and indicators of entering severe delinquency or bankruptcy in the post period. Because of the restriction of our main sample to those who are financially healthy in the pre-reform period, we report pre-reform data only for the risk score measure. The average pre-reform risk score for our sample is 721, rising to 730 in post-reform period. This increase is not informative regarding the impact of the reform on average risk scores since risk scores tend to rise with age. This age pattern is illustrated more clearly by a comparison of the average risk scores for successively older samples, 55-64 (column 7) and 65-74 (column 8) where pre-reform risk scores are 749 and 754, respectively. Not surprisingly, average pre-reform risk scores decrease across quintiles as county pre-reform TennCare enrollment rates rise, from 727 in the first quintile living in counties with the lowest enrollment rates, to 712 in the fifth quintile with the highest enrollment rates. The differences between the middle three quintiles are less pronounced.

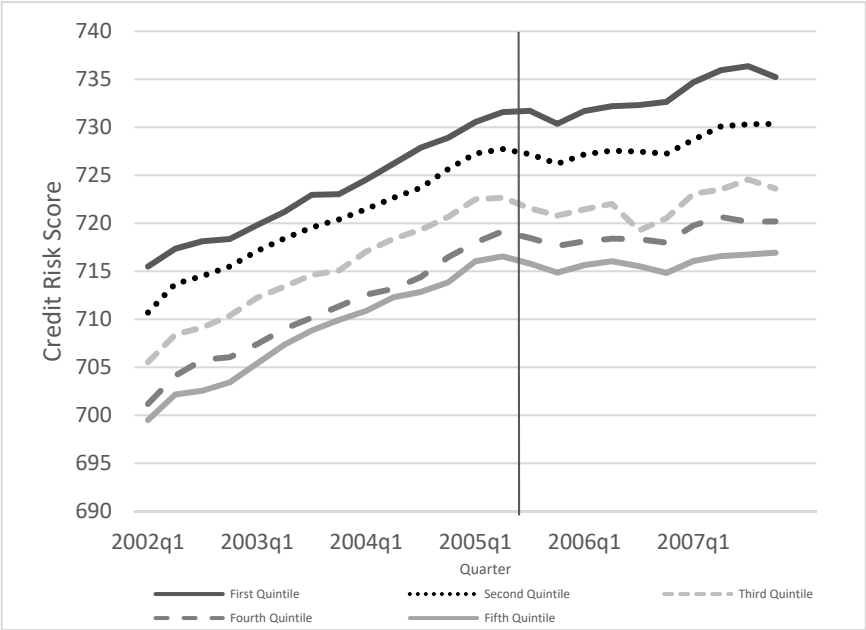
To understand the patterns of changes in the Equifax Risk Score, Figure 3 plots a time series of average scores by pre-reform enrollment quintiles. The average risk scores for all quintiles were increasing in the pre-reform period, as expected with aging (risk scores trend upward as individuals' age) and a period of economic recovery, and provide evidence of parallel pre-reform trends across samples with different treatment doses. In the post-reform period, growth slowed down for all quintiles, with the quintiles with the highest level of TennCare pre-reform exposure experiencing stagnant to falling risk scores.

Table 1. Summary Statistics

	Age 21-64	Quintiles based on County TennCare Pre-reform Enrollment (Age 21-64)					Age 55-64	Age 65-74	Pre-reform Delinquency
		First	Second	Third	Fourth	Fifth			
Treatment Variables									
Average County Enrollment	0.154	0.097	0.133	0.150	0.172	0.230	0.157	0.159	0.159
Pre-reform	(0.052)	(0.030)	(0.005)	(0.004)	(0.008)	(0.044)	(0.051)	(0.050)	(0.049)
Covariates									
Age	42.2	41.9	42.3	42.3	42.5	42.2	56.1	66.9	38.9
	(9.8)	(9.6)	(10.0)	(9.8)	(9.9)	(10.0)	(1.0)	(1.4)	(10.3)
Urban	0.73	1.00	0.92	0.87	0.56	0.28	0.71	0.71	0.74
	(0.44)	(0.02)	(0.27)	(0.34)	(0.50)	(0.45)	(0.45)	(0.46)	(0.44)
County Unemployment	5.324	5.197	5.200	5.355	5.369	5.512	5.343	5.347	5.524
Rate	(0.603)	(0.540)	(0.522)	(0.468)	(0.526)	(0.834)	(0.728)	(0.669)	(1.408)
Outcomes									
Risk Score (Pre-reform)	721	727	720	720	723	712	744	759	556
	(70.3)	(69.9)	(72.7)	(72.2)	(67.9)	(68.5)	(61.5)	(52.9)	(78.7)
Risk Score (Post reform)	730	738	730	729	731	720	755	766	580
	(80.1)	(77.4)	(81.2)	(83.7)	(78.7)	(79.5)	(66.6)	(57.7)	(76.5)
Amount of Severely	413.9	347.2	390.5	569.8	434.2	341.1	265.7	174.1	2,923.9
Delinquent Debt (2011$) (Post Reform)	(6709.0)	(5995.4)	(6569.5)	(9362.8)	(6521.6)	(4197.4)	(6517.1)	(3001.1)	(13918.0)
Share of Debt Severely	0.011	0.008	0.010	0.012	0.011	0.013	0.006	0.006	0.242
Delinquent (Post Reform)	(0.09)	(0.08)	(0.09)	(0.10)	(0.09)	(0.10)	(0.07)	(0.07)	(0.40)
Number of Accounts in	0.055	0.047	0.052	0.064	0.058	0.057	0.032	0.025	0.694
Severely Delinquent (Post Reform)	(0.45)	(0.44)	(0.42)	(0.48)	(0.49)	(0.40)	(0.38)	(0.27)	(1.19)
Share of Accounts)	0.012	0.010	0.011	0.013	0.012	0.014	0.006	0.005	0.262
	(0.09)	(0.08)	(0.09)	(0.09)	(0.09)	(0.10)	(0.06)	(0.06)	(0.38)
Entered Severe Delinquency	0.080	0.068	0.078	0.090	0.079	0.090	0.046	0.042	0.915
	(0.17)	(0.25)	(0.26)	(0.28)	(0.27)	(0.29)	(0.21)	(0.20)	(0.28)
Declared Bankruptcy	0.014	0.011	0.015	0.090	0.079	0.015	0.008	0.007	0.304
	(0.12)	(0.10)	(0.12)	(0.12)	(0.12)	(0.12)	(0.09)	(0.08)	(0.46)
N x T	2,388,939	617,273	357,886	471,845	478,058	463,877	253,977	274,013	1,726,991
N	100,966	26,053	15,213	19,930	20,163	19,607	10,759	10,982	73,394

Source: *Federal Reserve Bank of New York Consumer Credit Panel/Equifax, Tennessee Department of Health, Division of TennCare Administrative Records*

Figure 3. Equifax Risk Score by Pre-Reform County TennCare Enrollment Levels



Notes: The vertical line represent the start of reform. Source: *Federal Reserve Bank of New York Consumer Credit Panel/Equifax, Tennessee Department of Health, Division of TennCare Administrative Records*

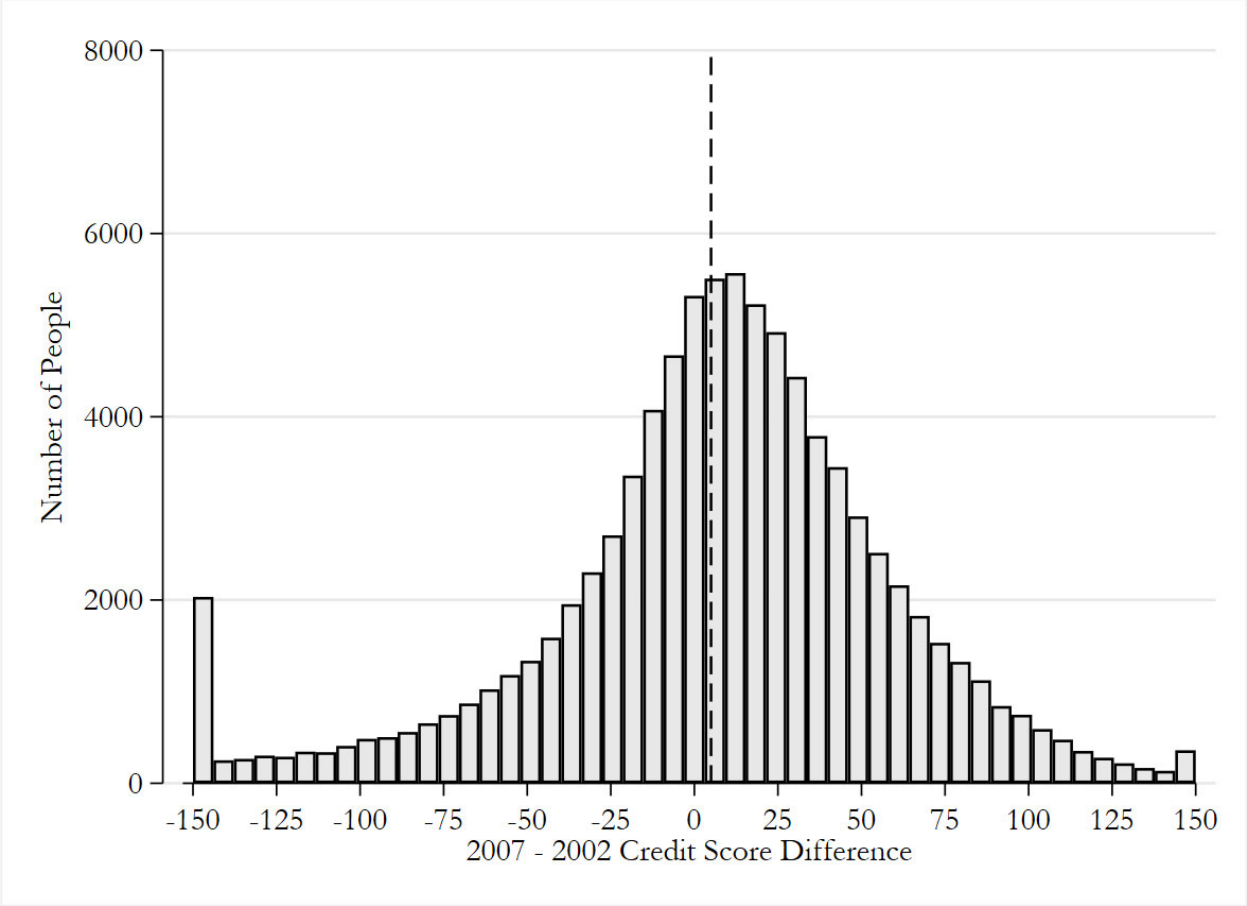
In subsequent robustness checks we relax the age and financial health criteria, estimating a triple-difference model that compares 55-64-year olds to 65-74-year olds and, separately, analyzing individuals who had severely delinquent debt or bankruptcy in the pre-reform period. We report the means for those samples in Table 1, Columns 7-9. Exposure to TennCare reform is similar across all three of these additional samples, with average pre-reform TennCare enrollment rates between 15.7 and 15.9 percent. The older samples are financially healthier on average than our baseline sample but are similar to one another with financial health improving slightly with age. Not surprisingly, the sample with delinquent debt in the pre-reform period has low credit scores, very high levels of severely delinquent debt, and high levels of bankruptcy. As noted earlier, these individuals have much lower ability to borrow.

As noted, our data include measures of risk score in both the pre-reform and post-reform periods. Below we descriptively examine the change in risk scores from before to after the

TennCare reform. Specifically, we calculate the change in each individual's risk score (the difference between their annual average risk score in 2002 and their annual average for 2007). We adjust these differences to account for the average change in risk scores for the five-year gain due to aging.[20] The histogram in Figure 4 shows the distribution of people based on their age-adjusted risk score change from the pre-reform to post period and two patterns are apparent. First, in the aftermath of the TennCare reform, there is a small positive change in average credit risk scores after accounting for the increasing trend due to age, with of mean increase of just under 6 points, likely due to the sustained expansionary period. Second, the distribution is skewed toward the negative tail of the distribution with a cluster of individuals who experienced extreme declines in credit scores, evidenced both by the thicker left tail of the distribution and the higher spike of credit score declines of 150 points or more relative to the gains of 150 or more. Specifically, 2.1% of the sample had a drop in their risk score in excess of 150 points relative to a 0.3% of the sample experiencing an increase of 150 point or higher in their risk scores. This would be consistent with adverse financial experiences such as a bankruptcy declaration or being sent to collections for at least some small portion of the population.

[20] The level of age-adjusted risk score is calculated by differencing the average risk score in 2002 for each birth year and the same variable for the birth year five years before.

Figure 4. Distribution of Age-Adjusted Change in Equifax Risk Scores – 2002-2007



Notes: Vertical dashed line represents mean change in credit risk score. Source: *Federal Reserve Bank of New York Consumer Credit Panel/Equifax*

V. Methods

A. Dose Response Model

In order to identify the effects of the reform on financial outcomes we use a dose-response strategy that utilizes variation in pre-reform TennCare enrollment across counties. This strategy is analogous to difference-in-differences, but instead of using an untreated control group, we compare across different levels of treatment simultaneously. We leverage variation across counties in Tennessee based on the "dose" of the reform (pre-reform TennCare enrollment, which represents the "potential to be disenrolled") to infer the likelihood of an individual being dropped

from coverage in each county. We estimate the following equation using ordinary least squares (OLS) for the adult, non-Medicare-age eligible population (ages 21-64):

$$Y_{icqy} = \gamma_0 + UR_{cqy} + \beta_1 During_{qy} + \beta_2 Post_{qy} + \beta_3\, TPRE_i \times During_{qy} + \beta_{DR} TPRE_i \times Post_{qy} + P_i + Y_y + Q_q + Age_{iqy} + \epsilon_{icqy} \quad (1)$$

where Y_{icqy} is a financial outcome for individual i, living in county c, during quarter q and year y. The above model includes a set of individual fixed-effects (P_i), year fixed effects (Y_y), quarter fixed effects (Q_q), and age fixed effects (Age_{iqy}) as well as the quarterly unemployment rate in an individual's county of residence (UR_{cqy}).[21] The reform is split into two periods: the implementation period ($During_{qy}$) identifies quarters between the third quarter of 2005 and the second quarter of 2006, when the TennCare reform was in process (the area between the two vertical lines in Figure 1), and the post-implementation period, ($Post_{qy}$), which includes quarters after the TennCare reform was complete, from the third quarter of 2006 through the end of our sample period in the last quarter of 2007.

The primary coefficient of interest in this regression is β_{DR}, the "dose response" (DR) estimator, which is the coefficient on the variable interacting a county's pre-reform TennCare enrollment rate ($TPRE_i$) with the indicator variable for the post-period.[22] This coefficient captures the effect of the reform by differencing outcomes across counties with differing enrollment rates before the reform; in other words it compares counties with different levels of potential to be disenrolled before and after the reform to infer the impact of the reform. Therefore, an estimate

[21] Results from all models estimated in this study are robust to the inclusion or exclusion of the unemployment rate, individual fixed effects, county fixed effects and county specific linear time trends. All of these variants of our results are available upon request.

[22] $TPRE_i$ is indexed by *i* as an individual's county of residence at any point in time is not necessarily their county of residence immediately prior to reform.

of $\hat{\beta}_{DR}$ is the effect of moving an individual from a county with no pre-reform TennCare enrollees to one that is fully enrolled, making the effect of this change in enrollment $\hat{\beta}_{DR} \times 1$. We can then scale this estimate by the median pre-reform enrollment rate to recover the impact on the average person in the median location ($\hat{\beta}_{DR} \times \overline{TPRE}$), where $0 \leq \overline{TPRE} \leq 1$. The identifying assumption of this model is that the differential in financial measures across counties would have trended similarly in the absence of the reform. Further, our scaling to the median assumes that the impact of reform increases linearly in the size of the pre-reform enrollment rate. To the extent that the effect is non-linear our estimate of the average effect will be biased (however still signed correctly). Deviation from these trends post-reform is captured by our coefficients as an estimate of the policy's impact.

The outcomes we examine in our models are the aforementioned continuous variables for credit score, the amount and share of debt that is severely delinquent, and the number and share of severely delinquent accounts. We also estimate a variant of equation (1) for two binary outcome variables: having any severely delinquent debt and incurring a bankruptcy in the past 24 months. This estimation is done with discrete-time hazard models to account for the absorbing nature (at least within the short-run time frame of our analysis) of these outcomes. In other words, we observe no movement out of bankruptcy and limited movement out of severe delinquency in the post period. [23]

B. Dose Response Event Study

We also perform a series of event studies which allow us to visualize the path of financial outcomes during and after TennCare reform, and for credit risk score allows us to check for pre-

[23] Bankruptcy is an absorbing state in that you are not at risk of reentering bankruptcy for seven to ten years after the original declaration due to credit bureau standards that leave bankruptcies on a credit report for that length of time.

trends between counties with different pre-reform enrollment rates.[24] Of particular concern is bias in pre-reform trends due to TennCare's re-verification in 2002. Our first event study model follows our main empirical specification in equation (1); however, we replace the interaction of the pre-reform TennCare enrollment rate and during/post with an interaction of the enrollment rate with a series of year-quarter specific indicators for the entire analysis period, excluding the second quarter of 2005, which is just before the reform began.

$$Y_{icqy} = \gamma_0 + UR_{cqy} + \Sigma_{t=2002Q2}^{2007Q4} (\beta_t \times TPRE_i \times I(Year.Quarter = t)_{qy}) + P_i + Y_y + Q_q + Age_{iqy} + \epsilon_{icqy} \quad (2)$$

C. Event Studies by Quintiles of Pre-reform TennCare Enrollment

In the models described thus far, exposure to the TennCare reform is represented by the continuous county-level measure of pre-reform TennCare enrollment. As an alternative to this continuous measure of treatment, we also estimate a series of event studies that allows for the impact of the reform to be non-linear (i.e. to differ in different quintiles of exposure to the reform). These event studies use only data from counties in three quintiles of exposure: the first (or bottom) quintile, which has the smallest dose and serves as a baseline and the omitted category, the second (or second from the bottom) quintile, which has the second smallest dose and which we expect to have the smallest effect relative to the baseline, and the fifth (or top) quintile, which has the largest dose and which we expect to have the largest effect relative to the baseline. The estimating equation takes the form:

$$Y_{icqy} = \gamma_0 + UR_{cqy} + \Sigma_{t=2002Q2}^{2007Q4} (\beta_t \times I(Quintile = Q)_i \times I(Year.Quarter = t)_{qy}) + P_i + Y_y + Q_q + Age_{iqy} + \epsilon_{icqy} \quad (3)$$

[24] All other variables are mechanically zero in the pre-reform period due to our sample requirements.

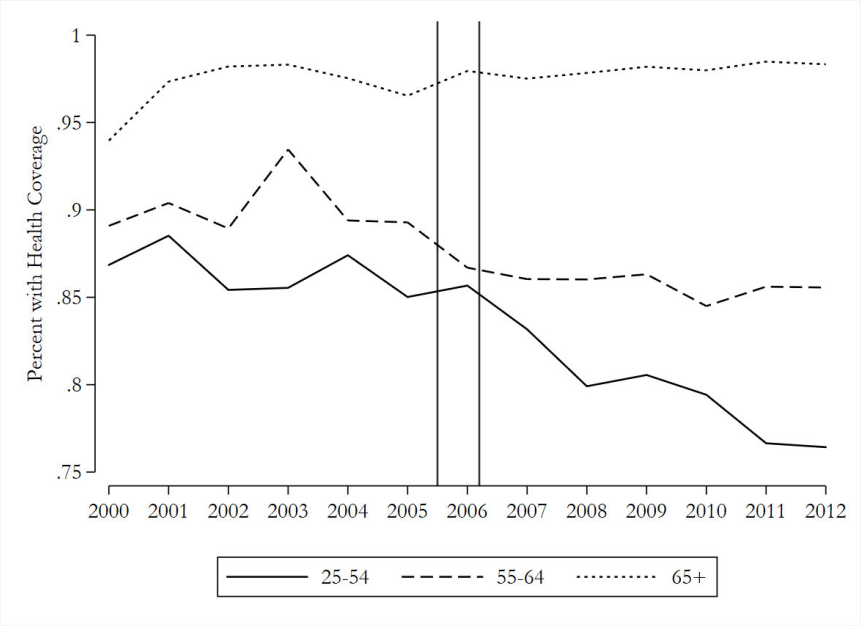
When we estimate this model for variables other than credit risk score it is run only on post-reform data, as these variables are always zero in the pre-period due to the sampling conditions.

D. Differential Dose Response

It is possible that the level of pre-period enrollment in TennCare is correlated with unobserved time-variant characteristics of the county and thus our coefficient of interest, β_{DR}, may be biased. Therefore, we utilize a plausible control group within each county that allows for an additional layer of variation to control for county-specific time-variant characteristics. This group consists of Medicare-age-eligible individuals (individuals over the age of 64 in all quarters). Even though individuals in the older group could still be affected by reduced TennCare eligibility, if they were dually eligible for Medicare, the likelihood of the Medicare age-eligible group losing health insurance completely due to the reform is substantially reduced. This can be observed in Figure 5, which plots insurance enrollment for different age groups in Tennessee using data from the Behavioral Risk Factor Surveillance System. While age groups under the age of 65 saw declines in insurance coverage during and after the reform, those who were Medicare age-eligible did not, presumably because if they were disenrolled from Medicaid coverage, these individuals were still eligible for coverage under Medicare.

There is the potential, however, that comparing the population aged 21-64 to the Medicare-eligible group may simply pick up differences in financial behavior between older and younger age groups and would not be reflective of trends related to Medicaid coverage. Thus, the sample is restricted to those within ten years of the age 65 Medicare cutoff in either direction, creating a relatively homogeneous sample in terms of both health and financial stability. Using this additional margin of variation across age groups, we introduce a new "differential dose response"

Figure 5. Share of Adults in Tennessee with Health Care Coverage by Age Group



Notes: Vertical lines from left to right represent start of reform and completion of implementation. Source: *Behavioral Risk Factor Surveillance System (Centers for Disease Control and Protection)*

(DDR) specification (analogous to a triple difference model) which compares these two groups, individuals aged 55 to 64 and individuals 65 to 74, within the same county and then compares the differences in their financial outcomes across counties with varying pre-reform enrollment rates.[25]

This specification mitigates the potential confounding mechanism that counties that are prone to have worse financial outcomes might also have higher (or lower) rates of disenrollment from TennCare. We estimate the following equation using OLS:

$$Y_{icqy} = \beta_0 + UR_{cqy} + Q_q \times I(55 \leq Age < 65)_{iqy} + Y_y \times I(55 \leq Age < 65)_{iqy} + C_c \times I(55 \leq Age < 65)_{iqy} + \beta_1 During_{qy} + \beta_2 Post_{qy} + \beta_3 TPRE_i \times During_{qy} + \beta_4 TPRE_i \times Post_{qy} + \beta_5 TPRE_i \times During_{qy} \times I(55 \leq Age < 65)_{iqy} + \beta_{DDR} TPRE_i \times Post_{qy} \times I(55 \leq Age < 65)_{iqy} + P_i + Y_y + Q_q + Age_{iqy} + \epsilon_{icqy} \quad (4)$$

[25] Our comparison of non-Medicare age-eligible adults to the Medicare age-eligible in the context of the TennCare reform follows work by Ghosh and Simon (2015) who made the same comparison in a triple differences framework to look at hospitalization outcomes.

The indicator variable $I(55 \leq Age < 65)_{iqy}$ takes the value of 1 if the individual is in the adult-age treatment group (55 to 64) versus the Medicare-age eligible control group (65 to 74). This captures the baseline differences between these two age groups. The model also includes all two-way combinations of the county fixed-effects, quarter fixed-effects, year fixed-effects and age-indicator variable. The $During_{qy}$ and $Post_{qy}$ variables are both interacted with $TPRE_i$ as in the previous model. Finally, the interaction between $Post_{qy}$, the age indicator, and $TPRE_i$, provides us with the main coefficient of interest: β_{DDR}. Given the set of fixed effects, β_{DDR}, the differential dose-response estimator, compares the difference in outcomes between the adult and Medicare age-eligible group in a specific county, and how that differential changes after the reform across differences in TennCare pre-reform enrollment rates. The identifying assumption for the model specified in equation (4) is that in the absence of the reform, the *difference* in outcomes between non-age-eligible adults and the age-eligible would have evolved similarly after the reform across counties.

V. Results

A. Base Dose Response Model

Results for estimation of equation (1) are reported in Table 2. Each column represents a separate regression of the impact of the TennCare reform on one of the financial outcomes discussed above. We report the coefficients on the variables of interest (the pre-reform TennCare enrollment rate multiplied by an indicator for either the period during TennCare reform or the post-reform period), the standard errors adjusted for clustering at the county of residence prior to the reform (Tennessee has 95 counties), and the number of observations.[26] Our main coefficient of

[26] The number of observations is smaller in the first column due to the sample construction allowing for incomplete credit information (missing credit risk score) for up to two quarters per individual.

interest measures the effect on an individual of being in a county affected by the TennCare reform. The estimated coefficient is the effect of the reform on financial outcomes of a person in a county with 100% pre-reform enrollment compared to an individual living in a county with 0% enrollment. In order to provide an "average" effect, we scale our estimate by 0.147, the preform county enrollment level for the median individual in our analysis sample. These effects should be interpreted with caution; though these values help to quantify the average effect of the reform on the population, the impact of the reform was most likely tightly concentrated among those who personally lost TennCare eligibility.

The coefficients reported in Table 2 indicate a pattern of poor financial outcomes associated with the TennCare reform. Falling credit scores, increasing severely delinquent debt and likelihood of filing for bankruptcy are evident for those with greater exposure to the reform both during the reform period (row 1) and in the post-period (row 2). Estimates from the DR model indicate that increased exposure to reform decreased credit risk scores in the post-reform period, with a precisely estimated coefficient of -18.923, representing a decrease in credit risk scores of 0.19 points during the seven-quarter post period for every 1 percentage point increase in a county's pre-reform enrollment level. The scaled estimate represents a post-reform drop of 2.8 points for the credit risk score on average for individuals with the median level of exposure. For perspective, the aggregate decline in the average FICO score during the Great Recession (October 2006 to the peak of the unemployment rate in October 2010) was four points (a drop from 690 to 686), making this estimated effect only slightly smaller than the size of the drop in average credit scores during the Great Recession.[27] Looking across the columns of Table 2, our estimates are precisely estimated,

[27] FICO data can be found at http://www.fico.com/en/blogs/risk-compliance/us-credit-quality-rising-the-beat-goes-on/

Table 2. Dose Response (DR) Model of the Effect of Reform on Financial Outcomes: Sample of Adults 21-64

	Equifax Risk Score	Severely Delinquent Debt (2011$)	Share of Debt that is Severely Delinquent	Number of Delinquent Accounts	Share of Delinquent Accounts	Having Any Severely Delinquent Debt (Hazard Model)	Bankruptcy in the Past 24 Months (Hazard Model)
Pre-Reform Enrollment x During (DR)	-8.586***	111.133	0.019***	0.055***	0.021***	0.028***	0.006***
	(2.88)	(229.88)	(0.00)	(0.02)	(0.00)	(0.01)	(0.00)
Pre-Reform Enrollment x Post (DR)	-18.923***	458.035	0.045***	0.126***	0.046***	0.019***	0.004**
	(4.36)	(401.41)	(0.01)	(0.04)	(0.01)	(0.00)	(0.00)
N x T	2,380,894	2,388,939	2,388,939	2,388,939	2,388,939	2,369,493	2,382,996
Post DR x 0.147 (Median Pre-Reform Enrollment)	-2.78	67.33	0.01	0.02	0.007	0.003	0.0006

Notes: Standard errors are clustered at the county-level (95 counties). All models were estimated using the reghdfe command in STATA, and include individual, age, year, and quarter fixed effects, as well as the local unemployment rate. {***} p<0.01 {**} p<0.05 {*} p<0.10. The number of individuals (N) for the 21-64 group is 100,966. Source: *Federal Reserve Bank of New York Consumer Credit Panel/Equifax, Tennessee Department of Health, Division of TennCare Administrative Records.*

except for the amount of severely delinquent debt, and present a general pattern of worsening financial stability for those with increasing exposure to the TennCare reform.

B. Dose Response Event Studies

The impact of exposure to the TennCare reform on financial outcomes is not likely uniform throughout the post-period. Results of an event study from the estimation of equation (2) for credit risk scores are plotted in Figure 6 (other outcomes are in Figure A2 in the appendix). This figure shows that there is little association between pre-reform TennCare enrollment and credit risk scores in the pre-reform period with estimates that are near zero and statistically insignificant prior to 2005 q2. These results display no evidence of anticipatory behavior related to the announcement of TennCare reform, at least for the Equifax Risk Score. The one exception is in 2003, when individuals in high-enrolling counties experienced significant increases in credit score relative to low enrolling counties, which is the time period just following the re-enrollment of individuals who had been dropped from the rolls during the re-authorization in 2002. After the TennCare reform, the pattern is quite different, with individuals in counties with high pre-reform TennCare enrollment experiencing declines in credit risk score compared to individuals in low pre-reform TennCare enrolling counties. These relative decreases in risk score get larger in magnitude as time since the TennCare reform increases. It should be noted that the decline in risk score continues throughout the 10 quarters of the post period of the data, suggesting that the full impact of the reform has not been fully captured. This is not unreasonable, as it takes times for accounts to become delinquent and health shocks do not occur in all periods. Event studies for the other outcome variables can be found in Appendix Figure A1. These figures show that the share of severely delinquent debt and delinquent accounts continues to rise throughout the post period. The probability of any severe delinquency and bankruptcy, in contrast, increase and remain at this

elevated level through the remainder of the post period. The pattern of changes in the amount of severely delinquent debt is more variable and not statistically significant.

Figure 6. Event Study: Equifax Risk Score

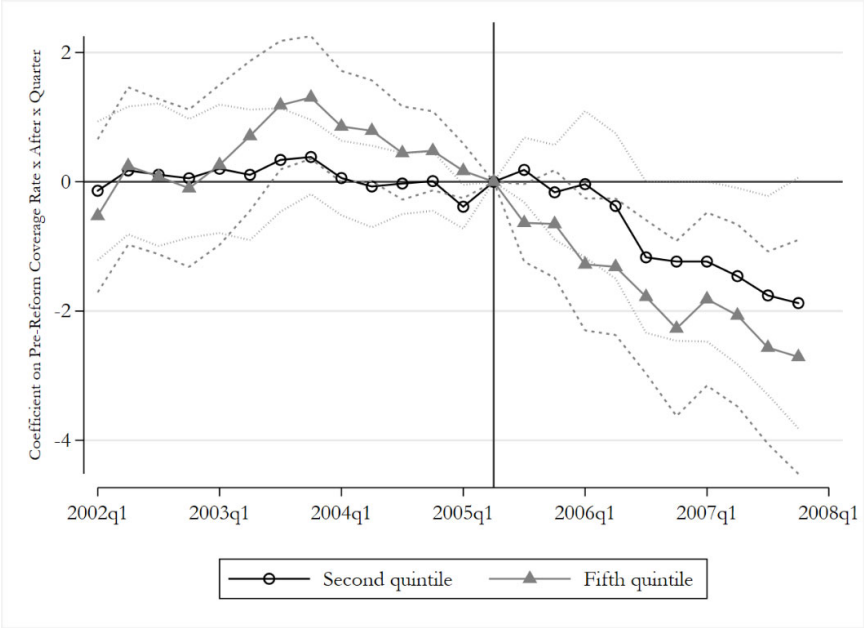
Notes: This figure plots β_t by quarter from equation (2). 95% confidence intervals noted by dashed lines. Standard errors are clustered at the county-level (95 counties). All models were estimated using the reghdfe command in STATA, and include individual, age, year, and quarter fixed effects, as well as the local unemployment rate. Vertical line represents the start of the reform, the horizontal line represents an estimate of zero. Source: *Federal Reserve Bank of New York Consumer Credit Panel/Equifax, Tennessee Department of Health, Division of TennCare Administrative Records.*

C. Event Studies by Quintile of Pre-reform TennCare Enrollment

Figure 7 reports results from estimation of equation (3). This figure illustrates not only how the impact of the reform evolved over time, but also the heterogeneity in different parts of the distribution of policy exposure. Specifically, the most exposed and least exposed quintiles (relative to the bottom quintile which serves as a baseline) evolved in parallel in terms of credit risk score prior to reform, including controls for age and unemployment. The exception is early 2003, where the most exposed quintile saw higher growth in credit risk scores, with the gap persisting roughly in parallel until the quarter of reform. This is more suggestive evidence that the increase seen in 2003 in the overall event study is due to the reverification, which led to loss of coverage in 2002,

followed by re-enrollment in 2003. Immediately following the reform, both the second and the fifth quintile began to see worsening credit risk scores, with the effect in the fifth quintile larger in magnitude, which is what one would expect given its higher exposure to TennCare pre-reform.

Figure 7. Event Study: Equifax Risk Score by Quintile



Notes: This figure plots β_t by quarter from equation (3). The baseline category if the first quintile (i.e.least exposed). The ommi95% confidence intervals noted by dashed lines. Standard errors are clustered at the county-level (95 counties). All models were estimated using the reghdfe command in STATA, and include individual, age, year, and quarter fixed effects, as well as the local unemployment rate. Vertical line represents the start of the reform, the horizontal line represents an estimate of zero. Source: *Federal Reserve Bank of New York Consumer Credit Panel/Equifax, Tennessee Department of Health, Division of TennCare Administrative Records.*

Similar figures for the other outcomes can be seen in Appendix Figure A2. In general, the measures of financial distress worsen post reform, and with the exception of the amount of debt which is 90 days past due or worse and bankruptcy, the most exposed quintile had an impact from the policy which was larger in magnitude.

D. Differential Dose Response (55-64 vs. 65-74)

Recognizing that there are individuals within Tennessee counties who are largely unaffected by the TennCare reform, Table 3 presents results from estimation of the differential dose response (DDR) in equation (4).This model compares the DR for a group of treated individuals between the ages of 55 and 64 (an age group that made up nearly 30% of the population

disenrolled from TennCare (Garthwaite, Gross and Notowidigdo 2014)) with that of individuals between the ages of 65 and 74 (a group only negligibly affected by the reform because of their eligibility for Medicare). The differences between the Medicare-age eligible group and the just-under-65 group are consistent in sign (with the exception of bankruptcy which has an estimate of zero) with those from the DR model. The effect of the TennCare reform on an average individual age 55-64 in a fully enrolled county is a drop in credit risk score of more than 8 points in the post period compared to someone age 65-74 over the same times period in the same county. Though these estimates are less precisely estimated and smaller in magnitude, the general pattern lends confidence to the results presented in our previous analyses.

E. Heterogeneity

The results discussed above suggest that losing health insurance and the financial protection it provides is harmful to individual financial well-being. The effects shown are best interpreted as the impact on the median person in the population and are analogous to an average treatment effect. However, the true effect of the reform was likely concentrated among those who were most directly affected. We explore this important heterogeneity in two ways, first by examining differences in the implied effect of the reform based on the "dose" received by different counties, and second by exploiting differences across individuals' pre-reform creditworthiness.

E.i Heterogeneity across Counties

Figure 8 is a histogram showing heterogeneity in the implied average effect of the reform by county on credit risk scores based on the DR model. The bars show the frequency (in percent of all counties) of the reduction in credit risk scores (measured along the x-axis) for the average county residents' exposure to the post-reform drop in enrollment. The vertical dashed line represents the effect for the county with the median pre-reform enrollment, and the dark curve is

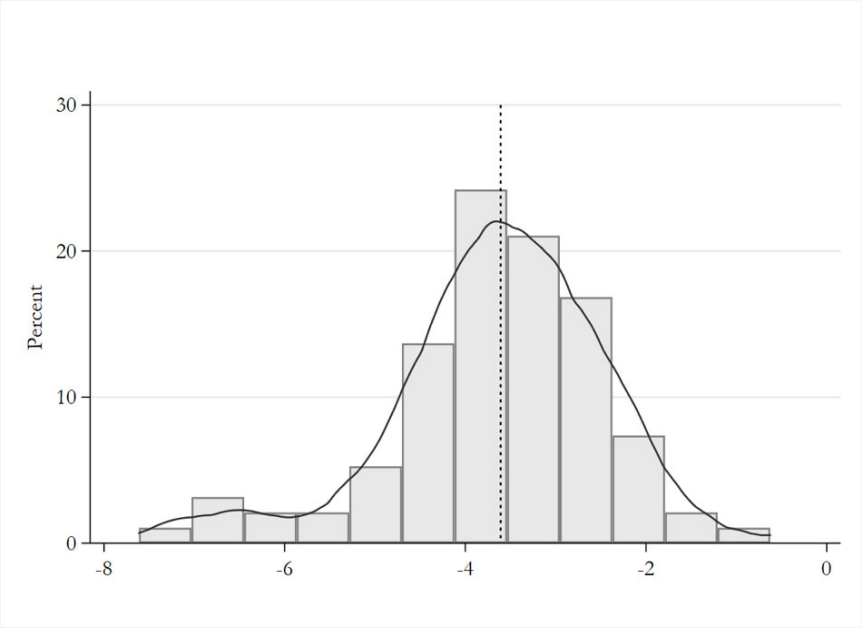
Table 3. Differential Dose Response (DDR) Model of the Effect of Reform on Financial Outcomes: Sample of Adults 55-74

	Equifax Risk Score	Severely Delinquent Debt (2011$)	Share of Debt that is Severely Delinquent	Number of Delinquent Accounts	Share of Delinquent Accounts	Having Any Severely Delinquent Debt (Hazard Model)	Bankruptcy in the Past 24 Months (Hazard Model)
Pre-Reform Enrollment x Age 21 to 64 x During (DDR)	-6.913***	203.902	0.003	0.021	0.004	0.009**	-0.001
	(2.64)	(128.31)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)
Pre-Reform Enrollment x Age 21 to 64 x Post (DDR)	-8.267*	750.533**	0.005	0.046	0.006	0.006	0.0001
	(4.50)	(288.35)	(0.01)	(0.03)	(0.01)	(0.00)	(0.002)
N x T	485,928	487,065	487,065	487,065	487,065	485,013	486,274
Post DDR x 0.147 (Median Pre-Reform Enrollment)	-1.22	110.3	0.0007	0.0068	0.0009	0.0009	0.0000

Notes: Standard errors are clustered at the county-level (95 counties). All models were estimated using the reghdfe command in STATA, and include individual, age, county, year, and quarter fixed effects, as well as the local unemployment rate. {***} p<0.01 {**}p<0.05 {*}p<0.10. The number of individuals (N) for the 55-64 group is 10.759. The number of individuals (N) for the Medicare age-eligible group is 10,982. Source: *Federal Reserve Bank of New York Consumer Credit Panel/Equifax, Tennessee Department of Health, Division of TennCare Administrative Records.*

an Epanechnikov kernel-smoothed probability distribution for counties having an effect of the reported magnitude.[28] The histogram shows that although most counties had effects somewhat similar to the median county, there is a long-left tail to the distribution. Counties with high pre-reform TennCare enrollment saw a decrease in credit risk scores for the average resident in the county of over 7 points, which is almost twice the size of the effect for the median county.

Figure 8: Distributions of Effects of Reform on Equifax Risk Scores



Notes: Individuals are assigned the predicted change in Equifax Risk Scores from the model estimated in Table 2. Vertical dashed line is estimate scaled by the median pre-reform TennCare enrollment, solid line is a kernel-density plot of estimates scaled by pre-reform TennCare enrollment. The vertical line Source: *Federal Reserve Bank of New York Consumer Credit Panel/Equifax*

E.ii Heterogeneity by Initial Credit Status

To further examine heterogeneity in the impact of the TennCare reform, the sample is divided into sub-populations based on credit risk score during the first quarter of the sampling frame. Individuals are divided into three categories based on Fannie Mae's creditworthiness cutoffs for credit scores that are used to assign individuals more or less preferential interest rates

[28] Histograms for the DR model estimates for other outcomes have a similar distribution and are available upon request.

(Fannie Mae 2017). The distribution of these categories within our sample, for the first quarter of observations, is reported in Table 4. Given that the sample used in analysis is selected to be financially healthy in the pre-period, the largest group is the least risky category (R3) and the smallest group is the riskiest category (R1).[29]

Table 4: Share of Sample by Fannie Mae Risk Categories

Equifax Risk Score Category	Equifax Risk Score (R) Range	Sample Percentage in Quarter 1, 2002
R1	330≤R1<660	23.03
R2	660≤ R2< 740	33.31
R3	R3≥740	43.66

Source: *Federal Reserve Bank of New York Consumer Credit Panel/Equifax*

Results for the DR model broken out by initial risk category are reported in Table 5. The first panel reports results for the riskiest group (R1), the middle panel for R2, and the bottom panel reports results for the least risky group (R3). TennCare reform is associated with lower creditworthiness across all levels of initial Equifax risk scores, however the differences in the results across groups is striking. Individuals in the riskiest two categories had average effects from the reform that were much larger in magnitude than those with better initial creditworthiness. For example, the *Post* DR coefficient for the *Equifax Risk Score* regression is more than three times larger in magnitude for category R1 than for R3.

There are a number of possible explanations for this pattern of results: a greater proportion of individuals in the bottom categories were directly impacted by the reform, those in the bottom

[29] On average, the population as a whole has improving creditworthiness over time, as measured by these categories. This pattern of increasing credit scores has a number of possible explanations, including but not limited to, the aging of our sample over the panel or an overall improvement in credit risk over time. Because we include q and y fixed effects, each of these are controlled.

categories experienced financial shocks that were greater than their ability to absorb them from savings (i.e. more financially fragile), or those with higher credit risk scores were better able to smooth their consumption (or some combination of the three). It is interesting to note that the coefficient on the amount of delinquent debt and the number of accounts models are negative for the riskiest categories (though not statistically different from zero), although the shares of delinquent debt significantly increased for individuals in all three groups. This may reflect the difficulty someone with a low initial credit risk score faced in obtaining credit, thus making them unable to accumulate large amounts of debt as lenders may have been unwilling to extend credit to them. The estimate itself has large standard errors, therefore we are cautious of interpreting this as a "reduction" in debt.

Individuals in the riskiest categories also did not see changes in the number of accounts delinquent, but did see changes in the share of accounts delinquent. This could be reflective of loss of sources of credit (a decrease on the extensive margin of accounts with new and, at least for a time, good debt), leaving bad debts to take on a disproportionate share of these individuals' credit reports. In general, these results suggest that TennCare reform is associated with a much more adverse impact on the overall financial well-being on the part of the population that was financially fragile prior to the reform.

E.iii. Heterogeneity by Urban-Rural Location

There may be policy relevant differences in the impact of the reform between urban and rural locations. Timely access to health care and specialists and opportunities for employer-provided health insurance may vary by geography and population density (Newhouse, 1990; Zhang et al., 2000; Rosenthal, Zaslavsky, and Newhouse, 2005), which could create geographic

Table 5. Dose Response (DR) Model of the Effect of Reform on Financial Outcomes by Initial Equifax Risk Score: Sample of Adults 21-64

	Equifax Risk Score	Severely Delinquent Debt	Share of Debt that is Severely Delinquent	Number of Delinquent Accounts	Share of Delinquent Accounts	Having Any Severely Delinquent Debt (Hazard Model)	Bankruptcy in the Past 24 Months (Hazard Model)
Panel A (DR) Equifax Risk Score CategoryR1 (N=23,256)							
Pre-Reform Enrollment x During (DR)	-24.343***	-1052.881*	0.026**	-0.004	0.034***	0.035**	0.004
	(6.50)	(578.96)	(0.01)	(0.05)	(0.01)	(0.01)	(0.01)
Pre-Reform Enrollment x Post (DR)	-36.494***	-980.856	0.065***	-0.03	0.058***	0.014	-0.0004
	(10.14)	(1065.31)	(0.02)	(0.10)	(0.02)	(0.01)	(0.00)
N x T	543,034	547,953	547,953	547,953	547,953	535,465	545,025
Post DR x 0.147 (Median Pre-Reform Enrollment)	-5.36	-144.2	0.0096	-0.0044	0.0085	0.0021	0.0000
Panel B (DR) Equifax Risk Score Category R2 (N=33,632)							
Pre-Reform Enrollment x During (DR)	-16.321***	-71.368	0.010*	0.012	0.010*	0.006	0.006*
	(5.86)	(301.03)	(0.01)	(0.02)	(0.01)	(0.01)	(0.00)
Pre-Reform Enrollment x Post (DR)	-35.131***	-424.279	0.023***	0.042	0.026***	0.010**	0.003*
	(8.05)	(370.39)	(0.01)	(0.03)	(0.01)	(0.00)	(0.00)
N x T	792,976	794,812	794,812	794,812	794,812	789,427	792,418
Post DR x 0.147 (Median Pre-Reform Enrollment)	-5.16	-62.4	0.0034	0.0062	0.0038	0.0015	0.0004
Panel C (DR) Equifax Risk Score Category R3 (N= 44,078)							
Pre-Reform Enrollment x During (DR)	-7.599**	310.624***	0.005***	0.035***	0.005***	0.011***	0.001
	(3.16)	(90.38)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)
Pre-Reform Enrollment x Post (DR)	-11.971***	467.008***	0.012***	0.063***	0.011***	0.003*	0.001
	(3.51)	(153.37)	(0.00)	(0.02)	(0.00)	(0.00)	(0.00)
N x T	1,044,857	1,046,148	1,046,148	1,046,148	1,046,148	1,044,576	1,045,526
Post DR x 0.147 (Median Pre-Reform Enrollment)	-1.76	68.7	0.0018	0.0093	0.0016	0.0004	0.0001

Notes: Standard errors are clustered at the county-level (95 counties). All models were estimated using the reghdfe command in STATA, and include individual, age, year and quarter fixed effects, as well as the local unemployment rate. {***} p<0.01 {**} p<0.05 {*} p<0.10. The number of individuals (N) for the 21-64 group is XXX. Source: *Federal Reserve Bank of New York Consumer Credit Panel/Equifax, Tennessee Department of Health, Division of TennCare Administrative Records.*

variation in how individuals are likely to respond to having and to losing health insurance. For example, urban individuals may be better able to adjust to the loss of public insurance if local employment opportunities are more plentiful. To identify any such differences, we divide our sample into two groups based on the individual's urban or rural location. We re-estimate equation (1) for individuals living in urban and rural counties separately. These results, reported in Table 6, show that urban areas saw a financial impact from the reform that was similar to that observed in rural areas. The urban results are slightly larger in magnitude and more precisely estimated than those for rural areas, but not sufficiently so for us to be able to confidently say that the two types of locations saw different impacts from the reform.

VII. Robustness

A. Alternative Measure of Treatment

We also use an alternative measure of the "dose" of the reform: the decline in TennCare enrollment in a county from immediately before to immediately after the reform. That is, we take the percentage of people in a county enrolled in TennCare in the two quarters prior to the beginning of reform (which are the first quarters of available data in TennCare administrative records), and compare it to the county enrollment in the two quarters after the reform was complete, in the latter half of 2006.[30] This drop in enrollment is a source of variation that directly measures the "dose" of the reform on a given county, at the cost of being less "clean" as there has been suggestive evidence that individuals have altered their employment and earning in response to the reform (Garthwaite, Gross and Notowidigdo, 2014). In this specification, we re-estimate equation (1) using the drop in the rate of TennCare enrollment ($Drop_i$) as an alternative measure of the intensity of the policy (i.e. as a replacement for $TPRE_i$).

[30] The decline in TennCare enrollment is expressed as a negative number (the decrease in enrollment multiplied by negative one) so that results in our two models are interpreted in the same direction.

Table 6. Dose Response (DR) Model of the Effect of Reform on Financial Outcomes by Rural-Urban Status: Sample of Adults 21-64

	Equifax Risk Score	Severely Delinquent Debt	Share of Debt that is Severely Delinquent	Number of Delinquent Accounts	Share of Delinquent Accounts	Having Any Severely Delinquent Debt (Hazard Model)	Bankruptcy in the Past 24 Months (Hazard Model)
Panel A (DR) Rural Counties (N=26,914)							
Pre-Reform Enrollment x During (DR)	-6.088	272.492	0.019***	0.044	0.019***	0.018*	0.001
	(5.67)	(313.27)	(0.01)	(0.03)	(0.01)	(0.01)	(0.00)
Pre-Reform Enrollment x Post (DR)	-17.570**	-416.575	0.046***	0.072	0.049***	0.020***	0.002
	(6.74)	(678.53)	(0.01)	(0.05)	(0.01)	(0.01)	(0.00)
N x T	635,190	637,063	637,063	637,063	637,063	631,238	635,268
Post DR x 0.147 (Median Pre-Reform Enrollment)	-2.58	-61.2	0.0068	0.0106	0.0072	0.0029	0.0003
Panel B (DR) Urban Counties (N=74,052)							
Pre-Reform Enrollment x During (DR)	-6.285	391.136	0.017***	0.074**	0.023***	0.031***	0.007**
	(4.66)	(380.76)	(0.01)	(0.03)	(0.01)	(0.01)	(0.00)
Pre-Reform Enrollment x Post (DR)	-19.952***	1627.952**	0.050***	0.214***	0.053***	0.026***	0.006**
	(7.03)	(673.56)	(0.01)	(0.06)	(0.01)	(0.01)	(0.00)
N x T	1,745,691	1,751,863	1,751,863	1,751,863	1,751,863	1,738,242	1,747,716
Post DR x 0.0147 (Median Pre-Reform Enrollment)	-2.93	239.3	0.0074	0.0315	0.0078	0.0038	0.0009

Notes: Standard errors are clustered at the county-level (95 counties). All models were estimated using the reghdfe command in STATA, and include individual, age, year, and quarter fixed effects, as well as the local unemployment rate. {***} p<0.01 {**}p<0.05 {*}p<0.10. Source: *Federal Reserve Bank of New York Consumer Credit Panel/Equifax, Tennessee Department of Health, Division of TennCare Administrative Records.*

In the results shown in Table 7, we are largely able to replicate the results in Table 2 with this secondary measure of policy exposure, a pattern that is not surprising given the high correlation ($\rho = 0.90$) between county level pre-reform enrollment and drop in enrollment post reform, which we plot in Figure A3. Although the results are somewhat similar, they are less precisely estimated, which is not surprising as there is less variation across in this alternate measure of policy exposure: the median county saw a drop of 5.4 percentage points, with drop rates ranging from 1.2 to 12.9 [31] Using the drop in TennCare enrollment as the treatment dose, we find that a one percentage point increase in exposure to the reform decreased average credit risk scores by 0.413 in the post period. This results in an impact on the average person in the median county of a 1.60 drop in credit risk score, which is somewhat lower than the 2.78 decrease found when utilizing the pre-reform enrollment rates. This model produces our best approximation of the average effect on financial outcomes for an individual who lost insurance through TennCare due to the reform. For example, the estimated effect on risk score for an individual who lost health insurance is a decline of 27.7 points during the reform and reaching a decrease of 41.3 points by the post period. This point-estimate fits with the pattern of risk score changes in Figure 4. This should still be viewed as a rough approximation at best: individuals who were disenrolled likely varied greatly in their experiences based on their health shocks post-reform, employment, borrowing behavior, and strategic bankruptcy decisions.

[31] The lone exception is the result for the amount of debt that is severely delinquent, which has imprecisely estimated opposite sign. This estimate could be due to improving finances for the impacted individuals (which seems unlikely given the general pattern of results in the table), or, more likely, the inability to borrow and with it less debt accumulation (both delinquent and non-delinquent).

Table 7. Dose Response (DR) Model of the Effect of Reform on Financial Outcomes: Sample of Adults 21-64

	Equifax Risk Score	Severely Delinquent Debt (2011$)	Share of Debt that is Severely Delinquent	Number of Delinquent Accounts	Share of Delinquent Accounts	Having Any Severely Delinquent Debt (Hazard Model)	Bankruptcy in the Past 24 Months (Hazard Model)
Drop in Enrollment x During (DR)	-27.707***	-542.614	0.031**	0.051	0.037**	0.035	0.009
	(6.68)	(675.99)	(0.01)	(0.08)	(0.02)	(0.03)	(0.01)
Drop in Enrollment x Post (DR)	-41.276***	-3006.465	0.06	0.083	0.066	0.021	0.002
	(12.88)	(2538.18)	(0.04)	(0.18)	(0.04)	(0.02)	(0.01)
N x T	2,380,894	2,388,939	2,388,939	2,388,939	2,388,939	2,369,493	2,382,996
Post DR x 0.0387 (Median Drop)	-1.60	-116.4	0.0023	0.0032	0.0026	0.0008	0.0001

Notes: Standard errors are clustered at the county-level (95 counties). All models were estimated using the reghdfe command in STATA, and include individual, age, year, and quarter fixed effects, as well as the local unemployment rate. PRTR is the pre-reform rate of TennCare enrollment. {***} p<0.01 {**} p<0.05 {*} p<0.10. The number of individuals (N) for the 21-64 group is 100,966. Source: *Federal Reserve Bank of New York Consumer Credit Panel/Equifax, Tennessee Department of Health, Division of TennCare Administrative Records.*

B. Subprime Mortgage Crisis

The time-period of our analysis includes the beginning of the crisis in subprime mortgage lending markets. A relatively large share of the subprime loans that originated in 2006 and 2007 became delinquent or were foreclosed upon in only a few months (Demyanyk and Hemert 2009). While Mayer et al. (2009) found that these subprime loans were concentrated in areas with high levels of growth, including Florida, California, Nevada, and the area around Washington, DC, they also found that the loans were concentrated in areas with moderate credit scores and with more black and Hispanic residents. Because Tennessee has a disproportionately higher black population than the nation as a whole and it is expected that those on Medicaid would have relatively weaker credit histories, there is concern that a concurrent rise in subprime loans and delinquencies could be driving the previous results. If this was the case, then mortgage loans would be the primary driver of these results and the impact would be less generalizable to different time periods. In order to test this theory, we recreate the four severely delinquent debt variables but for three specific debt categories: mortgages (including installment and revolving), auto loans, and non-mortgage revolving debt.[32] These results are shown in Table 8.

The results for mortgage debt are dramatically smaller in magnitude than our main results, which implies that our main findings were not driven by distressed mortgages and could not have been an artifact of the subprime mortgage crisis. However, the results do provide insight into how individuals handled debt in the aftermath of the TennCare Reform. Our analysis suggests that in the absence of insurance via TennCare, medical bills and/or other consumption may have been paid with revolving debt or that auto loan and/or non-mortgage revolving credit payments were delayed in order to cover increased medical costs.

[32] Total debt amounts, the proportion of individuals who have any auto, revolving or mortgage debt, as well as the share of total debt in each category are shown in Table A1.

Table 8. Dose Response (DR) Model of the Effect of Reform on Different Financial Outcomes: Sample of Adults 21-64

	Severely Delinquent Debt	Share of Debt that is Severely Delinquent	Number of Delinquent Accounts	Share of Delinquent Accounts
Panel A (DR) All Mortgages				
Pre-Reform Enrollment x During (DR)	-198.033	0.0003	-0.001	-0.001
	(170.89)	(0.00)	(0.00)	(0.00)
Pre-Reform Enrollment x Post (DR)	36.452	0.004*	0.004	0.004*
	(289.50)	(0.00)	(0.00)	(0.00)
N x T	2,388,939	2,388,939	2,388,939	2,388,939
Post DR x 0.147 (Median Pre-Reform Enrollment)	5.4	0.0006	0.0006	0.0006
Panel B (DR) All Auto Loans				
Pre-Reform Enrollment x During (DR)	86.132***	0.006***	0.007***	0.005***
	(20.25)	(0.00)	(0.00)	(0.00)
Pre-Reform Enrollment x Post (DR)	126.408***	0.011***	0.013***	0.011***
	(27.97)	(0.00)	(0.00)	(0.00)
N x T	2,388,939	2,388,939	2,388,939	2,388,939
Post DR x 0.147 (Median Pre-Reform Enrollment)	18.6	0.0016	0.0019	0.0016
Panel C (DR) All Non-Mortgage Revolving				
Pre-Reform Enrollment x During (DR)	235.397*	0.023***	0.044***	0.018***
	(141.34)	(0.01)	(0.01)	(0.00)
Pre-Reform Enrollment x Post (DR)	314.552	0.047***	0.080***	0.026***
	(260.86)	(0.01)	(0.03)	(0.01)
N x T	2,388,939	2,388,939	2,388,939	2,388,939
Post DR x 0.147 (Median Pre-Reform Enrollment)	46.2	0.0069	0.0118	0.0038

Notes: Standard errors are clustered at the county-level (95 counties). All models were estimated using the reghdfe command in STATA, and include individual, age, year and quarter fixed effects, as well as the local unemployment rate. {***} p<0.01 {**} p<0.05 {*} p<0.10. The number of individuals (N) for the 21-64 group is 100,966. Source: *Federal Reserve Bank of New York Consumer Credit Panel/Equifax, Tennessee Department of Health, Division of TennCare Administrative Records.*

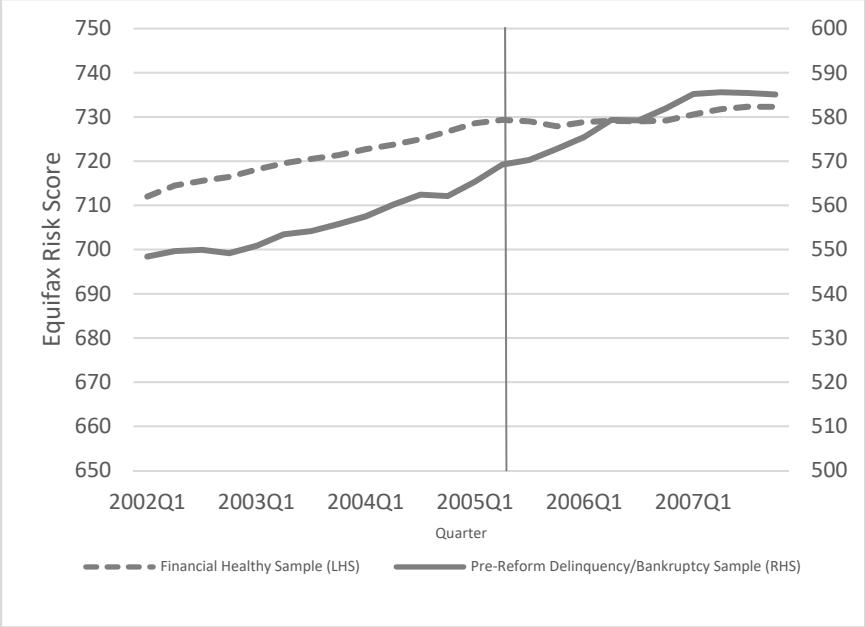
C. Sensitivity to Sampling Restrictions

We next examine the sensitivity of our results to the sampling restriction requiring individuals to be financially healthy (i.e. have no debt that is severely delinquent and no bankruptcy) in the pre-reform period. Recall that the purpose of this restriction was to remove individuals from the sample who would be treated differently in a systematic manner by credit scoring agencies and lending institutions. This restriction is also used to attempt to mitigate any contamination from BAPCPA's influence on strategic bankruptcy decisions. An additional concern is that these individuals have seen their credit risk scores downgraded and have reached a floor in which the impact of the TennCare reform cannot depress their scores further. This floor effect is consistent with the patterns shown in Figure 9 confirming that pre-trends in Equifax credit risk scores follow very different trends for the delinquent or bankrupt sample and the financially healthy sample.

The difference in circumstances for individuals with pre-reform delinquency is not limited to credit risk scores. These individuals also had systematically different access to credit, as illustrated in Figure 10, which plots average total debt for our analysis sample and for those excluded due to pre-reform poor financial health. We confirm that the sample with pre-reform severely delinquent debt or bankruptcy experience trends in total debt in the pre-period that diverge substantially from those in the financially healthy sample, as their debt levels were declining in the pre-period and the financially healthy sample identified growth.[33]

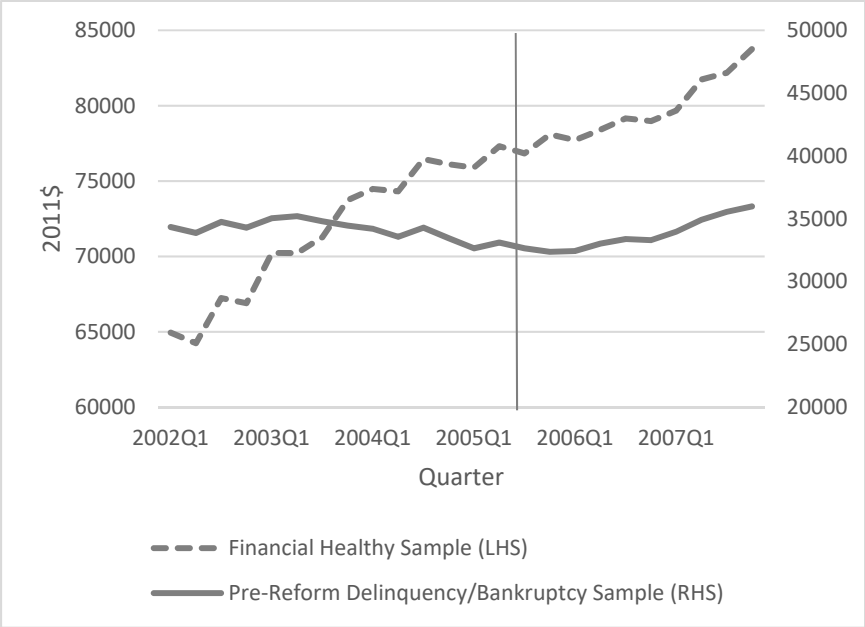
[33] It should also be noted that there is no evidence of anticipatory savings (decreased net borrowing) for the financially healthy sample.

Figure 9. Equifax Credit Risk Score by Pre-reform Financial Status



Notes: Values for the Primary (financially healthy) sample appear on the left axis and values for the Pre-Reform Delinquency/Bankruptcy sample appear on the right axis. The vertical lines represents the start of. Source: *Federal Reserve Bank of New York Consumer Credit Panel/Equifax*

Figure 10. Total Debt by Pre-reform Financial Status



Notes: Values for the financially healthy sample appear on the left axis and values for the Pre-Reform Delinquency/Bankruptcy sample appear on the right axis. The vertical line represents the start of reform. Source: *Federal Reserve Bank of New York Consumer Credit Panel/Equifax*

With such dramatically different pre-trends, rather than combine these samples, we estimate models separately for the samples with pre-reform severely delinquent debt and bankruptcy.[34] The first panel of Table 9 repeats estimation of equation (1) for the individuals who were excluded from the analysis sample due to having bad debt in the pre-reform period. Given the nature of the hazard models and the data, the probability of entering bankruptcy or severe delinquency cannot be estimated as these individuals have already reached the relevant state.

Compared to our main results, these individuals suffer larger consequences from the reform during the implementation period across the severely delinquent debt measures, which is reflective of their relatively fragile financial health. This is not the case for credit risk score, which is impacted to a much smaller extent than in our restricted sample. This is likely due to these individuals hitting "the floor" where their financial situation can no longer substantially influence their credit scores downward. Including these individuals in the main analysis sample would mask the impact of the TennCare reform credit risk scores by including a group of individuals who have credit scores that cannot deteriorate due to having already poor financial situations.

Individuals with pre-reform severe delinquency or bankruptcy carried far less debt in general, making the large increases in delinquent debt due to the reform for this population even more striking. Not only did this group see effects on amounts of delinquent debt that were larger in magnitude relative to those in our initially health sample, but these individuals did so while largely unable to borrow additional funds. This suggests that, due to the reform, a larger percent of their outstanding debt became delinquent (compare Table 9 to Table 2) without causing a larger

[34] Estimates of the DR model for a pooled sample, with no exclusions or controls for pre-reform severely delinquent debt or bankruptcy produce coefficients that suggest lower credit risk scores and greater delinquent debt associated with higher exposure to the reform as in the models in Tables 2 and 9. Without allowing for differential pre-trends, however, most of these estimates do not reach conventional levels of significance. An interacted models that allows for differential trends produces results that are similar to those Tables 2 and 9. These are available from the authors.

Table 9. Dose Response (DR) Model of the Effect of Reform on Different Financial Outcomes by Sample Selection: Sample of Adults 21-64

	Equifax Risk Score	Severely Delinquent Debt	Share of Debt that is Severely Delinquent	Number of Delinquent Accounts	Share of Delinquent Accounts	Having Any Severely Delinquent Debt (Hazard Model)
Panel A (DR) Individuals with Pre-Reform Severe Delinquency/Bankruptcy (N = 73,394)						
Pre-Reform Enrollment	-9.236**	2571.201	0.119***	0.398***	0.120***	-
x During (DR)	(4.45)	(1600.77)	(0.03)	(0.13)	(0.03)	-
Pre-Reform Enrollment	-9.848	1337.709	0.088**	0.356**	0.087**	-
x Post (DR)	(6.56)	(1624.45)	(0.04)	(0.14)	(0.04)	-
N x T	1,716,901	1,726,991	1,726,991	1,726,991	1,726,991	
Post DR x 0.147 (Median Pre-Reform Enrollment)	-1.45	196.6	0.0129	0.0523	0.0128	0.0146
Panel B (DR) Individuals who Never Experience Bankruptcy (N=99,511)						
Pre-Reform Enrollment	-6.519**	15.459	0.014***	0.043***	0.017***	0.023***
x During (DR)	(2.80)	(164.98)	(0.00)	(0.02)	(0.00)	(0.01)
Pre-Reform Enrollment	-16.251***	303.578	0.038***	0.112***	0.040***	0.017***
x Post (DR)	(3.85)	(313.95)	(0.01)	(0.04)	(0.01)	(0.00)
N x T	2,346,465	2,354,476	2,354,476	2,354,476	2,354,476	2,337,528
Post DR x 0.147 (Median Pre-Reform Enrollment)	-2.39	44.6	0.0056	0.0165	0.0059	0.0025

Notes: Standard errors are clustered at the county-level (95 counties). All models were estimated using the reghdfe command in STATA, and include individual, age, year, and quarter fixed effects, as well as the local unemployment rate. {***} p<0.01 {**} p<0.05 {*} p<0.10. The number of individuals (N) for the 21-64 group is 100,966. Source: *Federal Reserve Bank of New York Consumer Credit Panel/Equifax, Tennessee Department of Health, Division of TennCare Administrative Records.*

decrease in credit risk scores. This is a clear illustration of how including this group with a "floor problem" would not give a clear sense of how the reform impacted the vast majority of the affected population.

The second panel in Table 9 repeats estimation of equation (1) with the further restriction of excluding individuals who declare bankruptcy during the post period, after having no bankruptcy in the pre-reform period. The purpose of this exercise is to test for potential contamination from BAPCPA, which may have caused a change in bankruptcy filing behavior and would be problematic if that behavior was correlated with changes in TennCare enrollment changes. As no individual in this sample ever declares bankruptcy, we did not conduct this estimation for the financial outcome of declaring bankruptcy. The results are similar to those reported in Table 2, providing evidence that our main findings are not sensitive to changes in bankruptcy filing behavior, as documented by Sánchez (2014).

VIII. Comparison to previous literature

Unfortunately, our data do not allow for a direct test of asymmetry in the impact of losing versus gaining health insurance. One useful comparison is to Brevoort et al. (2019), who estimated an improvement in average credit scores of 0.53 points (one third the size of our estimate) due to the ACA Medicaid expansion using similar data from a different credit agency. This is suggestive of an asymmetry between gaining and losing Medicaid, such that losing insurance produces larger decreases in risk scores as compared to the increases from gaining insurance.

In contrast, Mazumder and Miller (2016) found a 0.34 point credit risk score change from a 1 percentage point change in their exposure measure utilizing the Massachusetts reform and the

same data source and method, whereas we found a 1 percentage point change of 0.19.[35] This difference suggests the potential of asymmetry in the opposite direction from comparisons with ACA studies. However, this difference could also be due to differences in the nature of the two reforms or in the different settings, as the population of Massachusetts impacted by that reform differed from the population impacted by the Tennessee Reform. For example, the Tennessee population was more comparable to those impacted by the ACA Medicaid expansions (Garthwaite, Gross and Notowodigdo 2014).

It is also important to consider the dynamics of the impact of insurance on credit risk scores. Our event studies show a worsening of risk scores and other financial variables in the post-reform period which continues for ten quarters until the end of our sample period, which ends in 2007 to avoid contamination from the Great Recession. It is possible that the negative impact of insurance loss would have continued given this trend in results, making our estimates a lower bound. This contrasts with studies such as Mazumder and Miller (2016) and Blascak and Mikhed (2018) who find that improvements in credit scores and delinquent debt from insurance expansions leveled off within 2 years.

Finally, it is important to consider differences in the samples used across studies, namely that in our study we exclude those with pre-reform delinquent debt and other studies using similar data do not. In our case, we exclude those who have credit risk scores which are largely unable to respond in a downward direction due to being near "the floor" for absorbing new information about delinquent debt, limiting our sample to how the majority of the population is scored. Other studies

[35] Our estimates of the effect of bankruptcy are also smaller than to those found by Mazumder and Miller (2016). They find that a 1 percentage point increase in exposure to the Massachusetts reform lowered the rate of bankruptcy by 0.03 percentage points, whereas we find that a 1 percentage point increase in exposure to the TennCare Reform increased the rate of bankruptcy by 0.004 percentage points.

in the literature that focus on expansion; those with pre-expansion delinquent debt who gained insurance and, with it, some economic stability, likely saw much larger increases in their credit risk scores relative to the majority of the population, as the ceiling on risk scores suggests a potential for low risk scores to adjust upwards relatively more easily than those in the bulk of the credit risk score distribution. Thus, it is difficult to make a true apples-to-apples comparison across studies as these studies of insurance expansion likely have larger estimates than they would if they excluded the population with pre-expansion delinquency or bankruptcy.

IX. Conclusion

This study provides the first evidence on the impact of losing health insurance on individual financial well-being. It appears that the loss of health insurance and its associated financial protection has economically significant consequences for those affected; the results demonstrate that losing Medicaid eligibility likely reduces credit risk scores and negatively impacts multiple measures of debt delinquency. Further, when our findings are compared to results from the ACA Medicaid expansion (Brevoort et al. 2019), the magnitude of the effects are much larger due to a reform based around insurance contraction than one based on insurance expansion, suggesting that there may be some asymmetry between gaining and losing insurance at play.[36]

In terms of mechanisms, it seems unlikely that any single factor accounts for the whole story in terms of the impact of reform on personal financial well-being. For example, Dobkin et al. (2018) estimate that the negative impact of a hospitalization on an individual who was uninsured prior to the hospitalization's credit score is approximately 5 points. This is only about 1/8 of our point estimate for losing insurance, and while some of this difference may be due to differences in

[36] The ACA Medicaid expansions and the TennCare reform are not exact opposites of one another, so differences in the policies and impacted populations certainly played a role as well. However, Garthwaite, Gross, and Notowodigdo (2014) argue that the TennCare reform had more demographic similarities to the ACA Medicaid expansion than other reforms such as the Massachusetts expansion.

the sample populations and context, as Dobkin et al.'s (2018) study was set in California, it is unlikely that the entirety of the estimated negative impact of losing Medicaid is due to suffering negative health shocks (and specifically suffering hospitalizations) while uninsured. Interestingly, our estimated impacts are closer in magnitude to the effect of new medical debt in collection estimated by Brevoort et al. (2019). They find that in the 3 years after a medical debt is newly delinquent (a way of accounting that lines up well with our sampling restrictions), credit scores fall by an average of 13.54 points, whereas our point estimate for losing insurance is 18.92, suggesting that new problematic medical debt may account for a large portion of our findings.

However, it remains likely the case that our total estimated effect is due to a combination of effects on behavior that is driven both by health and financial events and behaviors. Our results estimate effects of the TennCare reform net of all these possible responses. This net estimate is still incredibly salient for cost and benefit calculations around rollbacks of recent Medicaid expansions, due to the respective reforms' demographic similarities. However, to more fully understand the mechanisms by which insurance loss impacts financial well-being, researchers will need individually linked administrative data, such as that used by Miller et al. (2018) to look at the Medicaid expansion in Michigan.

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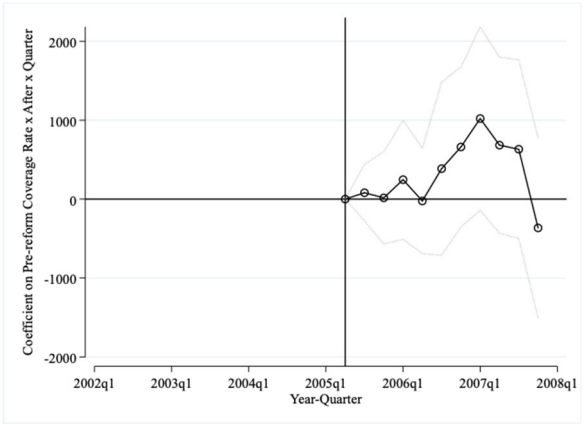
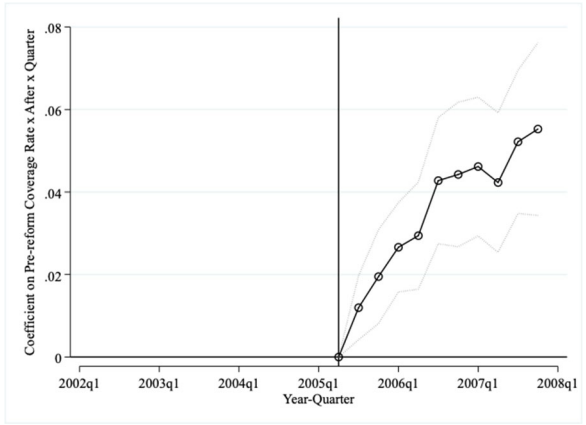
Appendix figures and tables

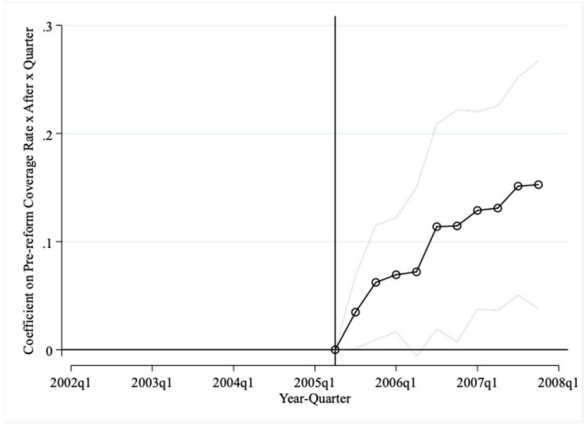
Figure A1: Event Study: Other Credit Outcomes



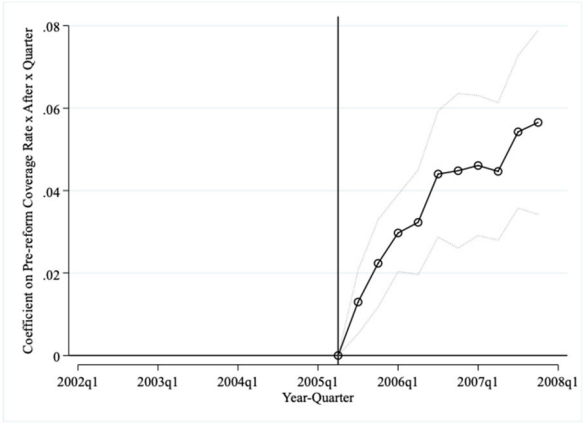
(a) *Total Severely Delinquent Debt (2011$)*



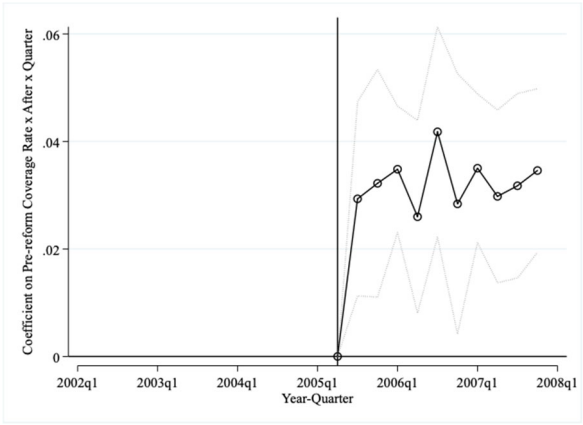
(b) Share of the Debt that is Severely Delinquent



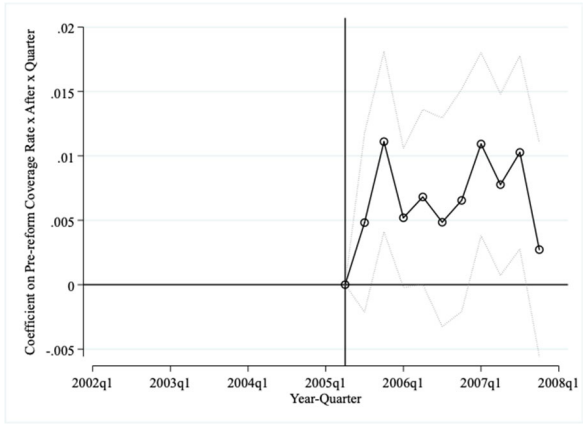
(c) Number of Severely Delinquent Accounts



(d) *Share of Accounts that are Severely Delinquent*



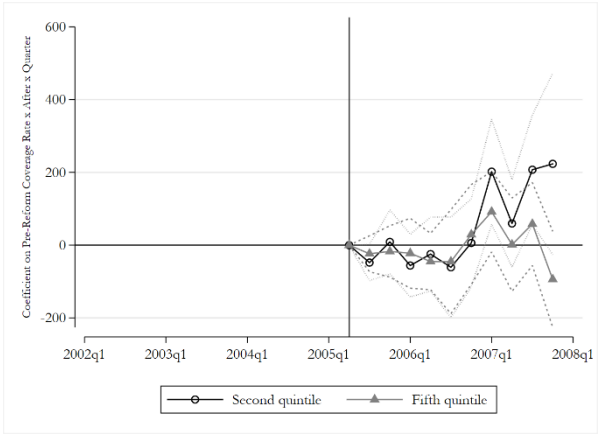
(e) *Probability of Severe Delinquency*



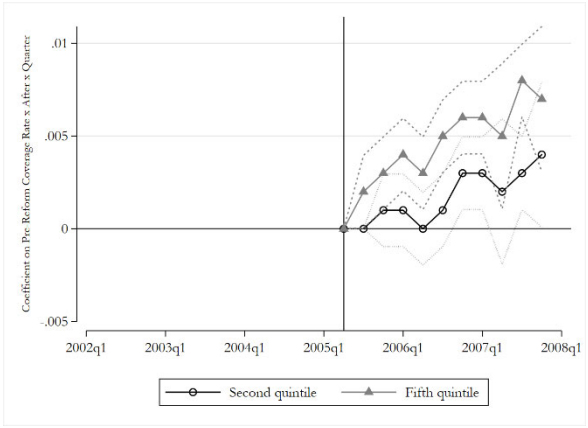
(f) *Probability of Bankruptcy*

Notes: These figures plot β_t by quarter from equation (2). 95% confidence intervals noted by dashed lines. Notes: Standard errors are clustered at the county-level (95 counties). All models were estimated using the reghdfe command in STATA, and include individual, age, year, and quarter fixed effects, as well as the local unemployment rate. The number of individuals (N) for the 21-64 group is 100,966. Vertical line represents the start of the reform, the horizontal line represents an estimate of zero. Source: *Federal Reserve Bank of New York Consumer Credit Panel/Equifax, Tennessee Department of Health, Division of TennCare Administrative Records.*

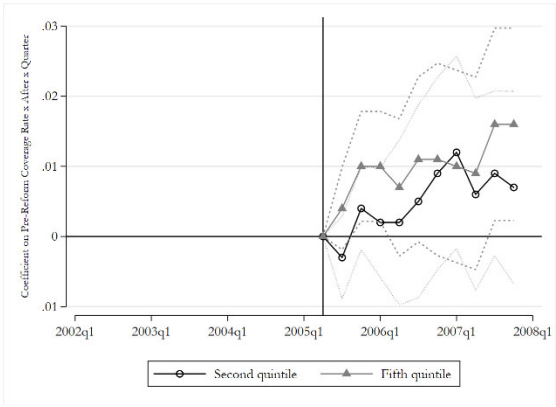
Figure A2: Event Study: Other Credit Outcomes by Quintile



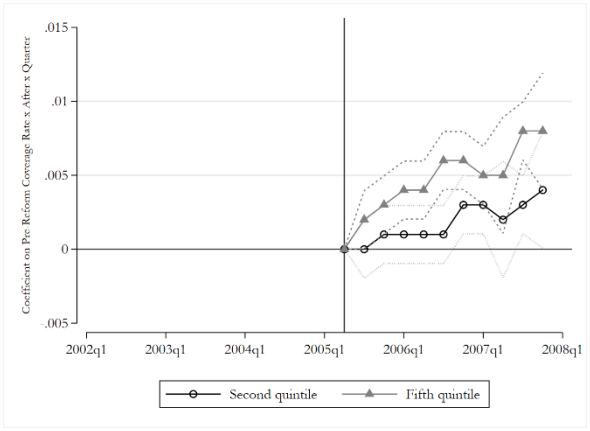
(a) *Total Severely Delinquent Debt (2002$)*



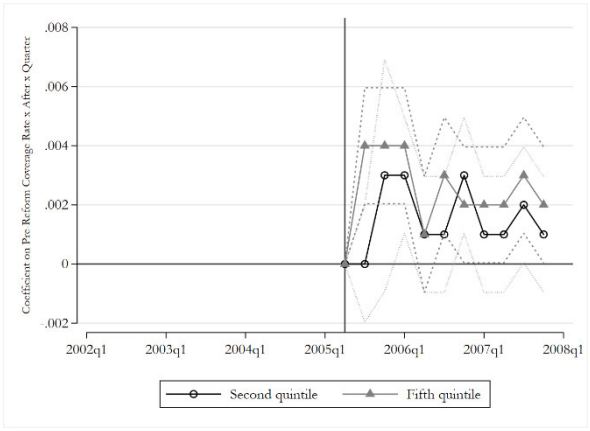
(b) Share of the Debt that is Severely Delinquent



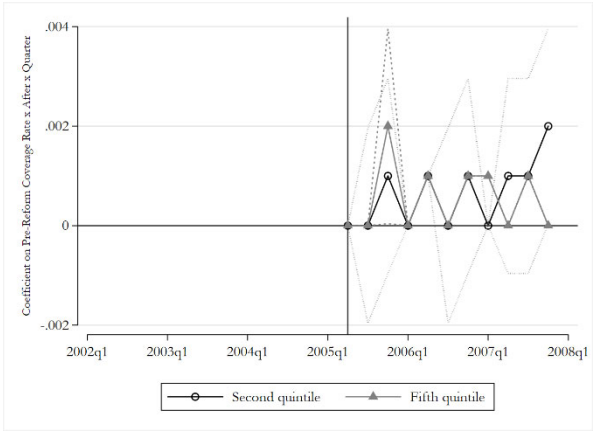
(c) Number of Severely Delinquent Accounts



(d) *Share of Accounts that are Severely Delinquent*



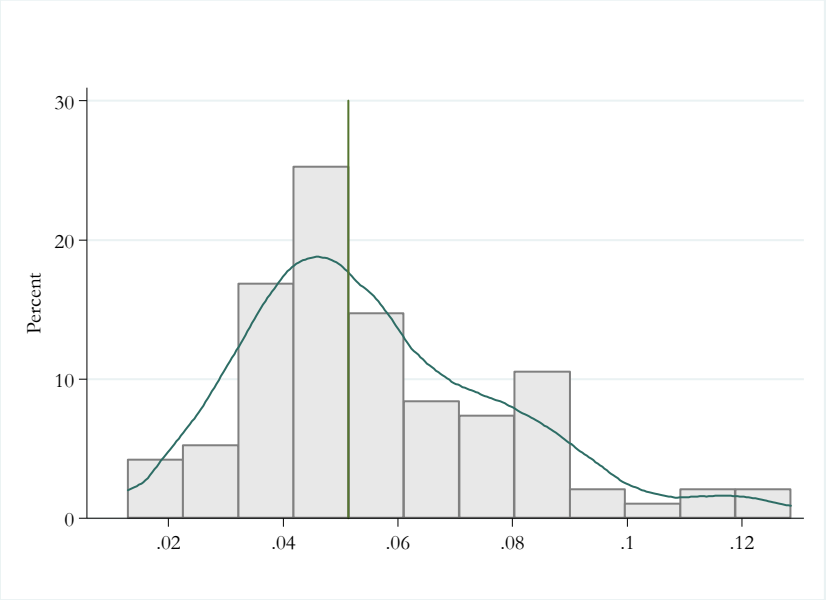
(e) *Probability of Severe Delinquency*



(f) *Probability of Bankruptcy*

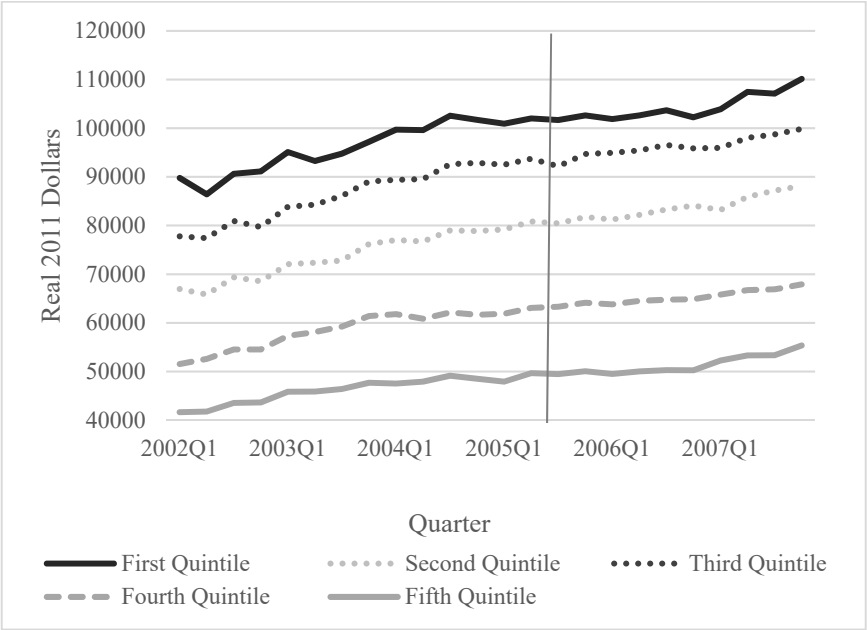
Notes: These figures plot β_t by quarter from equation (3). The baseline category if the first quintile (i.e.least exposed). 95% confidence intervals noted by dashed lines. Notes: Standard errors are clustered at the county-level (95 counties). All models were estimated using the reghdfe command in STATA, and include individual, age, year, and quarter fixed effects, as well as the local unemployment rate. {***} p<0.01 {**}p<0.05 {*}p<0.10. The number of individuals (N) for the 21-64 group is 100,966. Source: Vertical line represents the start of the reform; the horizontal line represents an estimate of zero. *Federal Reserve Bank of New York Consumer Credit Panel/Equifax, Tennessee Department of Health, Division of TennCare Administrative Records.*

Figure A3: Variation in County TennCare Reform



Notes: Vertical line is median drop in TennCare enrollment, solid line is a kernel-density plot of drop in TennCare enrollment. Source: *Tennessee Department of Health, Division of TennCare Administrative Records*

Figure A4: Trends in Total Debt by Quintile of Pre-Reform TennCare Enrollment (2011$)



Notes: The vertical line represents the start of the reform. Source: *Federal Reserve Bank of New York Consumer Credit Panel/Equifax*

Table A1 Total Debt and Debt by Type

	Age 21-64	Quintiles based on County TennCare Pre-reform Enrollment (Age 21-64)				
		First	Second	Third	Fourth	Fifth
Total Debt ($2011)	82,201	104,054	81,210	99,108	66,488	52,905
	(116897)	(131379)	(114949)	(127344)	(93450)	(98373)
Any Auto Loan	0.393	0.396	0.386	0.410	0.395	0.376
	(0.488)	(0.489)	(0.487)	(0.492)	(0.489)	(0.485)
Any Revolving Credit	0.745	0.759	0.748	0.779	0.741	0.695
	(0.436)	(0.428)	(0.434)	(0.415)	(0.438)	(0.460)
Any Mortgage	0.531	0.604	0.536	0.581	0.496	0.416
	(0.499)	(0.489)	(0.499)	(0.493)	(0.500)	(0.493)
Debt Shares (%):						
Auto Loans	12.895	11.124	12.466	12.231	13.931	15.189
	(25.485)	(23.280)	(24.939)	(24.306)	(26.578)	(28.350)
Revolving Credit	26.696	23.952	26.893	26.879	28.347	28.304
	(36.691)	(35.087)	(36.871)	(36.247)	(37.635)	(37.871)
Mortgages	39.901	47.687	40.542	44.442	35.666	28.796
	(41.702)	(42.457)	(41.799)	(41.848)	(40.435)	(38.723)
N x T	2,388,939	617,273	357,886	471,845	478,058	463,877
N	100,966	26,053	15,213	19,930	20,163	19,607

Sample of individuals age 21-64 with no severely delinquent debt 2003-2005. Source: *Federal Reserve Bank of New York Consumer Credit Panel/Equifax*