Losing Public Health Insurance: TennCare Disenrollment and Personal Financial Distress

Laura M. Argys, Andrew I. Friedson, M. Melinda Pitts and D. Sebastian Tello-Trillo

Abstract: A primary goal of health insurance is smoothing out financial risk that comes with health shocks. We estimate the effect of losing health insurance on individual financial well-being. Utilizing a plausibly exogenous shock to health insurance status resulting from a sudden disenrollment from Tennessee's Medicaid program in 2005, we find that the disenrollment caused a 3.12 point decline in credit risk score for the median individual in Tennessee. We also find increases in the amount and share of delinquent debt and bankruptcy risk. These findings are concentrated among individuals who had relatively worse financial status before the disenrollment. This study is the first to examine the impact on personal financial well-being of losing any form of public assistance.

JEL Codes: D14, H75, I13

Keywords: Medicaid, Public Assistance, Household Finance, Debt, Bankruptcy

Contact Information: Laura M. Argys Department of Economics, CB 181; University of Colorado Denver PO Box 173364; Denver, CO 80217-3364, 303-315-7011, Laura.Argys@ucdenver.edu. Andrew I. Friedson Department of Economics, CB 181; University of Colorado Denver; PO Box 173364 Denver, CO 80217-3364; andrew.friedson@ucdenver.edu. M. Melinda Pitts, Federal Reserve Bank of Atlanta, Research Department, 1000 Peachtree Street NE, Atlanta, GA 30309-4470, 404-498-7009, melinda.pitts@atl.frb.org. D. Sebastian Tello-Trillo 235 McCormick Rd, Garrett Hall L031, University of Virginia, Charlottesville, VA 22904 Sebastian.tello@virginia.edu.

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, has been associated with higher balances of debt in collections, an increased rate of bankruptcy, lower credit scores, less access to credit (as measured by credit limits), and less borrowing activity, with these negative outcomes persisting for at least four years after the hospital admission (Dobkin et al. 2018). Additionally, medical conditions are associated with increased likelihood of an individual entering bankruptcy[1].

Health insurance status has been found to play a substantial role in the ability to weather 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. In other words, 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 understanding 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 benefit of health insurance. A 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 papers have 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

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[1] See Zhu (2011) and Ramsey et al. (2013), among others.
[2] To put the size 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).

discontinuities in coverage around an eligibility cutoff. These studies show that the presence of insurance indeed lowers out-of-pocket spending, and the most recent of these studies show 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.

More recent studies utilized measures of individual financial well-being from third-party financial records, either through the use of credit report data (Mazumder and Miller 2016; Hu et al. 2016, Brevoort et al. 2017, Blascak and Mikhed 2018) 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. Instead, we examine the impact of a sudden and large-scale Medicaid disenrollment, and, to our knowledge, are the first to study the impact of 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.

Understanding the interplay between insurance loss and personal finance is an important gap in the literature; it may not be as salient to the policy debate to use evidence from an insurance expansion to predict the outcomes from an insurance contraction. Increases in a household's income via new eligibility for a program or cash transfer have been shown to increase that household's borrowing behavior (Agarwal, Liu, and Souleles 2007; Agarwal and Qian 2014), creating debt that is not discharged if the same program is suddenly taken away and the household becomes unable to meet its debt obligations. This could create asymmetry in the financial impact of losing

versus gaining an entitlement. Health insurance may also directly induce asymmetries in personal financial security via changes in patient behavior (and associated risk of an expensive health shock) if insured individuals do not revert to previous behavior when insurance is lost.[3]

In this study, we consider the effect of losing public health insurance eligibility on personal financial health for approximately 170,000 individuals throughout Tennessee in 2005. This exercise is particularly relevant for current policy considerations as the population affected by the Tennessee disenrollment 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 disenrollment more plausibly 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. 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.

I. Policy Variation: TennCare's Creation and Eventual Disenrollment

In the early 1990s, Tennessee offered traditional fee-for-service Medicaid to children and family members enrolled in other welfare programs.[4] 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

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[3] An example of this type of moral hazard is found by Dave and Kaestner (2009) in that after health insurance expansion, smoking increases. Due to the addictive nature of smoking, a complete reversal once health insurance is withdrawn is unlikely.

[4] 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).

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.[5]

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.[6]

By the early 2000s Tennessee once again experienced growing budget deficits, this time driven by the rising cost of the TennCare program.[7] 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.[8]

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

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

[6] 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 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).

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

[8] There are no exact estimates of the number of individuals who lost TennCare due to reverification, however, Figure 1 shows the trends in number of enrollees.

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 disenrollment by plotting the number of people enrolled in TennCare over time.[9] The steep drop in enrollment beginning in 2005 that is visible in Figure 1 is our primary source of identifying variation in the analyses to follow.

A. Mechanisms

There are two major routes through which losing health insurance could affect financial outcomes: through large one-time household medical expenditures (such as hospital visits), or through continuing household medical expenditures (such as managing chronic health conditions).[10] Medical expenses may result either from a health shock or a health state that requires ongoing spending on medical resources (for example, paying for an in-home medical device and its maintenance, prescription drugs, or ongoing therapy). In this section, we discuss findings from the literature that provide insight into these two pathways.

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[9] The state has annual enrollment data of TennCare before 2005 and monthly enrollment data afterwards.

[10] Others mechanism such as the possibility of changes in employment are discussed later in this section.

Figure 1. TennCare Enrollment 2000-2013
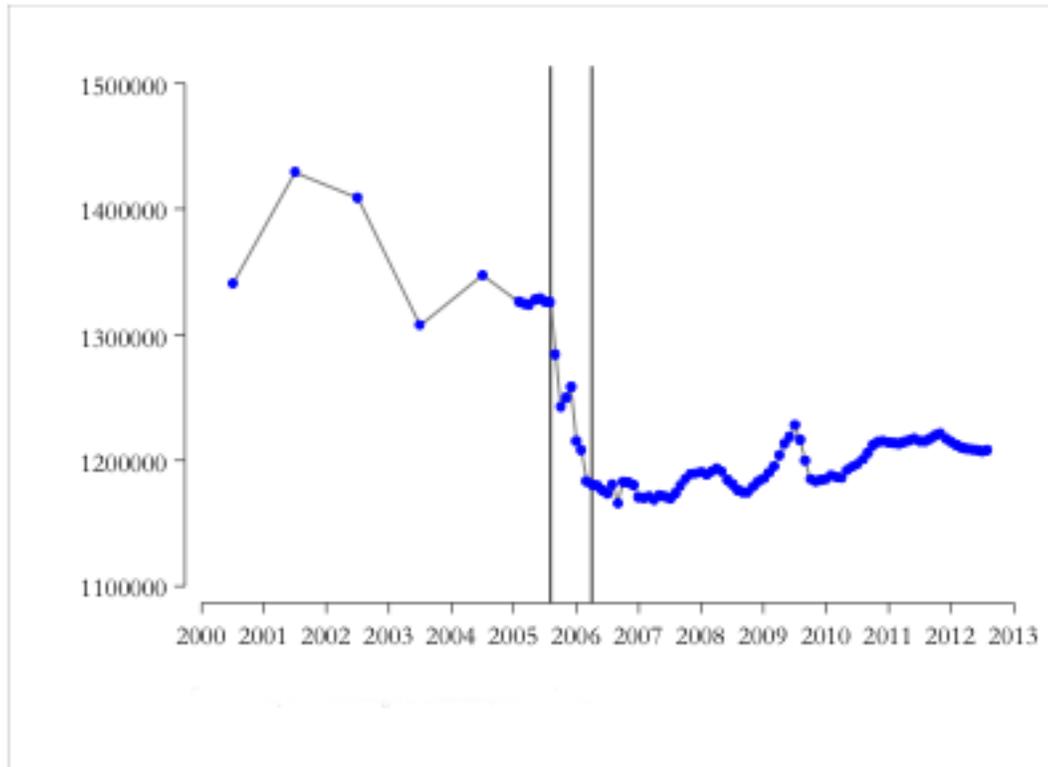
Source: *Tennessee Department of Health, Division of TennCare Administrative Records.*

A.i. One-Time Medical Expenditures

Substantial expenses could accrue to an individual who has lost insurance if a medical event

occurs that requires a major health intervention such as a visit to the Emergency Department (ED)

or a surgery. This could result from an unforeseen health issue or an existing health condition that

deteriorates over time and results in a major intervention. It is important to note that the latter could

be caused by reduced access to primary care in the absence of insurance coverage. Tarazi et al (2017)

and Tello-Trillo (2017) provide evidence that this indeed was the case in Tennessee; they report that

the disenrollment decreased access to care (specifically due to cost) by 4 percentage points, a 15

percent change from pre-disenrollment levels.

Unconditional on the insurance status of the individual, Dobkin et al. (2018) find that a hospitalization is associated with a higher balance of debt in collection (averaging approximately $6,000 for the uninsured), an increased rate of bankruptcy, lower credit score, less access to credit (as measured by credit limits), and less borrowing activity. It is reasonable to expect these effects to be more pronounced for hospitalizations of patients without the protection of health insurance. In addition, the authors note that it is not only medical bills that lead households to experience financial strain, but that illness status post-hospital-discharge is also associated with a substantial decline in income. Sanger-Katz (2018) estimated that "people in their 50s who are admitted to the hospital will experience a 20 percent drop in income that persists for years. Overall, income losses dwarfed the direct costs of medical care."

Previous research suggests that ED visits in particular may have contributed to financial strain in the aftermath of the TennCare contraction. Although there is no strong evidence of an increase in the overall number of ED visits after the TennCare disenrollment, 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%. Hospitalizations in general may also have contributed to financial distress among the disenrolled. Ghosh and Simon (2015) found an increase in the uninsured share of hospitalizations after the disenrollment, while the total number of hospitalizations remained constant. Taken as a whole, these studies suggest that even though there was no significant change in the total number of admissions the share of people who were uninsured at the time of a major medical intervention increased.

Health care can be expensive; lack of health insurance, by definition, exposes individuals to larger medical bills, all else equal. Among households with insufficient resources to pay medical bills on time and in full, borrowing is an option, depending on the household's current credit situation. If sufficient credit is not available, medical bills could become delinquent debt or their payment

could cause delays in other debt obligations. In either case, substantial borrowing, or the inability to make payments on time, would affect overall measures of financial health. Garthwaite, Gross and Notowidigdo (2014) document that the amount of uncompensated care claimed by hospitals increased almost immediately following the TennCare disenrollment. As this increase in uncompensated care occurred almost immediately after the reform, we hypothesize that the disenrollment affected financial outcomes with little lag.

A.ii. Repeated Medical Expenditures

Individuals with chronic conditions may require regular management through drugs, medical devices or therapeutic services. These management activities represent a repeated medical expenditure that is more expensive 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 also result in debt or delayed payment.

There is a sparse literature that provides suggestive evidence that the TennCare disenrollment is associated with an increase in chronic cases that require expensive hospitalizations, exacerbating the expense. Tello-Trillo (2017) finds an increase in individuals who report an inability to afford prescription drugs due to cost; however, this result is not statistically significant. Also, Maclean et al. (2018), find post-reform increases in hospitalizations related to mental health or

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[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).

substance abuse diagnoses. Taken together, these results are suggestive that less affordable prescriptions due to lack of insurance may have increased hospitalizations.

A.iii. Other Pathways

There are other responses that may have mitigated the impact of the TennCare disenrollment on financial outcomes. Garthwaite, Gross, and Notowidigdo (2014) show that the TennCare disenrollment 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 - $4,900 for individuals initially at 75%-200% of the federal poverty line.

A second behavioral response that might mitigate or offset financial loss is moral hazard; individuals who lose health insurance could adopt healthier behaviors and therefore have improvements in their health status and reduction in health-related expenditures. Tello-Trillo (2017) finds only weak evidence in support of this mechanism in response to the TennCare disenrollment. For the purpose of this study, we interpret our findings as net of any of these potentially offsetting effects. For example, finding that the disenrollment caused significantly worse financial outcomes would mean that these are effects in spite of any plausible offsetting effects such as increased employment.

II. Data

Our data comes from two main sources: the Federal Reserve Bank of New York's Consumer Credit Panel/Equifax (CCP) and Tennessee's administrative Medicaid enrollment records

(TennCare Records). We also use county level unemployment rates obtained from the Bureau of Labor Statistics.

A. CCP Data

The CCP is a nationally-representative 5-percent sample of individuals with credit reports maintained by Equifax. 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. For a detailed description of the data and the methodology underlying its creation, see Lee and van der Klaauw (2010).

For the purposes of this study, we sample individuals from the CCP between the first quarter (q1) of 2002 and the fourth quarter (q4) of 2007.[12] All individuals sampled live in Tennessee for the duration of the sampling frame and do not change their county of residence, thus allowing us to accurately capture TennCare disenrollment exposure. All individuals in the sample remain in the CCP during the sampling frame (no exit due to death or discontinuance of their credit report) and are neither bankrupt nor in severe delinquency during the pre-reform period. Additionally, for the primary analysis we focus on individuals over the age of 21 in 2002 who do not become Medicare-age eligible (65) by 2007. Thus, we conduct our analyses on a sample of initially financially-healthy individuals who do not leave the panel or change county of residence and are not age-eligible for Medicare throughout the period of analysis.[13]

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[12] The period of the analysis is selected so as to not confound the results by overlapping with the Great Recession.
[13] The implication of the selection criteria is explored in the results section.

Using the sample from the CCP, we calculate the following measures of individual financial well-being as outcome measures. The first outcome of interest is the credit risk score, which is the Equifax analog to an individual's FICO credit score. The score ranges from 330 to 830 and is a measure of an individual's probability of being severely delinquent (more than 90-days overdue) 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 calculate the amount of total debt, share of total debt, number of accounts and share of accounts that are "severely delinquent" for each individual in our sample. Severely delinquent is an industry term for debt that is 90 days or more past due, which is the point at which a creditor can initiate recovery through a collection agency.[14] 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 carry debt in general to have debt or accounts past due, and higher-income individuals tend to carry more debt. Therefore, an increase in 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. 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

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[14] These outcomes are comparable to those used in previous literature. For example, see Mazumder and Miller (2016) and Hu et al. (2016).

financial well-being, but we consider a worsening of several or all of these measures together to be strong evidence of worsening in individual financial status.

Finally, we construct 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. Given that there is persistence of severe delinquency in the data and that once an individual is in bankruptcy they remain in that state during the sample time frame, the analysis sample only includes individuals that have no severely delinquent debt and are not in bankruptcy in the pre-reform period. This 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.[15]

Summary statistics for our outcome variables are reported in Table 1 for the full sample and for subsamples based on age and time period (pre- or post-reform). The measures of delinquent debt are not reported in the pre-period as the sample is constructed to include only individuals who were financially healthy before the disenrollment. Table 1 indicates that during the period over which we conduct our analyses, credit risk scores were, on average, improving and those who are Medicare-age eligible tend to be in better financial circumstances than the remainder of the adult population: they have higher credit risk scores, lower measures of delinquent debt, and lower risk of bankruptcy.

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[15] Thus our main results should be interpreted as the impact of the TennCare reform on individuals who are initially financially healthy. We discuss the impact of the TennCare reform for the group that is initially in financial distress in the Results section.

Table 1. Sample Summary Statistics

	All Ages		21-64		65 +	
	Pre-Reform	Post-Reform	Pre-Reform	Post-Reform	Pre-Reform	Post-Reform
Credit Risk Score	735.472	742.797	724.394	732.447	768.612	773.761
	(-66.749)	(-77.158)	(-68.246)	(-80.881)	(-48.8412)	(-53.9783)
Severely Delinquent Debt	-	428.189	-	520.000	-	153.536
		(-6856.58)		(-7737.719)		(-2905.65)
Share of Debt that severely delinquent	-	0.012	-	0.0132	-	0.008
		(-0.096)		(-0.101)		(-0.081)
Number of Delinquent Accounts	-	0.057	-	0.069	-	0.023
		(-0.454)		(-0.505)		(-0.238)
Share of Delinquent Accounts	-	0.013	-	0.015	-	0.007
		(-0.090)		(-0.096)		(-0.065)
Severe Delinquency	-	0.029	-	0.034	-	0.014
		(-0.168)		(-0.181)		(-0.119)
Bankruptcy 24 Months	-	0.008	-	0.009	-	0.003
		(-0.088)		(-0.096)		(-0.058)
Number of Individual-Quarter observations (N x T)	1,644,846	822,423	1,232,756	616,378	412,090	206,045
Number of Individuals (N)	117,489	117,489	88,054	88,054	29,435	29,435

Preform period includes Q1 2002-Q2 2005. Post-Reform includes Q3 2006-Q4 2007. Source: *Federal Reserve Bank of New York Consumer Credit Panel/Equifax*

B. 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.[16] County population data from the Census are used to construct TennCare enrollment rates.[17]

These data are then used to create two county-level measures of exposure to the TennCare disenrollment. The first measure is the rate of TennCare enrollment in a county before the

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[16] These data are publicly available at this site: http://www.tn.gov/tenncare/topic/enrollment-data.
[17] These data are available at: https://www.census.gov/popest/data/intercensal/county/CO-EST00INT-01.html.

disenrollment began, which is calculated as the average county enrollment rate over the first 6 months of 2005. This variable measures a county's capacity to disenroll and is in keeping with previous studies of insurance expansions and contractions using similar methods.[18]

The second measure is the rate of decline in TennCare enrollment in a county after the reform.[19] That is, we take the percentage of people in a county enrolled in TennCare in the two quarters prior to the beginning of disenrollment, the first quarters of data availability for TennCare administrative records, and compare it to the county enrollment in the two quarters after the disenrollment was complete, in the latter half of 2006. This drop in enrollment serves as a direct measure of the "dose" of the disenrollment on a given county.

As shown in Panel A of Figure 2, there is substantial variation in the pre-reform rate of TennCare enrollment across counties in Tennessee. The median county had 19% of its adult population covered by TennCare, with proportions ranging from 3.3% to 40%. In addition, the median county saw a drop of 5.4 percentage points, with drop rates ranging from 1.2 to 12.9 (as shown in Panel B of Figure 2). As expected, disenrollment is positively correlated ($\rho = 0.90$) with pre-reform county enrollment levels (Figure A1).

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[18] Examples include Medicare (Finklestein and McKnight 2008), the Massachusetts reform (Miller 2012; Mazumder and Miller 2016), the TennCare disenrollment (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).

[19] The decline in TennCare enrollment is expressed as a negative number (the decrease in enrollment multiplied by -1) so that results in our two models are interpreted in the same direction.

Figure 2: Variation in County-Level TennCare Enrollment and Disenrollment Percentages

Panel A: Variation in Pre-Reform Enrollment
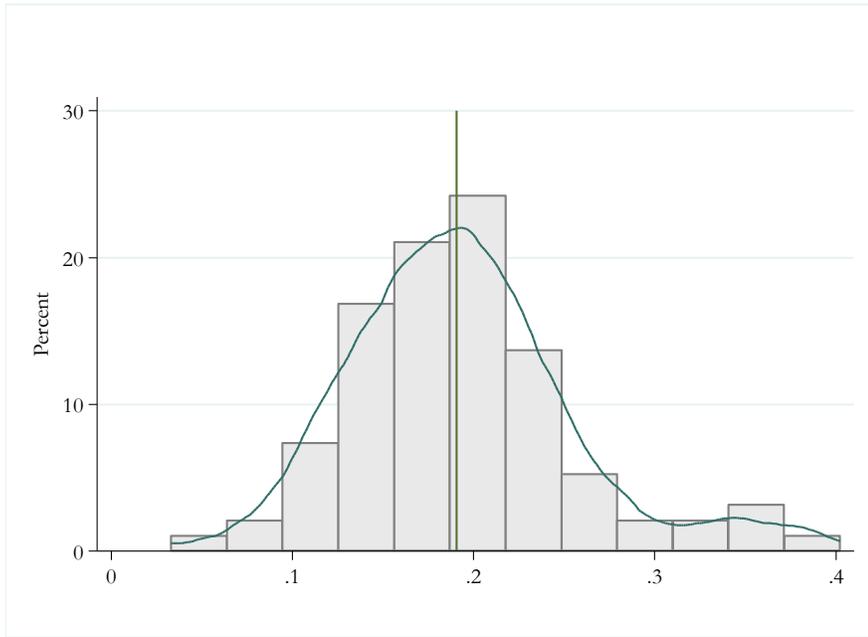
Panel B: Variation in Disenrollment
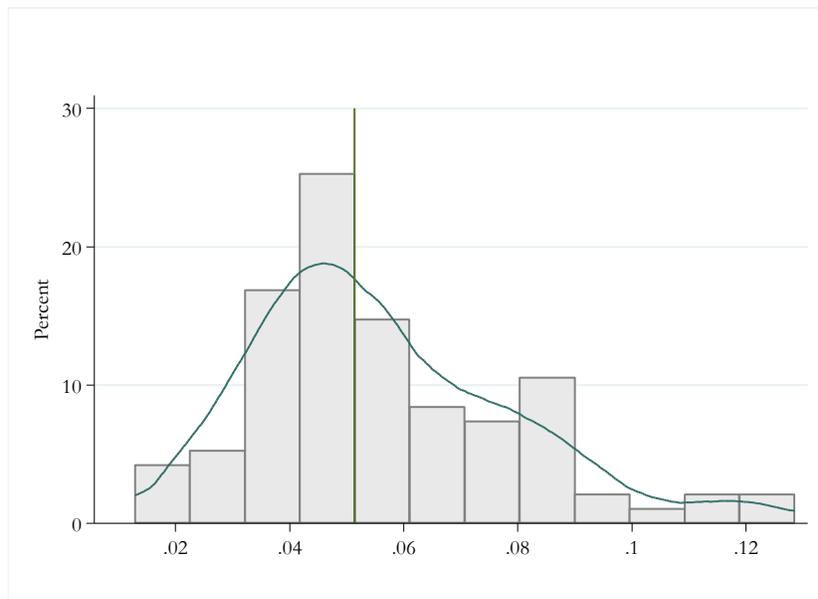
Source: *Tennessee Department of Health, Division of TennCare Administrative Records.*

III. Methods

In order to identify the effects of the reform on financial outcomes we use a dose-response strategy that leverages variation of the intensity of the pre-reform 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. We leverage variation across counties in Tennessee based on the "dose" of the reform (TennCare pre-reform enrollment rate) 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):

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

$$(1)$$

where Y_{icqy} is a financial outcome for individual i, living in county c, during quarter q and year y. The model above 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 county's quarterly unemployment rate (UR_{cqy}).[20] 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 disenrollment 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 disenrollment 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}, our "dose response" (DR)

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[20] County fixed effects are unnecessary as we restrict our sample to individuals who do not change county of residence and individual fixed effects are included. Results from all models estimated in this study are robust to the inclusion or exclusion of the unemployment rate, individual fixed effects, and county specific linear time trends. All of these variants of our results are available upon request.

estimator, which is the coefficient on the variable interacting a county's TennCare pre-reform enrollment rate (*TPRE*) with the indicator variable for the post-period. This coefficient captures the effect of the reform by differencing outcomes across counties with differing enrollment rates before the reform. The identifying assumption of this model is that the differential in financial measures across counties would have trended similarly in the absence of the disenrollment. 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 risk score, the amount and share of debt that is severely delinquent, and the number and share of severely delinquent accounts. We also estimate discrete-time hazard models for two binary outcome variables: having any severely delinquent debt and incurring a bankruptcy in the past 24 months.

IV. Results

A. Results based on the Pre-reform TennCare Enrollment Rate

Results for analyses using the pre-reform TennCare county enrollment rates are reported in Table 2. Each column represents a separate regression of the impact of the TennCare reform on each of the financial outcomes discussed above. We report the coefficients of interest (the pre-reform TennCare enrollment rate multiplied by an indicator for either the period during TennCare disenrollment or the post-reform period), the standard errors adjusted for clustering at the county level (Tennessee has 95 counties), and the number of observations. Our main coefficient of interest measures the average effect of pre-reform county enrollment changing from 100% to 0%, which can be viewed as a rough measure of the impact of coverage loss on the average individual who was enrolled in TennCare prior to the changes in policy. In order to facilitate a comparison of the effect of the TennCare reform to other policy changes, two alternative measures are calculated by

scaling our estimate by median pre-reform enrollment rates. These calculations are similar to average treatment effects. The first measure reflects the effect on the "median individual" by scaling the estimate using the pre-reform county TennCare enrollment rate for the median person across Tennessee (i.e. each person is assigned their county's rate and then the median value is selected). The second reflects the impact of the reform for the average person in a county with the median pre-reform TennCare rate, by scaling the estimate by the median county's pre-reform TennCare enrollment rate.[21] These median effects should be interpreted with caution; though these values help to quantify the average effect of the reform on the population as a whole, the impact of the reform was most likely tightly concentrated among those who personally lost TennCare eligibility.

Estimates from the DR model indicate that increased exposure to TennCare decreased credit risk scores in the post-reform period, with a coefficient of -21.25. This suggests that an average individual initially covered by TennCare who subsequently lost coverage would have seen their credit risk score drop by over 20 points following the disenrollment period. The estimate also represents an aggregate drop of 4.1 points for individuals in the median county. This is quite a large decrease; for context, the aggregate change in the average FICO score during the Great Recession (October 2006 to the peak of the unemployment rate in October 2010) was also four points (a drop from 690 to 686).[22]

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[21] The median pre-reform TennCare enrollment rate across all individuals of ages 21-64 is 0.1470 and the median pre-reform TennCare coverage rate for the population of ages 21-64 across all counties is 0.1913.

[22] 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 Disenrollment on Financial Outcomes: Sample of Adults 21-64

	Credit 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)
Pre-Reform TennCare Rate x During (DR)	-10.72***	175.20	0.020***	0.065***	0.022***	0.025***	0.007***
	(3.20)	(232.60)	(0.004)	(0.019)	(0.004)	(0.004)	(0.002)
Pre-Reform TennCare Rate x Post (DR)	-21.25***	749.37*	0.049***	0.150***	0.050***	0.017***	0.004**
	(4.55)	(414.31)	(0.007)	(0.044)	(0.008)	(0.004)	(0.002)
N x T	2,113,296	2,113,296	2,113,296	2,113,296	2,113,296	2,093,798	2,107,876
Post DR x 0.1470 (Median PRTR across Individuals)	-3.12	110.16	0.007	0.022	0.007	0.003	0.001
Post DR x 0.1913 (Median PRTR across Counties)	-4.07	143.35	0.009	0.029	0.010	0.003	0.001

Notes: Standard errors are clustered at the county-level (95 counties). All models were estimated using the HDFE 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 88,054. Source: *Federal Reserve Bank of New York Consumer Credit Panel/Equifax, Tennessee Department of Health, Division of TennCare Administrative Records.*

Regressions of additional financial outcomes also provide evidence of a negative shock, which reinforces the idea that changes in these outcomes reflect a deterioration in financial stability rather than a change in income or other mechanisms. While it is not surprising that there is regression to the mean for the financial variables, given the criteria of no delinquent debt in the pre-reform period, the results suggest that the increase in delinquent debt was larger for counties with higher rates of Tenncare exposure pre-reform. We find that for individuals living in a county with the median TennCare pre-reform enrollment rate, severely delinquent debt in the post-reform period is $143, or about $750 for the average individual who was enrolled in TennCare before the reform. We also see evidence that the share of debt that is severely delinquent, the number of delinquent accounts and share of delinquent accounts had more growth in counties with higher pre-reform Tenncare exposure. In addition, our hazard-model estimates suggest that individuals living in these counties with more Tenncare exposure have a higher probability of both becoming severely delinquent on any account and entering bankruptcy. The results suggest an increase in the probability of severe delinquency of 0.1 percentage points and bankruptcy of 0.3 percentage points for both the median person and for a person living in the median county. For context, in 2008, the most recent year of available data from the American Bankruptcy Institute, Tennessee had an annual bankruptcy rate of 7.64 per 1,000, or a 0.19 percent risk of individual bankruptcy in a given quarter.

Although we focus on the impact of the TennCare disenrollment on individual financial outcomes in the post-reform period in this discussion, we also report coefficients for the impact *during* the TennCare disenrollment. As expected, these effects are generally smaller than the effects in the post-reform period, as there was only partial disenrollment during that time period and a shorter period of time during which individuals might experience health shocks and accumulate medical debt. In general, the effects during the disenrollment are about half the size of the post-reform effects, with the exception of the hazard models of the probability of becoming severely

delinquent and on filing for bankruptcy, which are somewhat larger during the disenrollment. It should be noted that this pattern of results from the hazard models likely reflects the fact that the most financially vulnerable experience severely delinquent debt and bankruptcy more quickly.

B. Heterogeneity of Results

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 disenrollment 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 disenrollment based on the "dose" received by different counties, and second by exploiting differences across individuals' pre-reform creditworthiness.

B.i. Heterogeneity across Counties

Figure 3 is a histogram showing heterogeneity in the implied average effect of the disenrollment 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 green line represents the effect for the county with the median pre-reform enrollment, and the dark curve is an Epanechnikov kernel-smoothed probability distribution for counties having an effect of the reported magnitude.[23] 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-

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[23] Histograms for the remainder of the DR model estimates have a similar distribution.

reform Tenncare enrollment saw a decrease in credit risk scores for the average resident in the county of approximately 7 points, which is almost twice the size of the effect for the median county.

B.ii. Heterogeneity by Initial Credit Status

To further examine heterogeneity in the impact of the TennCare disenrollment, 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 (Fannie Mae 2017). The distribution of these categories within our sample is reported in Table 3. 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 most risky category (R1).[24]

Figure 3: Distributions of Effects of Disenrollment on Credit Scores
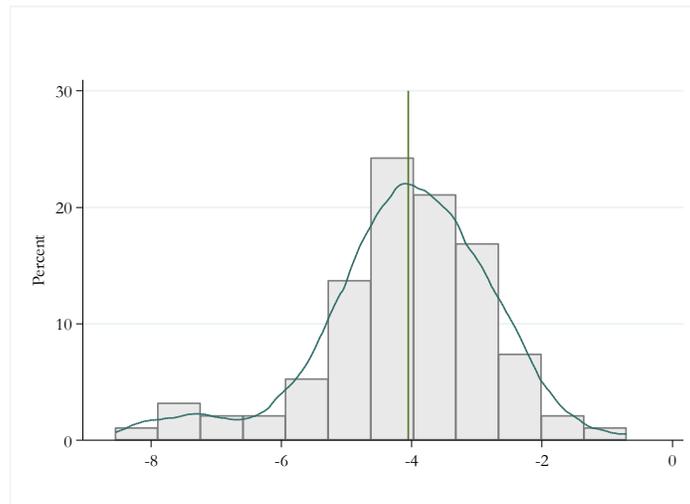
Source: *Tennessee Department of Health, Division of TennCare Administrative Records, Federal Reserve Bank of New York Consumer Credit Panel/Equifax,* authors' calculations.

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[24] 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, reformulation of the risk score, or an overall improvement in credit risk over time. Because we include q and y fixed effects, each of these are controlled.

Table 3. Share of Sample by Fannie Mae Risk Categories

Credit Risk Score Category	Credit Risk Score (R) Range	All Ages		21-64		65 +	
		Pre-Reform	Post-Reform	Pre-Reform	Post-Reform	Pre-Reform	Post-Reform
R1	330≤R1<660	0.145	0.135	0.179	0.165	0.042	0.046
		(0.352)	(0.342)	(0.383)	(0.371)	(0.200)	(0.209)
R2	660≤ R2< 740	0.283	0.217	0.321	0.246	0.170	0.128
		(0.451)	(0.412)	(0.467)	(0.431)	(0.376)	(0.334)
R3	R3≥740	0.572	0.649	0.500	0.589	0.789	0.826
		(0.495)	(0.477)	(0.500)	(0.492)	(0.408)	(0.379)

Notes: Standard deviations in parentheses. 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 4. 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 credit 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 *Credit 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 categories experienced financial shocks that were greater relative to their savings' ability to absorb them, 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 is negative for the riskiest categories, although the shares of each significantly increased. This likely reflects the difficulty someone with a low initial credit risk score faced in obtaining credit, thus making them unable to

Table 4. Dose Response (DR) Model of the Effect of Disenrollment on Financial Outcomes by Initial Credit Score Category: Sample of Adults 21-64

	Credit 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) Credit Score CategoryR1 (N=18,856)							
Pre-Reform TennCare Rate x During (DR)	-27.576***	-1223.864*	0.028*	-0.003	0.033**	0.029*	0.005
	(6.833)	(564.385)	(0.014)	(0.051)	(0.012)	(0.011)	(0.006)
Pre-Reform TennCare Rate x Post (DR)	-40.341***	-819.172	0.067**	-0.038	0.056*	0.012	-0.001
	(10.959)	(1227.033)	(0.023)	(0.111)	(0.022)	(0.009)	(0.005)
N x T	452,544	452,544	452,544	452,544	452,544	439,633	449,929
Panel B (DR) Credit Score Category R2 (N=29,278)							
Pre-Reform TennCare Rate x During (DR)	-19.064**	86.430	0.013*	0.025	0.012*	0.011	0.009*
	(5.995)	(333.197)	(0.006)	(0.022)	(0.006)	(0.007)	(0.004)
Pre-Reform TennCare Rate x Post (DR)	-38.363***	54.031	0.030**	0.079*	0.032***	0.012**	0.003
	(8.184)	(377.990)	(0.009)	(0.037)	(0.008)	(0.004)	(0.002)
N x T	702,672	702,672	702,672	702,672	702,672	697,570	700,438
Panel C (DR) Credit Score Category R3 (N= 39,920)							
Pre-Reform TennCare Rate x During (DR)	-8.658*	325.052**	0.006***	0.036***	0.005**	0.011***	0.001
	(3.432)	(96.204)	(0.002)	(0.010)	(0.001)	(0.003)	(0.001)
Pre-Reform TennCare Rate x Post (DR)	-12.689***	489.889**	0.013***	0.070***	0.012***	0.004	0.001
	(3.642)	(156.314)	(0.003)	(0.016)	(0.003)	(0.002)	(0.001)
N x T	958,080	958,080	958,080	958,080	958,080	956,595	957,509

Notes: Standard errors are clustered at the county-level (95 counties). All models were estimated using the HDFE 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 88,054.
Source: *Federal Reserve Bank of New York Consumer Credit Panel/Equifax, Tennessee Department of Health, Division of TennCare Administrative Records.*

accumulate large amounts of debt as lenders were unwilling to do business with them. These results suggest that the TennCare Medicaid disenrollment is associated with a much more adverse impact on the overall financial well-being of the part of the population that was financially fragile prior to the reform.

In the main analyses described above, we limit the sample to those who were financially healthy in the pre-reform period. In order to explore the impact of this sample restriction, the main model is also re-estimated only for those who were severely delinquent or in bankruptcy in the pre-reform period. These results are reported in Appendix Table A1. In general, the impact of the reform was felt more quickly during the period of change. The impact of disenrollment on the credit score is smaller than for the financially healthy sample, which is not surprising as the credit score already reflected a higher probability of being delinquent. The impact on the number and share of accounts, as well as the share of severely delinquent debt, is larger, particularly in the period the change was taking place. While not significant by conventional measures, the increase in the amount of delinquent debt is of a much larger magnitude.

B.iii. Heterogeneity by Urban-Rural Location

Both because 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), one might not be surprised to see differences in the impact of TennCare disenrollment on financial outcomes in rural areas as compared to urban areas. To identify any such differences we divide our sample into two groups based on the individual's urban or rural location.[25] We re-estimate equation (1) for individuals living in urban and rural counties separately. These results, reported in Table 5, show some differences in

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[25] Counties within an MSA were deemed urban and non-MSA counties were classified as rural using U.S. Census delineation files from 2005 located at https://www2.census.gov/programs-surveys/metro-micro/geographies/reference-files/2005/historical-delineation-files/list4.txt

Table 5. Dose Response (DR) Model of the Effect of Disenrollment on Financial Outcomes by Rural-Urban Status: Sample of Adults 21-64

	Credit 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=23,709)							
Pre-Reform TennCare Rate x During (DR)	-14.00** (5.39)	361.7 (353.6)	0.022*** (0.007)	0.065** (0.031)	0.022*** (0.007)	0.023** (0.009)	0.003 (0.004)
Pre-Reform TennCare Rate x Post (DR)	-24.96*** (6.72)	-125.2 (678.7)	0.050*** (0.011)	0.100* (0.054)	0.054*** (0.012)	0.022*** (0.007)	0.001 (0.002)
N x T	568,194	568, 194	568, 194	568, 194	568, 194	562,196	566,358
Panel B (DR) Urban Counties (N=64,345)							
Pre-Reform TennCare Rate x During (DR)	-4.66 (4.925)	394.19 (373.27)	0.018*** (0.006)	0.075** (0.034)	0.022*** (0.006)	0.023*** (0.006)	0.007** (0.003)
Pre-Reform TennCare Rate x Post (DR)	-18.35** (7.631)	1901.22** (724.33)	0.053*** (0.011)	0.233*** (0.064)	0.055*** (0.012)	0.017*** (0.005)	0.006** (0.003)
N x T	1,545,102	1,545,102	11,545,102	1,545,102	1,545,103	1,531,277	1,541,201

Notes: Standard errors are clustered at the county-level (95 counties). All models were estimated using the HDFE 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 88,054. Source: *Federal Reserve Bank of New York Consumer Credit Panel/Equifax, Tennessee Department of Health, Division of TennCare Administrative Records.*

financial distress resulting from the TennCare disenrollment by urbanicity. In all cases, the signs of the coefficients point to worsening financial health in the *Post* period, although the effects vary in magnitude and are sometimes less precisely estimated in rural counties. In particular, the effect of TennCare disenrollment on the share of both delinquent debt and delinquent accounts is similar for rural and urban residents. The amount of additional delinquent debt in the *Post* period, however, is substantially larger, by more than $1,700, for urban residents. A substantially higher probability of bankruptcy for urban residents in the aftermath of the TennCare reform further demonstrates a severe financial impact for those in urban counties. Conversely, the impact on credit risk scores are larger in rural counties. In general, these results suggest that the findings in the previous model are widespread and not driven solely by persons living in either rural or urban counties.

V. Robustness Analysis and Extensions

In this section, we test the validity of our main results by estimating the effects of the TennCare reform on more granular measures of financial distress, examining the underlying assumptions of the DR model, comparing estimates for sub-populations within counties, and examining the magnitude of the effects specifically for those disenrolled during the TennCare reform.

A. 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 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 reproduce the same debt variables as in Tables 2 and 3, but for three specific debt categories: mortgages (including installment and revolving), auto loans, and non-mortgage revolving debt (i.e. credit card debt). These results are shown in Table 6.

These results suggest that the subprime crisis does not drive our main findings given that the largest and most precise estimates are in the auto and revolving debt categories. However, the results do provide insight into how individuals handled debt in the aftermath of the TennCare disenrollment. Our analysis suggests that in the absence of TennCare, medical bills and/or other consumption may have been paid with revolving debt. Another possibility is that auto loan and revolving credit payments were delayed in order to cover increased medical costs (or both possibilities occurred).

Table 6. Dose Response (DR) Model of the Effect of Disenrollment 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 TennCare Rate x During (DR)	-165.8	0.0003	-0.0004	-0.00002
	(179.1)	(0.002)	(0.002)	(0.002)
Pre-Reform TennCare Rate x Post (DR)	119.5	0.006*	0.006	0.006*
	(313.0)	(0.003)	(0.003)	(0.003)
N x T	2,113,296	2,113,296	2,113,296	2,113,296
Panel B (DR) All Auto Loans				
Pre-Reform TennCare Rate x During (DR)	77.5***	0.005***	0.007***	0.005***
	(20.8)	(0.001)	(0.002)	(0.001)
Pre-Reform TennCare Rate x Post (DR)	146.2***	0.012***	0.015***	0.012***
	(34.8)	(0.002)	(0.003)	(0.002)
N x T	2,113,296	2,113,296	2,113,296	2,113,296
Panel C (DR) All Revolving				
Pre-Reform TennCare Rate x During (DR)	325.1**	0.025***	0.050***	0.020***
	(133.2)	(0.005)	(0.010)	(0.003)
Pre-Reform TennCare Rate x Post (DR)	577.5*	0.052***	0.089**	0.028***
	(278.6)	(0.010)	(0.028)	(0.006)
N x T	2,113,296	2,113,296	2,113,296	2,113,296

Notes: Standard errors are clustered at the county-level (95 counties). All models were estimated using the HDFE 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 88,054. Source: *Federal Reserve Bank of New York Consumer Credit Panel/Equifax, Tennessee Department of Health, Division of TennCare Administrative Records.*

B. Event Study

We also extend our analysis by performing an event-study with our main outcome, the credit risk score. This allows us both to map out the differences in pre-trends between high- and low-pre-reform enrollment counties and to visualize adverse financial outcomes during and after the TennCare reform. Of particular concern is bias in pre-reform trends due to TennCare's re-verification in 2002. The event study model follows our main specification; however, we replace the interaction of the pre-reform TennCare enrollment rate and during/post with an interaction of the

pre-reform rate and year-quarter specific indicators for the entire analysis period, excluding the second quarter of 2005, which is just before disenrollment began. Namely this specification is:

$$Y_{icqy} = \gamma_0 + UR_{cqy} + \beta_1 During_{qy} + \beta_2 Post_{qy}$$

$$+ \Sigma_{t=2002Q2}^{2007Q4} (\beta_t \times TPRE_c \times I(Year.Quarter = t)_{qy} \qquad (2)$$

$$+ P_i + Y_y + Q_q + Age_{iqy} + \epsilon_{icqy}$$

We plot the results from this specification in Figure 4. The vertical axis shows the magnitude of the coefficient on $TPRE_c \times I(Year.Quarter = t)_{qy}$, or the effect of the pre-reform enrollment rate on credit-risk score. Thus, the horizontal red line represents a zero effect. The vertical red line is the beginning of the post-reform period. Although there is some evidence of seasonality, there is no obvious pre-period trend (the trend line is approximately horizontal in the pre-reform period), followed by a striking continual drop in credit risk scores once the reform is enacted.

C. Differential Dose Response

It could also be the case that the pre-reform level of 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. Thus, we leverage the fact that

individuals age 21 to 64 were most affected by the reform and compare them to individuals age 65 and older.

Figure 4: Event Study: Credit Risk Score
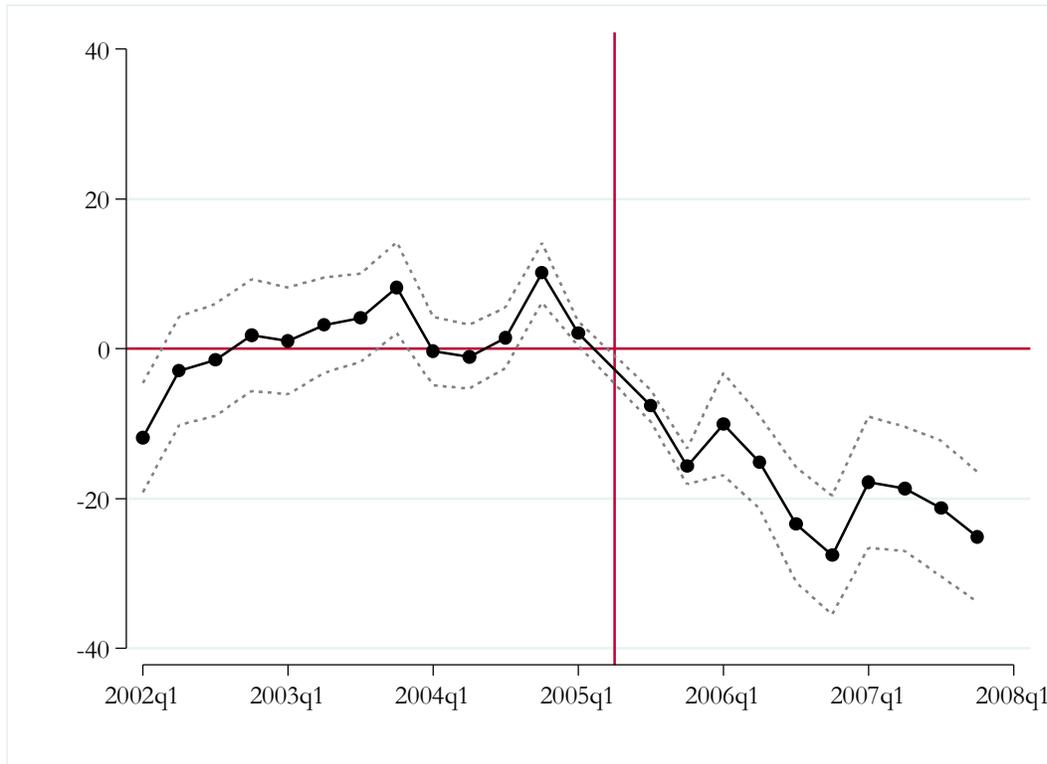
Source: Source: *Tennessee Department of Health, Division of TennCare Administrative Records, Federal Reserve Bank of New York Consumer Credit Panel/Equifax*, authors' calculations.

Figure 5 provides evidence of self-reported health insurance coverage across the two age groups in Tennessee using data from the Centers for Disease Control's Behavioral Risk Factor Surveillance System (BRFSS) data. These data confirm that the population between the ages of 21 and 64 report a striking loss of health insurance at the time of the TennCare reform. In contrast, the older population, over the age of 65, demonstrate no such decline. These patterns reflect the fact that even if some older individuals lost TennCare eligibility, they did not remain uninsured for long, likely reporting insurance coverage in the BRFSS due to Medicare.

Figure 5: Uninsured Rates by Age Groups
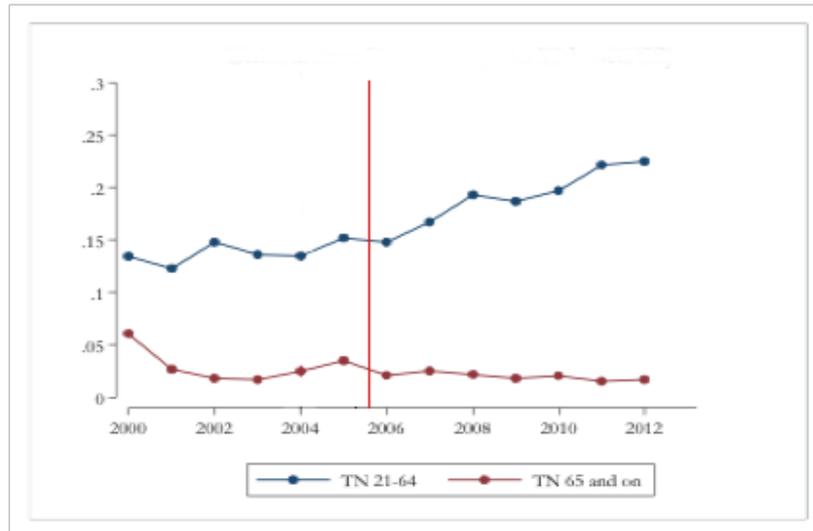
Source: *Behavioral Risk Factor Surveillance System (Centers for Disease Control and Protection).*

The lack of an impact of the TennCare reform on this older group is also tested directly by replicating the dose response model in equation one for the Medicare-age eligible population only (ages 65 and over). Those results, shown in Appendix Table A2, support the notion that there is no relationship between TennCare Disenrollment and the financial health of the Medicare-age eligible population in the post-reform period, thus providing support for the use of this group as a control.

Using this additional margin of variation across age groups, we introduce a new "differential dose response" (DDR) specification (analogous to a triple difference model) which compares adults aged 21 to 64 to individuals 65 and older within the same county and then compares the differences

in their financial outcomes across counties with varying pre-reform enrollment rates.[26] 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:

$$Y_{icqy} = \beta_0 + UR_{cqy} + Q_q \times I(21 \leq Age < 65)_{iqy} + Y_y \times I(21 \leq Age < 65)_{iqy} + C_c$$

$$\times I(21 \leq Age < 65)_{iqy} + \beta_1 During_{qy} + \beta_2 Post_{qy} + \beta_3 TPRE_c \times During_{qy}$$

$$+ \beta_4 TPRE_c \times Post_{qy} + \beta_5 TPRE_c \times During_{qy} \times I(21 \leq Age < 65)_{iqy}$$

$$+ \beta_{DDR} TPRE_c \times Post_{qy} \times I(21 \leq Age < 65)_{iqy} + P_i + Y_y + Q_q + Age_{iqy}$$

$$+ \epsilon_{icqy}$$

The indicator variable $I(21 \leq Age < 65)_{iqy}$ takes the value of 1 if the individual is in the adult-age treatment group (21 to 64) versus the Medicare-age eligible control group (65 and older). 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 $TPRE_c$ as in the previous model. Finally, the interaction between $Post_{qy}$, the age indicator, and $TPRE_c$, 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 is that in the absence of the disenrollment, the *difference* in outcomes between non-age-eligible adults and the age-eligible would have evolved similarly after the reform across counties.

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

The estimates from the DDR model, shown in Table 7, exhibits similar patterns to the DR model. Again, exposure to the disenrollment (via higher levels of pre-reform enrollment) is associated with lower credit risk scores; in this case, the coefficient is slightly smaller in magnitude (-16.78), resulting in the median resident of Tennessee ages 24-64 seeing a decrease of 2.5 points compared to credit risk scores among those age 65 and older. The DDR coefficients of the models of delinquent debt were all positive, and statistically significant at conventional levels. Results for the risk of carrying any severely delinquent debt were almost four times as large as that found by the DR model and more precisely estimated. Additionally, the DDR model also detects a statistically significant increase in the risk of bankruptcy of 0.4 percentage points for the average individual aged 21-64 relative to the older cohort, where the DR model found a 0.1 percentage point increase.[27] In general, the younger age group in high-exposure counties experienced larger relative declines in financial health when compared to the younger age group in low-exposure counties.

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[27] Bankruptcy data can be found at http://www.abi.org/newsroom/bankruptcy-statistics?page=17.

Table 7. Differential Dose Response (DDR) Model of the Effect of Disenrollment on Financial Outcomes: Sample of All Adults

	Credit (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)
Pre-reform TennCare Rate x Age 21 to 64 x During (DDR)	-12.46***	589.4***	0.019***	0.091***	0.022***	0.028***	0.006***
	(2.10)	(102.9)	(0.002)	(0.012)	(0.003)	(0.002)	(0.001)
Pre-reform TennCare Rate x Age 21 to 64 x Post (DDR)	-16.78***	1098.3***	0.029***	0.154***	0.034***	0.021***	0.008***
	(3.71)	(254.3)	(0.005)	(0.026)	(0.005)	(0.003)	(0.001)
N x T	2,819,736	2,819,736	2,819,736	2,819,736	2,819,736	2,797,691	2,813,622
DDR x 0.1470 (Median PRTR for All Individuals)	-2.46	161.45	0.004	0.023	0.005	0.012	0.004
DDR x 0.1913 (Median PRTR for All Counties)	-3.21	210.11	0.006	0.029	0.006	0.016	0.005

Notes: Standard errors are clustered at the county-level (95 counties). All models were estimated using the HDFE command in STATA, and include individual, age, county, 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 88,054. The number of individuals (N) for the Medicare age-eligible group is 31,629. The number of individuals for the DDR model is 124,888. Source: *Federal Reserve Bank of New York Consumer Credit Panel/Equifax, Tennessee Department of Health, Division of TennCare Administrative Records.*

There is the potential that the differential dose response analysis is simply picking up differences in financial behavior between older and younger age groups and is not reflective of trends related to Tenncare coverage. To test this theory, the sample was restricted to those within ten years of the age 65 Medicare cutoff in either direction, thus creating a more homogeneous sample in terms of both health and financial stability. Table 8 presents the results from this estimation. The differences between the Medicare-age eligible group and the just under-65 group are not as large, but the results are consistent in sign with the analysis of the full sample and precisely estimated.[28] This suggests either that the impact of TennCare disenrollment was mitigated for this group or that the ability to weather financial shocks is higher. Regardless, this supports the finding that the differential dose response is picking up the impact of the disenrollment and not just cohort differences.

D. Effects on the Financial Well-being of the Disenrolled

In a final analysis, we seek to estimate the magnitude of the impact on financial outcomes of the TennCare reform for the disenrolled. To meet this goal, we estimate the model described in equations (1) and (2) by replacing the pre-reform TennCare enrollment rate with the share of the population that was disenrolled in each county during the implementation of the reform. The result of estimating these models are reported in Table 9 (DR) and Table 10 (DDR). The direction of these impacts match with results reported in the original model. The magnitudes, however, are much larger; an expected pattern considering that the model in Tables 9 and 10 is intended to provide a measure of the effect only on the disenrolled, not all individuals with exposure to TennCare.[29]

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[28] Ideally one would also perform a falsification test on a different time period. Given the timing of available data, the only possible falsification exercise would use 2003 as a false disenrollment date. This, however, is not a clean test due to the recertification in 2002-2003.

[29] All other analyses using the rate of TennCare enrollment in this paper were replicated using the TennCare disenrollment rate with similar results. These results are available upon request.

Table 8. Differential Dose Response (DDR) Model of the Effect of Disenrollment on Financial Outcomes: Sample of Adults 55-74

	Credit 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)
Pre-reform TennCare Rate x age 55-64 x During (DR)	-6.33*** (2.26)	189.6 (117.8)	0.011*** (0.003)	0.046*** (0.015)	0.010*** (0.003)	0.013*** (0.002)	0.002 (0.002)
Pre-reform TennCare Rate x Post (DR)	-8.36** (3.71)	407.1 (267.6)	0.012* (0.007)	0.052* (0.030)	0.012* (0.007)	0.010*** (0.003)	0.003 (0.002)
N x T	1,184,808	1,184,808	1,184,808	1,184,808	1,184,808	1,178,881	1,182,745
DDR x 0.1470 (Median PRTR for All Individuals)	-1.23	59.8	0.002	0.008	0.002	0.001	0.000
DDR x 0.1913 (Median PRTR for All Counties)	-1.60	77. 9	0.002	0.010	0.002	0.002	0.001

Notes: Standard errors are clustered at the county-level (95 counties). All models were estimated using the HDFE command in STATA, and include individual, age, county, 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 55-64 group is 31,649. The number of individuals (N) for the 65-74 group is 17,718. The number of individuals for the DDR model is 49,367. Source: *Federal Reserve Bank of New York Consumer Credit Panel/Equifax, Tennessee Department of Health, Division of TennCare Administrative Records.*

Table 9. Dose Response (DR) Model of the Effect of Disenrollment on Financial Outcomes (Using County Rate of Dropping off TennCare): Sample of Adults 21-64

	Credit 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)
TennCare Drop Rate x During (DR)	-33.72***	-494.3	0.038***	0.076	0.043**	0.042*	0.012
	(7.53)	(750.9)	(0.014)	(0.089)	(0.017)	(0.022)	(0.008)
TennCare Drop Rate x Post (DR)	-46.46***	-2517.0	0.072	0.124	0.075	0.026*	0.002
	(14.14)	(2832.2)	(0.045)	(0.202)	(0.046)	(0.015)	(0.006)
N x T	2,113,296	2,113,296	2,113,296	2,113,296	2,113,296	2,093,798	2,107,876
DR x 0.0387 (Median TennCare Drop for All Individuals)	-1.80	-97.4	0.003	0.005	0.003	0.002	0.000
DR x 0.0550 (Median TennCare Drop for All Counties)	-2.56	-138.4	0.004	0.007	0.004	0.002	0.001

Notes: Standard errors are clustered at the county-level (95 counties). All models were estimated using the HDFE 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 21-64 group is 88,054. The number of individuals for the DDR model is 124,888. Source: *Federal Reserve Bank of New York Consumer Credit Panel/Equifax, Tennessee Department of Health, Division of TennCare Administrative Records.*

Table 10. Differential Dose Response (DDR) Model of the Effect of Disenrollment on Financial Outcomes (Using County Rate of Dropping off TennCare): Sample of All Adults

	Credit (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)
TennCare Drop Rate x Age 21 to 64 x During (DDR)	-50.08***	868.8	0.061***	0.235***	0.063***	0.095***	0.023***
	(7.04)	(744.3)	(0.008)	(0.053)	(0.011)	(0.007)	(0.004)
TennCare Drop Rate x Age 21 to 64 x Post (DDR)	-63.19***	469.8	0.082***	0.322**	0.082***	0.057***	0.023***
	(11.34)	(1901.0)	(0.018)	(0.125)	(0.023)	(0.009)	(0.004)
N x T	2,819,736	2,819,736	2,819,736	2,819,736	2,819,736	2797691	2813622
DDR x 0.0387 (Median TennCare Drop for All Individuals)	-2.45	18.2	0.003	0.012	0.003	0.002	0.001
DDR x 0.0550 (Median TennCare Drop for All Counties)	-3.48	25.8	0.005	0.018	0.004	0.003	0.001

Notes: Standard errors are clustered at the county-level (95 counties). All models were estimated using the HDFE 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 21-64 group is 88,054. The number of individuals (N) for the Medicare age-eligible group is 31,629. The number of individuals for the DDR model is 124,888. Source: *Federal Reserve Bank of New York Consumer Credit Panel/Equifax, Tennessee Department of Health, Division of TennCare Administrative Records.*

Results from the DR model suggest that disenrolled individuals experience a decline in credit risk scores of over 45 points and an increase in the probability of being severely delinquent of 4.2 percentage points during the reform and 2.6 points after the reform. The DDR results are mostly larger, with the typical disenrolled individual seeing a drop in their credit score of over 60 points. In addition, disenrolled individuals are 5.7 percentage points more likely to have severely delinquent debt and face over a 2 percentage point increase in the likelihood of bankruptcy.

VI. 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 large consequences for those affected. The results suggest that losing Medicaid eligibility reduces credit risk scores and negatively impacts multiple measures of financial delinquency. These effects are substantial enough to increase the likelihood of bankruptcy.

Two questions follow naturally from our results: 1) how do these effects compare to those from similar studies that examine expansions of insurance? and 2) what is the effect on an individual who is directly impacted by disenrollment? In other words, what is the expected financial impact on an individual who suffers insurance loss due to the reform?

The closest study to ours in terms of methods and data is by Mazumder and Miller (2016), who use the same data source (the CCP) to analyze the effect of the Massachusetts insurance expansion on financial outcomes. They estimate that a 1 percent increase in coverage in a county increased that county's credit risk scores by approximately 0.34 points. Our DR model based on the drop in coverage finds that the median county (which had a median drop of coverage of 3.87 percentage points across all individuals) experienced a decline in the average credit risk score of approximately 1.8 points. If we assume (as Mazumder and Miller did) that the effect is roughly

linear, this translates to a 1 percent decrease in coverage in a county decreasing that county's average credit risk score by 0.47 points. This estimate, which is over 50% larger, is suggestive of asymmetry in losing versus gaining insurance.[30]

The second question is more difficult to answer, as the available financial data do not distinguish those who lost insurance from those who did not. The best estimate of the impact on an individual who loses coverage is the point estimate for the DR estimator using the enrollment drop dose-response variable, which is the effect for the average individual if the entire county drops from insured to uninsured. This number is by no means a perfect estimate of the effect on an individual but is the best estimate that we can offer with the data available. This estimate implies that the individual impact of insurance loss is severe, greatly decreasing credit risk scores (63 points) and greatly increasing bankruptcy risk. These effects not only directly influence individual financial well-being, but there is an indirect effect as well; worse credit risk scores will result in worse offered terms for any borrowing activities and less access to credit, thus a decreased ability to smooth consumption and weather economic downturns. In addition, holding severely delinquent debt has also been linked to other poor health outcomes, including mortality (Argys et al. 2017).

Our estimates provide evidence that removing Medicaid should not solely be viewed as eliminating affordable access to healthcare but should also be seen as potentially removing an important layer of financial protection from its enrollees. The results point out the effects of the disenrollment net of all the possible responses from the individual, providers and organizations that provide uncompensated care. We identify significant negative consequences to the financial well-being of current recipients that would need to be considered in the cost and benefit calculations around rollbacks of recent Medicaid expansions.

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[30] These differences could also reflect differences in the affected populations and sample selection.

References

Argys, Laura, Andrew Friedson, and Melinda Pitts. "Killer Debt: The Impact of Debt on Mortality" 2016. Federal Reserve Bank of Atlanta Working Paper 2106-14.

Agarwal, Sumit, Liu, Chunlin, and Nicholas S. Souleles. 2007. "The Reaction of Consumer Spending and Debt to Tax Rebates – Evidence from Consumer Credit Data" *The Quarterly Journal of Economics* 115(6): 986-1019.

Agarwal, Sumit, and Wenlan Qian. 2014. "Consumption and Debt Response to Unanticipated Income Shocks: Evidence from a Natural Experiment in Singapore" *The American Economic Review* 104(12): 4205-4230.

Baicker, Katherine, Taubman, Sarah L., Allen, Heidi L., Bernstein, Mira, Gruber, Jonathan H., Newhouse, Joseph P., Schneider, Eric C., Wright, Bill J., Zaslavsky, Alan M. and Amy N. Finkelstein. 2013. "The Oregon Experiment – Effects of Medicaid on Clinical Outcomes" *The New England Journal of Medicine* 368: 1713-1722.

Barcellos, Silvia Helena, and Mirelle Jacobson. 2015. "The Effects of Medicare on Medical Expenditure Risk and Financial Strain" *American Economic Journal: Economic Policy* 7(4): 41-70.

Blascak, Nathan, and Vyacheslav Mikhed. 2018. "Did the ACA's Dependent Coverage Mandate Reduce Financial Distress for Young Adults?" Federal Reserve Bank of Philadelphia Working Paper 18-03.

Boben, PJ. 2000. "Medicaid Reform in the 1990s." *Health Care Financing Review, 22(2): 1-5.*

Bredesen, Phil. 2004 "Governor Bredesen's Press Remarks on TennCare" Governor's Communication Office.

Brevoort, Kenneth, Grodzicki, Daniel and Hackman, Martin "Medicaid and Financial Health" Working Paper, online version found at https://martinhackmann.files.wordpress.com/2017/07/bgh_draft_july24_upload.pdf

Chang, Cyril F., and Stephanie C. Steinberg, "TennCare Timeline: Major Events and Milestones from 1992 to 2016," Methodist Le Bonheur Center for Healthcare Economics, the University of Memphis, September 2016. (online) http://www.memphis.edu/mlche/index.php.

Courtemanche, C., J. Marton, and A. Yelowitz. 2016. "Who Gained Insurance Coverage in 2014, the First Year of Full ACA Implementation*?" Health Economics* 25: 778-784.

Courtemanche, C., J. Marton, B. Ukert, A. Yelowitz, and D. Zapata. 2017. "Early Impacts of the Affordable Care Act on Health Insurance Coverage in Medicaid Expansion and Non-Expansion States" *Journal of Policy Analysis and Management,* 36 (1): 178-210.

Courtemanche, C., J. Marton, B. Ukert, A. Yelowitz, and D. Zapata. 2018. "Early Effects of the Affordable Care Act on Health Care Access, Risky Health Behaviors, and Self-Assessed Health" *Southern Economic Journal* 84(3): 660-691.

Courtemanche, C., Andrew Friedson, Andrew P. Koller, and Daniel I. Rees. 2017. "The Affordable Care Act and Ambulance Response Times" National Bureau of Economic Research Working Paper No. 23722

Dave, Dhaval, and Robert Kaestner. 2009. "Health Insurance and ex ante Moral Hazard, Evidence from Medicare" *International Journal of Health Care Finance and Economics,* 9(4): 367.

Demyanyk, Yuliya and Otto Van Hemert. 2008. "Understanding the Subprime Mortgage Crisis" Federal Reserve Bank of St. Louis Supervisory Policy Working Paper.

Dobkin, Carlos, Finkelstein, Amy, Kluender, Raymond, and Matthew Notowidingdo. 2018. "The Economic Consequences of Hospital Admissions" *American Economic Review* 108(2): 308-352.

Doty, Michelle M., Collins, Sara R., Rustgi, Sheila D., and Jennifer L. Kriss. 2008. "Seeing Red: The Growing Burden of Medical Bills and Debt Faced by U.S. Families" Commonwealth Fund. New York.

Engelhardt, Gary V., and Jonathan Gruber. 2011. "Medicare Part D and the Financial Protection of the Elderly" *American Economic Journal: Economic Policy* 3(4): 77-102.

Finkelstein, Amy, and Robin McKnight. 2008. "What did Medicare do? The Initial Impact of Medicare on Mortality and Out of Pocket Medical Spending" *Journal of Public Economics* 92(7): 1644-1668.

Finkelstein, Amy, Taubman, Sarah, Wright, Bill, Bernstein, Mira, Gruber, Jonathan, Newhouse, Joseph, P., Allen, Heidi, Baicker, Katherine, and the Oregon Health Study Group, 2012. "The Oregon Health Insurance Experiment: Evidence from the First Year" *Quarterly Journal of Economics* 127(3): 1057-1106.

Garthwaite, Craig, Tal Gross, and Matthew Notowidigdo. 2014. "Public Health Insurance, Labor Supply and Employment Lock." *Quarterly Journal of Economics* 653 - 693.

Ghosh, Ausmita and Kosali Simon. 2015. "The Effect of Medicaid on Adult Hospitalizations: Evidence from Tennessee's Medicaid Contraction" National Bureau of Economic Research Working Paper No. 21580.

Gross, Tal, and Matthew J. Notowidigdo. 2011. "Health Insurance and the Consumer Bankruptcy Decision: Evidence from Expansions of Medicaid" *Journal of Public Economics* 95: 767-778.

Fannie Mae Loan-Level Price Adjustment (LLPA) Matrix. Accessed online on August 28, 2017 at: https://www.fanniemae.com/content/pricing/llpa-matrix.pdf

Heavrin, Benjamin, Rongwei Fu, Jin Han, Alan Storrow, and Robert Lowe. 2011. "An Evaluation of Statewide Emergency Department Utilization Following Tennessee Medicaid Disenrollment." Academic Emergency Medicine.

Hu, Luoja, Kaestner, Robet, Mazumder, Bhashkar, Miller, Sarah, and Ashley Wong. 2016. "The Effect of the Patient Protection and Affordable Care Act Medicaid Expansions on Financial Well-Being" National Bureau of Economic Research Working Paper 22170.

Hwang, Wenke, Weller, Wendy, Ireys, Henry, and Gerard Anderson. (2001). Out-of-pocket medical spending for care of chronic conditions. *Health affairs, 20(6), 267-278.*

Lee, Donghoon and Wilbert van der Klaauw. 2010. "An Introduction to the FRBNY Consumer Credit Panel." *Federal Reserve Bank of New York Staff Report 479.*

Maclean, Catherine, McClellan, Chandler and Sebastian Tello-Trillo. 2018. Losing public insurance and mental health care and mental illness: Evidence from a large-scale Medicaid disenrollment. Working paper.

Martin, Anne B., Hartman, Micah, Washington, Benjamin, Catlin, Aaron, and the National Health Expenditure Accounts Team, 2017. "National Health Spending: Faster Growth in 2015 as Coverage Expands and Utilization Increases" *Health Affairs* 36(1): 1-11.

Mayer, Christopher, Karen Pence, and Shane M. Sherlund. 2009. "The Rise in Mortgage Defaults." *Journal of Economic Perspectives*, 23(1): 27-50.

Miller, Sarah. 2012. "The Effect of Insurance on Emergency Room Visits: An Analysis of the 2006 Massachusetts Health Reform." *Journal of Public Economics* 893-908.

Mazumder, Bhashkar, and Sarah Miller. 2016. "The Effects of the Massachusetts Health Reform on Household Financial Distress" *American Economic Journal: Economic Policy* 8(3): 284-313.

Newhouse, Joseph P. 1990. "Geographic Access to Physician Services" *American Journal of Public Health* 11: 207-230

Ramsey, Scott, Blough, David, Kirchhoff, Anne, Kreizenbeck, Karma, Fedorenko, Catherine, Snell, Kyle, Newcomb, Poll, Hollingworth, William, and Karen Overstreet. 2013. "Washington State Cancer Patients Found to be at Greater Risk for Bankruptcy than People without a Cancer Diagnosis." *Health Affairs* 32(6): 1143-1152.

Rosenthal, Meredith B., Alan Zaslavsky, and Joseph P. Newhouse. 2005. "The Geographic Distribution of Physicians Revisited" *Health Services Research* 40(6p1): 1931-1952.

Sanger-Katz, Margaret (2018, March 21). Getting Sick Can Be Really Expensive, Even for the Insured Retrieved from https://nyti.ms/2GPBQn3

Tarazi, Wafa W, Tiffany L Green, and Lindsay M Sabik. 2017. "Medicaid Disenrollment and Disparities in Access to Care: Evidence from Tennessee." Health services research 52 (3):1156-1167

Tello-Trillo, D. Sebastian. 2017. "Effects of Losing Public Health Insurance on Health Care Access, Utilization and Health Outcomes: Evidence from the TennCare Disenrollment" *mimeo.*

Woolridge, Julia, Leighton Ku, Teresa Coughlin, Lisa Dubay, Marilyn Ellwood, Shruti Rajan, and Sheila Hoag. 1996." Implementing State Health Care Reform: What have we learned from the first year? The first annual report of the Evaluation of Health Reform in Five States." Princeton: Mathematica Policy Research INC.

Zhang, P., T. Guoyu, and Irwin. "Utilization of preventive medical services in the United States: A comparison between rural and urban counties.

Zhu, Ning. 2011. "Household Consumption and Personal Bankruptcy" *Journal of Legal Studies* 40: 1-37.

Appendix Table A1. Dose Response (DR) Model of the Effect of Disenrollment on Financial Outcomes: Sample of Adults 21-64 with Severe Delinquencies or Bankruptcies in Pre-period.

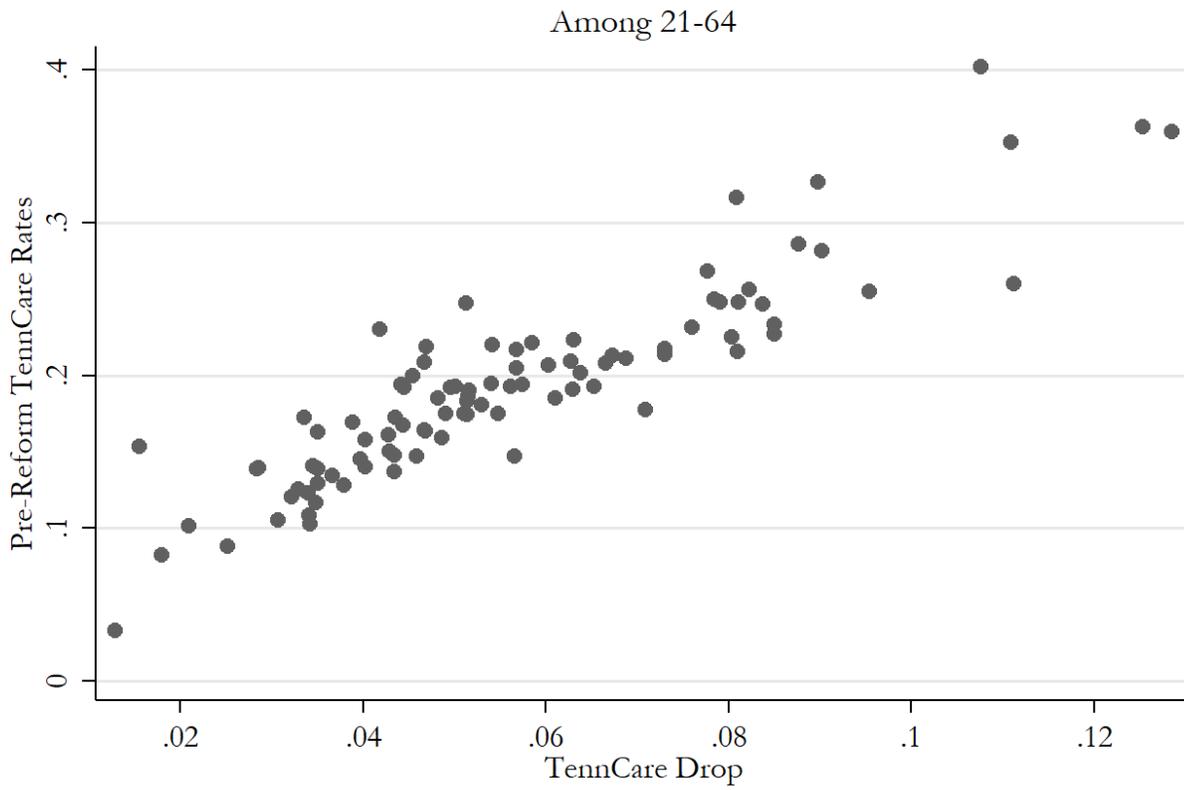|	Credit Risk Score	Severely Delinquent Debt	Share of Debt that is Severely Delinquent	Number of Delinquent Accounts	Share of Delinquent Accounts
Pre-Reform TennCare Rate x During (DR)	-9.825**	2740.342	0.109***	0.374***	0.113***
	(4.917)	(1724.049)	(0.029)	(0.132)	(0.031)
Pre-Reform TennCare Rate x Post (DR)	-9.792	1284.457	0.057	0.320**	0.056
	(6.875)	(1669.283)	(0.041)	(0.153)	(0.043)
N x T	706,440	706,440	706,440	706,440	706,440
DR x 0.1470 (Median PRTR for All Individuals)	-1.439	188.815	0.008	0.047	0.008
DR x 0.1913 (Median PRTR for All Counties)	-0.275	36.120	0.002	0.009	0.002

Notes: Standard errors are clustered at the county-level (95 counties). All models were estimated using the HDFE command in STATA, and include individual, age, county, year, and quarter fixed effects, as well as 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 59,295. Source: *Federal Reserve Bank of New York Consumer Credit Panel/Equifax, Tennessee Department of Health, Division of TennCare Administrative Records.*

Appendix Table A2. Dose Response (DR) Model of the Effect of Disenrollment on Financial Outcomes: Sample of Medicare-Age Eligible

	Credit 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)
Pre-Reform TennCare Rate x During (DR)	7.57	-285.0*	-0.011***	-0.031***	-0.005	-0.005	-0.001
	(4.917)	(145.7)	(0.004)	(0.011)	(0.004)	(0.004)	(0.002)
Pre-Reform TennCare Rate x Post (DR)	-8.02	-174.4	0.006	0.002	0.011	0.003	-0.001
	(5.79)	(200.3)	(0.006)	(0.021)	(0.006)	(0.003)	(0.001)
N x T	706,440	706,440	706,440	706,440	706,440	703,893	705,746
DR x 0.1470 (Median PRTR for All Individuals)	-1.18	-25.6	0.001	0.000	0.002	0.000	0.000
DR x 0.1913 (Median PRTR for All Counties)	-1.53	-33.4	0.001	0.000	0.002	0.001	0.000

Notes: Standard errors are clustered at the county-level (95 counties). All models were estimated using the HDFE 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 Medicare age eligible group (age 65 and older) is 31,629. Source: *Federal Reserve Bank of New York Consumer Credit Panel/Equifax, Tennessee Department of Health, Division of TennCare Administrative Records.*

Figure A1: Correlation between Pre-reform TennCare Rates and Drop Rates for ages 21-64

Source: *Tennessee Department of Health, Division of TennCare Administrative Records.*