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Moving the goalposts

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Abstract

In this paper, we examine the joint response of a household's labor supply and credit decisions following an unanticipated wealth shock. Specifically, we exploit the grandfather provision embedded in a 2005 Texas pension reform act using a regression discontinuity design (RDD). Importantly, the change in retirement benefits did not coincide with a contemporaneous income shock. The timing of the wealth shock offers an additional benefit relative to the consideration of a contemporaneous wealth shock, which may ease the budget constraint for a credit-constrained household, thereby affecting labor and credit decisions through an alternate channel. We find that a worker experiencing a decline in future expected retirement benefits responds by delaying retirement for 0.25 years. Moreover, perhaps counterintuitively, we find that she also responds by increasing her credit demand in the short run. One possible explanation for these results is the reduction in leisure time as a result of delayed retirement, inducing a worker to increase her expenditure-based consumption during the time she remains in the workforce.

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1. Introduction

Are all wealth shocks created equal? Put differently, to what extent do the lessons learned about labor supply and other household decisions from *contemporaneous* wealth shocks extend to a change in future expected wealth? For instance, the labor-leisure trade-off suggests that a household responds to a positive contemporaneous wealth shock by decreasing its labor supply, a prediction with prior empirical support (e.g., Brown, Coile, and Weisbenner (2010), Disney and Gathergood (2018)). However, if households are financially constrained, then a shock to contemporaneous wealth may also result in a relaxation of this constraint, thereby amplifying the wealth effect on lifetime labor supply. Moreover, the easing of this constraint likely plays a more prominent role when considering how wealth shocks affect a household's leverage choice, a decision which has broad consequences for the propagation of shocks through a local economy (Mian, Rao, and Sufi (2013), Mian and Sufi (2014), Bernstein, McQuade, and Townsend (2016)). Thus, a household may exhibit a different response to a change in future expected wealth than to a commensurate change in contemporaneous wealth. To this end, we examine the joint response of a household's lifetime labor supply and leverage choice to a change in future expected wealth.

Understanding this particular wealth effect is important for multiple reasons. First, anticipating a household's labor and credit response to a change in future expected wealth is vital when considering reforms to the existing Social Security system. Moreover, while many individuals utilize individual savings accounts, giving them the ability to adjust their asset allocation and the corresponding risk as they near retirement, 78% of public sector workers (as of 2011) relied on defined benefit pension plans (Wiatrowski (2012)). Aubry, Crawford, Munnell, et al. (2018) find that the funding ratios of these plans have demonstrated a steady decline over the 15-year period. Leibowitz and Ilmanen (2016) document a similar trend in the funding ratios of corporate defined benefits plans from the Milliman Top 100. The degree of underfunding in these defined benefit plans raises concerns over the certainty of future income realized upon retirement.

Identifying the effect of an unanticipated wealth shock in a reduced-form setting is challenging. First, innovations to a household's permanent income are likely correlated with changes in contemporaneous income. To overcome this concern, one approach taken by the existing literature is to exploit the cash windfall associated with either lottery outcomes (Imbens, Rubin, and Sacerdote (2001), Cesarini, Lindqvist, Notowidigdo, and Östling (2017)) or inheritances (Brown, Coile, and Weisbenner (2010)). However, while this approach is able to disentangle a wealth effect from a change in contemporaneous income, the realization of the cash windfall may also ease a household's credit constraint. For these reasons, we instead study the effects of a shock to future expected wealth stemming from a 2005 Texas pension reform act that reduced the retirement benefits of public school employees.

To identify the effects on labor and credit, we use a regression discontinuity design (RDD) to exploit a "grandfather" provision in the pension reform act. The provision, which was based on an employee's age and years of service at a particular day, left the retirement benefits of qualifying employees unchanged. In contrast, an employee narrowly missing the qualification criteria experienced a reduction in her expected retirement benefits. Importantly, eligibility for the grandfather provision is not associated with a change in contemporaneous income. Moreover, because the law only impacts future retirement benefits, it is unlikely to affect a household's budget constraint at the time it was passed. Our paper yields two main findings.

First, a public school employee experiencing a reduction in retirement benefit generosity responds by extending her time until retirement. Specifically, a worker that narrowly misses qualifying for the grandfather provision delays retirement for 0.25 years relative to a worker with retirement benefits left unchanged. This change represents a 2.7% increase in average years of remaining service for workers in the sample. This result is consistent with previous work studying inheritance receipts (Brown, Coile, and Weisbenner (2010)) and lottery winnings (Imbens, Rubin, and Sacerdote (2001), Cesarini, Lindqvist, Notowidigdo, and Östling (2017)),

supporting the view that leisure is a normal good and that wealth shocks are positively correlated with the probability of retirement. Thus, while the reduction in retirement benefits serves to decrease the future expected wealth for a given amount of labor supplied, a worker's ability to delay retirement allows her to partially offset this negative wealth shock. Next, we examine the pension reform act's effect on a worker's demand for consumer credit. Perhaps counterintuitively, we find that a worker experiencing a negative future wealth shock responds by *increasing* her credit usage. More precisely, a worker narrowly missing the necessary criteria to qualify for the grandfather provision exhibits an increase in her total outstanding debt balance of roughly $1,600 relative to a worker qualifying for the grandfather provision. When examining the response of different credit types, we find that the change is attributed almost completely to an increase in automobile-related debt and installment loans, which plausibly represent an increase in durable consumption. One possible way to reconcile a reduction in expected future wealth with this increase in debt usage is a worker's differential treatment of expenditure-based consumption while employed relative to consumption during retirement. This is consistent with Aguiar and Hurst (2005), who argue the reduction in expenditure-based consumption at retirement can be explained by a simultaneous increase in a retiree's leisure time. Specifically, the extra leisure time afforded to an individual in retirement allows her to derive more utility from a given expenditure amount. Taken together, this response emphasizes the importance of considering the joint effect of a wealth shock on both the labor supply and credit demand of a household.

Our paper contributes to a mature literature that studies household labor, savings, and consumption choices along multiple dimensions. First, while the existing literature generally analyzes this trade-off in the context of a life-cycle model, such models typically restrict a household's ability to borrow against future income streams or durable assets (e.g., homes) (Gourinchas and Parker (2002); Low, Meghir, and Pistaferri (2010); French (2005); French and Jones (2011)). This stands in stark contrast to a second, more recent, strand of the literature documenting the increasing propensity of individuals to borrow against their accumulated real estate wealth (e.g., Mian and Sufi (2011)). By taking a reduced-form approach which exploits a discontinuity in the pension reform act, we are able to cleanly identify the effect of a reduction in future expected wealth on labor and credit outcomes without depending on a structural model.

Moreover, the paper is closely related to the strand of literature which exams the effect of a wealth shock on labor participation. Bottazzi, Trucchi, and Wakefield (2019) examine how a household's labor supply responds to a change in the value of its investment portfolios using Italian data. In related work, Bertoni and Brunello (2017) examine the role of Italian pension reforms in crowding out labor participation of younger workers as older workers extend their time until retirement. We complement this work by cleanly identifying the effect of a pension reform shock on the joint response of labor and credit using a discontinuity in the reform. In related work, Imbens, Rubin, and Sacerdote (2001) and Cesarini, Lindqvist, Notowidigdo, and Östling (2017) both examine how labor supply responds to a wealth effect by studying the response of lottery winners, finding a reduction in labor supply. Similarly, Brown, Coile, and Weisbenner (2010) focus on the increase in wealth due to inheritance receipts, documenting an increase in retirement probabilities associated with the cash windfall. We complement this work examining the role of contemporaneous wealth shocks by instead focusing on the effect of a change in *future* expected wealth.

The remainder of this paper is organized as follows: Section 2 discusses details of the pension reform act and the identification strategy employed. Section 3 discusses the data we use and the final sample we consider. We present our primary findings in Section 4. Finally, we discuss potential economic mechanisms and discuss future steps in Section 5, while Section 6 concludes.

2. Institutional details & empirical strategy

This section describes the institutional details of the pension reform studied and the empirical approach we adopt to identify its effect.

2.1. Texas pension reform act of 2005

To identify the effect of a future wealth shock on a worker's choice over both labor provision and credit utilization, we turn to a Texas pension reform act. More precisely, the 79th Texas State Legislature passed State Bill (SB) 1691 in the final week of May 2005. In effect, the bill reduces the defined benefits paid out to public school employees retiring in the future in two ways. First, the bill extends the period over which an employee's average salary, which determines her monthly retirement benefit, is computed. While benefits were previously based on the highest three years of salary, the pension reform act extends this window to consider the highest five years of salary. Under the assumption that nominal wages have a positive expected growth rate, this extension results in a decreased expected retirement benefit. Second, the law eliminates an employee's ability to receive a subsidized early retirement. Instead, employees retiring prior to the age of 60 face a significant reduction in their benefits. If a teacher faces any risk of exiting the labor market prior to the full vesting of her retirement benefits, perhaps due to the realization of a shock that increases the cost of exerting effort, this second change is also associated with a decrease in the expected value of retirement benefits. In sum, conditional on an individual leaving her planned retirement date unchanged, these modifications to the pension plan are associated with a decreased expected value of future retirement benefits.

Importantly, the pension reform act does not modify the benefits of all employees and instead "grandfathers" some existing employees into the existing benefit distribution plan. More precisely, a worker qualifies for the grandfather provision if she meets either of the following criteria: 1) she is at least 50 years old as of August 31, 2005, or 2) her age and years of service as of August 31, 2005, sum to at least 70 years. Our empirical design, which we discuss in more detail below, is based on the discrete change in expected benefits at the thresholds for these two criteria.

Finally, SB 1691 did not modify contemporaneous employment prospects or salaries of public school employees. Thus, by comparing outcomes between grandfathered workers and those with a change in expected benefits, the pension reform act provides an ideal setting to examine the effect of a change in expected future wealth, absent a correlated change in either employment prospects or contemporaneous wealth.

2.2. RDD & grandfather provision

While the enactment of the pension reform act reduces the expected retirement benefits of existing workers, the bill also provides an exemption for some employees based on two arbitrary thresholds. Our empirical methodology exploits these cutoffs in a regression discontinuity design (RDD). In this sense, the approach we outline below is similar to other papers examining the effect of exemptions in laws based on arbitrary thresholds (e.g., Battistin, Brugiavini, Rettore, and Weber (2009)).

Traditionally, an RDD exploits discrete jumps in a policy function as a forcing variable crosses specific thresholds. In the context of our setting, the discrete change in the policy function simply corresponds to a worker's eligibility for the grandfather provision which leaves her expected retirement benefits unchanged. However, the consideration of multiple criteria when determining a worker's eligibility results in multiple potential forcing variables which must be taken into account. To this end, we begin by constructing a forcing variable for each criteria. More precisely, we define $Force_{age}$ to be a worker's age (including fractions of a year) as of August 31, 2005, minus 50. Thus, a negative value for this forcing variable indicates an individual is less than 50 years of age as of August 31, 2005. Similarly, we define $Force_{combined}$ to be the sum of a worker's age and years of service as of August 31, 2005, less 70. Finally, we define *Running Variable* (abbreviated *Run. Var.*) to be the maximum of $Force_{age}$ and $Force_{combined}$. Therefore, a positive value of *Running Variable* corresponds to a worker who qualifies for the grandfather provision and thus does not face a reduction in expected retirement benefits after the passage of SB 1691. The methodology allows us to collapse the two-dimensional space spanned by a worker's eligibility for the grandfather provision along both criteria into a one-dimensional forcing variable.

Following the construction of *Running Variable* for each worker employed by a public school as of the 2004-2005 school year, we use the following specification to estimate the effect of reducing the generosity of an individual's expected retirement benefits:

$$Y_i = \beta 1(RunVar < 0) + \sum_{n=1}^{N} \theta_n RunVar_i^n + 1(RunVar < 0) \sum_{n=1}^{N} \varphi_n RunVar_i^n + \varepsilon_i$$

where Y_i is the outcome of interest for individual i. The dependent variables we consider here include a worker's retirement (proxied for by a departure from the employment records), as well as the change in open credit lines, credit limits, and outstanding balances. The estimated change in outcome variables due to a reduction in expected retirement benefits is given by β. We control for continuous changes in the outcome variable due to changes in the forcing variable (*Running Variable*) with an N degree polynomial estimated separately for each side of the threshold. We choose the polynomial order for the *Running Variable* control such that N minimizes the Bayesian information criterion. Note that when considering credit outcomes, we focus on changes in the outcome variable to reduce noise associated with worker-specific variation in credit demanded. Finally, in our primary analysis we consider workers with a corresponding value of *Running Variable* that falls within five years of the threshold. This value was chosen to maximize the potential sample size subject while keeping data costs below our budget constraints.

3. Data & sample selection

This section describes the data sources used in the analyses, sample construction, and presents summary statistics for the final sample considered.

3.1. Data

The bulk of our empirical tests rely on the intersection of two data sources: employment records of Texas public school workers, and a disaggregated credit panel provided by one of the three major consumer credit bureaus operating in the United States.

We obtain the set of comprehensive administrative records for public school employees in Texas from the Texas Education Agency (TEA). Specifically, we acquire the set of payroll records for all public school employees in Texas from 1999 to 2018. Each employment record provides the employee's name, date of birth, demographics, years of service, tenure at current district, salary, and education level. The initial sample of payroll records contains an average of 470,000 workers per year, with more than 1.2 million unique workers appearing in the payroll records over the sample period.

The second primary data source we utilize consists of individual-level consumer credit information provided by one of the three major U.S. credit bureaus. The credit records contain information related to all major liabilities associated with an individual at a particular point in time. The data includes attributes related to the contemporaneous balance of debt outstanding along with information regarding recent credit activity (e.g., the number of new credit lines opened in the past six months).

The credit panel we consider consists of seven cross-sectional snapshots. The first snapshot is designed to capture worker behavior prior to the realization of the future wealth shock. Thus, the first cross-section contains credit information as of April 2005, one month prior to the passage of the pension reform act. The next three snapshots occur at six-month intervals relative to the initial period. The final three cross-sections provide credit information 3, 5, and 10 years following the enactment of the pension reform.

3.2. Matching process

The TEA administrative data is sufficient to study the change in a worker's labor provision following the permanent income shock. However, to examine a worker's credit demand response to the shock, we must link the employment records with the corresponding credit records. To do this, we contract with the credit bureau (CB) to perform the matching process. Specifically, we provide the CB with each worker's full legal name, her birth date (month and year), and a historical residential or mailing address. Importantly, the address provided need not be current as the CB is able to match against prior addresses, eliminating concerns of survivorship bias.

While the employment records contain each worker's legal name and date of birth, they do not contain residential addresses. Thus, in order to link employment records used to determine eligibility for the grandfather provision to the credit information, we must first determine each worker's residential and/or mailing address. We produce an address for each worker using the following two-step process: First, we attempt to match each worker to the electoral roll of registered voters provided by the Texas Secretary of State. Each electoral record contains the voter's name and date of birth, which we use to match against our employment records. Moreover, the voter records also contain a historical mailing address and physical address. Second, for any workers we are not able to match to voter records, we attempt to recover a residential address from driver's license records provided by the Texas Department of Public Safety. Specifically, we link employment records to driver's licenses using a worker's legal name and exact date of birth. Thus, for tests involving a worker's choice of credit outcomes, the sample is restricted to employees who are either a registered voter or have a driver's license.

3.3. Final sample

While we obtain a comprehensive set of TEA employment records, our empirical strategy is based on employees near the thresholds used to determine eligibility of the grandfather provision. Specifically, we restrict our focus to individuals within five years of either eligibility cutoff. While the administrative records cover 456,000 workers employed in the 2004-2005 school year, following this restriction our sample is reduced to 120,000 workers. Moreover, after matching this sample with voter rolls and the driver's license database, we are able to identify residential addresses for 113,000 workers. From this set of workers, we are able to link 86.4% to the credit files, yielding a final sample of 98,000 individuals.

Table 1 reports summary statistics for the sample through the progression of these restrictions. Statistics are based on values measured in the 2004-2005 school year. In the full sample, public school employees receive an average salary of $40,800, slightly higher than the $37,000 in wages reported in the national average wage index for 2005 (SSA (2019)). Workers have an average of 10.24 years of service, with 6.8 years in their current school district (tenure). Moreover, a majority of workers are female Caucasians while one-quarter of workers hold an advanced degree. Finally, a worker in the full sample has neither an average age (44.3 years) or combined age and years of service (55.6 years) that would qualify for the grandfather provision. Observable characteristics remain relatively similar when restricting the sample to workers that fall within five years of the grandfather provision with one exception. Predictably, the average age of workers within five years of the provision is closer to 50 years of age. Characteristics do not appear to exhibit any large changes when considering only workers for which we are able to identify a residential address. Finally, when restricting the sample to only workers linked to a credit record, characteristics remain relatively similar. Perhaps the largest change when imposing the set of sample restrictions is the relative share of female workers, which increases from 74% to 81% when progressing from the full sample to the final sample we consider. Overall, the imposition of our sample restrictions is not associated with a large change in observable characteristics most likely correlated with credit usage (e.g., salary).

Table 1. Summary statistics

	All Employees	< 5 Years from Thresh.	Matched Address	Has Credit Record
	(1)	(2)	(3)	(4)
Employment				
Pay ($)	40,831.22	40,468.38	40,605.11	40,631.65
	(13,299.93)	(13,293.82)	(13,305.24)	(13,071.53)
Experience (Years)	10.24	10.48	10.55	10.71
	(10.01)	(8.51)	(8.50)	(8.47)
Tenure (Years)	6.81	7.06	7.11	7.20
	(8.12)	(7.24)	(7.24)	(7.24)
Ethnicity				
Caucasian	0.65	0.66	0.67	0.69
	(0.48)	(0.47)	(0.47)	(0.46)
Hispanic	0.24	0.22	0.22	0.20
	(0.43)	(0.42)	(0.42)	(0.40)
African American	0.10	0.10	0.10	0.10
	(0.31)	(0.30)	(0.30)	(0.29)
Other	0.01	0.01	0.01	0.01
	(0.11)	(0.10)	(0.10)	(0.10)
Other Characteristics				
Advanced Degree	0.24	0.23	0.24	0.24
	(0.43)	(0.42)	(0.42)	(0.43)
Female	0.74	0.76	0.76	0.81
	(0.44)	(0.43)	(0.43)	(0.39)
Age (years)	44.34	49.17	49.16	49.14
	(10.97)	(3.05)	(3.05)	(3.05)
Age + Service (years)	55.59	60.64	60.71	60.85
	(18.21)	(8.29)	(8.28)	(8.25)
Running Variable	-3.73	-0.13	-0.13	-0.14
	(12.65)	(2.90)	(2.90)	(2.91)
N (Teachers)	454,858	120,295	113,469	97,994

This table reports summary statistics through the progression of the samples.

4. Main results

Does a reduction in the expected future wealth of a worker conditional on an expected retirement date lead her to prolong retirement to compensate for the drop in expected wealth? Moreover, how does the negative shock and response in labor provision impact a worker's credit demand? In answering these questions, we first provide supportive evidence validating our empirical approach. We then leverage the discontinuity embedded in the pension reform act's grandfather provision to identify the effect of the expected wealth shock on labor provision. Finally, we turn to the effect of the benefit reduction on credit outcomes.

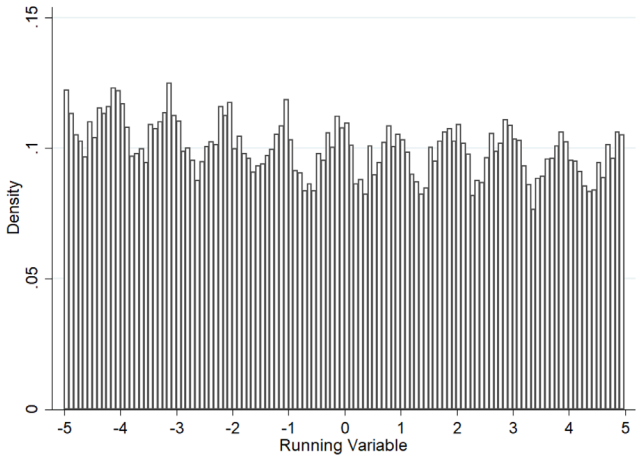
4.1. Validating identifying assumptions

Our empirical strategy requires that worker characteristics do not exhibit a commensurate jump at the threshold used to determine eligibility for the grandfather provision. While a worker is unable to manipulate the *Running Variable*, one potential challenge to this assumption is the anticipation of the pension reform act that induces some workers to self-select out of the sample (leave the Texas public school system) prior to the passage of the law. We now consider this possibility and verify that observable worker characteristics do not vary at the threshold.

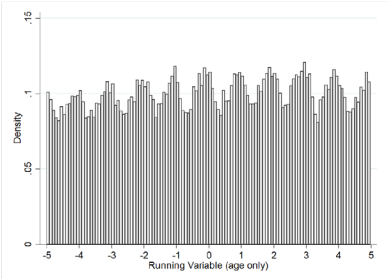
We begin by examining the density of the forcing variable for workers employed immediately prior to the passage of the pension reform act. Figure 1 reports a histogram depicting the density of workers near the thresholds used to determine grandfather eligibility. Panel A reports monthly counts of observations according to the final forcing variable, *Running Variable*, which is the maximum value across the two criteria by which an employee may achieve grandfathered status. Two broad patterns emerge. First, the sample exhibits moderate seasonality within a year. Recall, a key component used in determining eligibility is a worker's age. This seasonality is likely due to uneven birth rates across months of the year (Udry and Morris (1967)). The second pattern apparent in the figure is a general downward trend across the 10-year window considered. This pattern may be partially attributed to either general attrition in employment as workers age or increased hiring rates over time. Even still, the data does not exhibit a drastic change in density when contrasting workers qualifying for the grandfather provision relative to those that were within five years of qualifying but are not grandfathered into the previous benefit plan.

Figure 1. Density of workers w.r.t. Running Variable

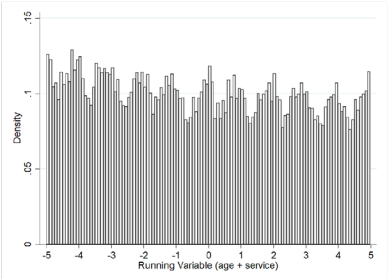
Panel A: Final Running Variable



Panel B: Age Based



Panel C: Age + Service Based



This figure reports the histogram of observations in the final sample with respect to the factors used to determine eligibility for the grandfather provision. Reported is the the density of observations with respect to the final running variable (Panel A), the age-based criteria (Panel B), and the sum of age and years of service criteria (Panel C).

Panel B and Panel C of Figure 1 report histograms when separately considering the two criteria, based on age (Panel B) and age plus service (Panel C), used to decide the grandfather provision. Panel B, which reports the density based on a worker's age, confirms the seasonality in the final running variable is due to variation in month of birth. Overall, Figure 1 is consistent with the inability of a worker to manipulate the forcing variable or anticipation of the pension reform act which might lead to concerns of a sample selection bias.

Next, we consider the key assumption underlying an RDD. Our identification assumption requires that all worker characteristics varied continuously around the thresholds used to determine eligibility for the grandfather provision. While we cannot evaluate unobservable characteristics, we are able to consider the change in observable worker characteristics.

We begin with Figure 2, which illustrates the possible change in worker characteristics around the policy threshold in a reduced form setting. Specifically, this figure shows the conditional mean of worker characteristics, measured in the year prior to the passage of the pension reform act, as a function of *Running Variable*, which captures the distance of a worker to the criteria determining grandfather eligibility. We begin by considering the change in a worker's salary in Panel A of Figure 2. The panel illustrates a strong positive correlation between the *Running Variable* and worker pay. This is unsurprising, as an increase in *Running Variable* is associated with an increase in either a worker's years of service, age, or both. More importantly, there does not appear to be a discontinuous change in salaries at the threshold, which partitions workers experiencing a change in retirement benefits from workers who do not experience a change in benefits. The remaining panels illustrate the conditional mean of other worker characteristics for a change in the *Running Variable*. Overall, there is little evidence of a discontinuous change in the likelihood of holding an advanced degree (Panel B), in the number of days employed (Panel C), or being female (Panel D). However, there appears to be a slight increase in the likelihood of a worker being from a minority ethnicity (Panel E). One possible explanation for this reduced form result is a time-series change in either historical hiring patterns or the self-selection of individuals into particular industries that varied across ethnic groups. We discuss the implications of this last result below.

Figure 2. Change in observable covariates at threshold for grandfather provision

Panel A: Salary

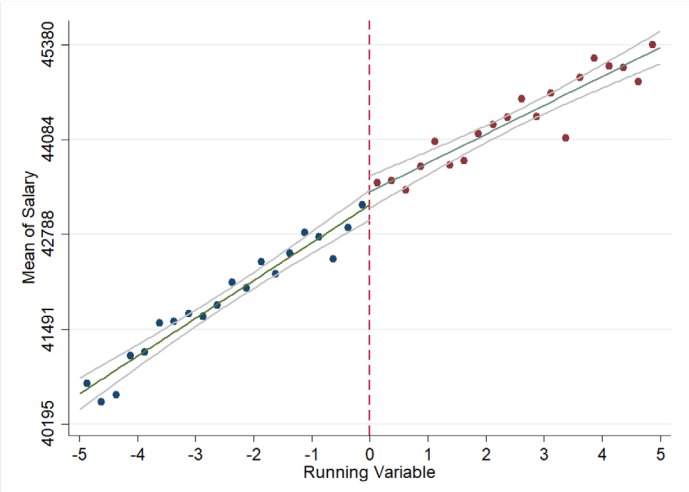
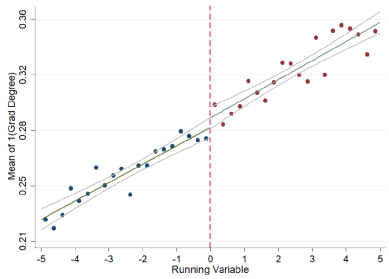
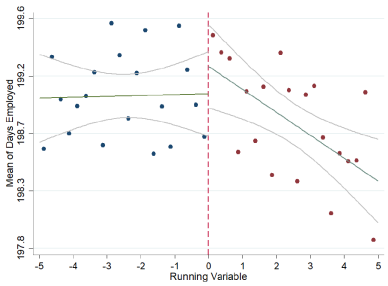


Figure 2. Change in observable covariates at threshold for grandfather provision (continued)

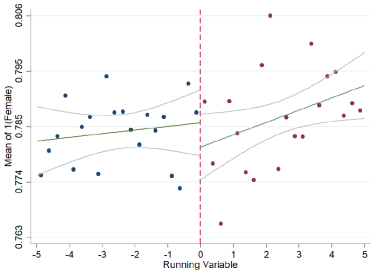
Panel B: Grad Degree



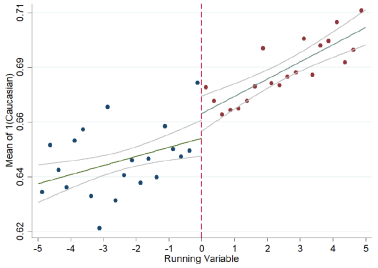
Panel C: Days Employed



Panel D: Gender



Panel E: Ethnicity



This figure reports the change in observable covariates around the threshold used to determine eligibility for the grandfather provision. Reported are the changes in annual salary (Panel A), likliehood of possessing a graduate degree (Panel B), days employed per year (Panel C), likelihood of being female (Panel D), and likelihood of being a minority (Panel E). Gray bands correspond to the 95% confidence interval.

Next, we empirically test the reduced-form patterns depicted in Figure 2 in a regression framework. Specifically, we estimate OLS regressions of the form described in Equation (1). Table 2 reports the results for each of the worker characteristics examined in the previous figure. Standard errors are clustered by school district of employment. In the first specification, we focus on a worker's salary in the year prior to the passage of the pension reform act. The primary variable of interest, 1(*Run Var < 0)*, is an indicator variable which takes a value of one if a worker does not qualify for the grandfather provision and instead experiences a reduction in future expected retirement benefits. The point estimate on this coefficient is statistically indistinguishable from zero at traditional confidence intervals, which is not consistent with a discontinuous change in salaries at the threshold determining eligibility for the grandfather provision. The specification includes first-degree polynomial (linear) controls for *Running Variable* which are allowed to vary on either side of the threshold. Moreover, we fail to find a statistically significant change at the threshold for a worker's achievement of a graduate degree (Column 2), number of days employed (Column 3), or gender (Column 4). Finally, in Column 5, we do find statistically significant evidence (at the 10% level) that the likelihood of a worker being Caucasian does decrease for those individuals who barely miss qualifying for the grandfather provision. We delay discussion of the implications that this result has for our primary analysis until later. Overall, the results presented in Figure 2 and Table 2 present limited evidence that workers marginally qualifying for the grandfather provision systematically differ from those who barely missed qualifying.

Table 2. Discontinuity in observable covariates

Dependent Variable:	(1) Days Employed	(2) Grad. Degree	(3) Salary	(4) 1(Female)	(5) 1(Caucasian)
1(Run. Var. < 0)	-0.212	-0.006	-168.246	0.005	-0.010*
	(-0.94)	(-1.25)	(-1.12)	(1.05)	(-1.84)
Run. Var.	0.008	0.012***	518.737***	0.001	0.004**
	(0.12)	(9.34)	(10.95)	(0.53)	(2.49)
Run. Var. x 1(Run.Var. < 0)	-0.188**	0.000	-123.005**	0.002	0.003*
	(-2.01)	(0.22)	(-2.27)	(0.98)	(1.75)
Polynomial	1	1	1	1	1
Bandwidth (yrs.)	5	5	5	5	5
Observations	124,928	124,928	124,928	124,928	124,928
R-squared	0.000	0.007	0.010	0.000	0.002
Unconditional Mean	198.88	0.29	43,173.40	0.79	0.67
Std. Dev.	21.11	0.45	13,763.22	0.41	0.47

This table shows OLS regressions where the dependent variable (denoted in the header) is an observable covariate of workers near the threshold for the grandfather provision. The main variable of interest is *1(Run. Var. < 0)*, an indicator that takes on a value of one if a worker does not qualify for the grandfather provision of the pension reform act. The sample consists of all workers within 5 years of the threshold determining grandfather eligibility. Reported *t*-statistics in parentheses are heteroscedasticity-robust and clustered by school district. *** p < 0.01, ** p < 0.05, * p < 0.1.

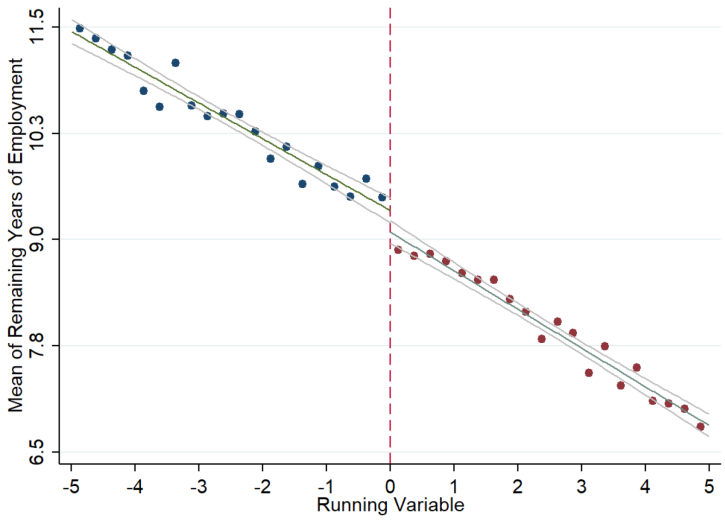
4.2. Labor participation

The pension reform act served to decrease the expected retirement benefits of affected retirees for a given wage path and years of service. However, if a worker's retirement decision is a function of expected retirement benefits, she may plausibly opt to delay retirement following the change in benefits to partially offset the reduction in benefit generosity. Thus, the negative effect of the pension reform act on permanent income may be substantially reduced by the increase in labor supplied.

We begin with Figure 3, which illustrates the change in a worker's future labor provided around the grandfather provision threshold in a reduced form setting. Specifically, this figure shows the conditional mean of a worker's remaining years of service, measured as of the year prior to the passage of the pension reform act (2004-2005 school year). The figure plots this mean as a function of *Running Variable*, which captures the distance of a worker to the criteria determining grandfather eligibility. For all workers yet to retire as of the 2017-2018 school year (the last year of the sample), we must infer the remaining years of service. To do this, we consider all public school workers employed in the 2000-2001 school year. Using this sample, we estimate the total years of service as a function of service as of 2000-2001. More precisely, for each discrete value of service as of 2000-2001, we compute the average years of remaining service for workers present in the 2000-2001 school year. Using this mapping between current years of service and expected total years of service, we infer the remaining years of service for those workers not yet retired as of the 2017-2018 school year.

Two trends emerge from the figure. First, the expected years of remaining service for a worker generally decreases with *Running Variable*. This result is unsurprising, as a more negative value of *Running Variable* corresponds to a worker that is either younger, has worked fewer years, or both. More importantly, the figure depicts a discrete drop in remaining years of service when comparing a worker who slightly misses qualifying for the grandfather provision to an individual who just meets the requirements. This is consistent with an individual extending the time to retirement when experiencing a reduction in expected future wealth.

Figure 3. Change in years until retirement at threshold for grandfather provision



This figure reports the change in remaining years of employment around the threshold used to determine eligibility for the grandfather provision. Gray bands correspond to the 95% confidence interval.

Table 3 extends the suggestive evidence presented in the previous figure, formally testing for the presence of a discontinuity at the cutoff. The test estimates an OLS regression where the dependent variable is the remaining years of service for a public school employee. Similar to the tests described in Table 2 above, the primary explanatory variable of interest is 1(*Run Var* < *0*), an indicator variable corresponding to a worker who does not qualify for the grandfather provision. The regressions also include linear controls for *Running Variable* which are allowed to vary on either side of the threshold. The point estimate of 1(*Run Var* < *0*) is 0.251 (*t*-stat=–2.78), indicating that a worker experiencing a reduction in future retirement benefits as a result of the pension reform act responds by working roughly one-quarter of a year more prior to retiring.

One limitation of the previous analysis is that some public school employees are yet to retire as of the 2017-2018 school year. For these censored workers, we must infer remaining years of service from a previous generation of workers employed earlier in the sample period. One concern is that our estimates are being driven by these censored observations. To examine this possibility, we consider the possibility that the likelihood of a worker having a censored employment record is a function of the discrete change in the policy function at the grandfather threshold. More precisely, we replace the dependent variable considered in the previous analysis with an indicator that takes on a value of one if a worker is in our sample in the final year of coverage, and zero otherwise. The results of this analysis are presented in Figure IA.1 and the second specification of Table 3. Taken together, the results do not indicate an obvious discrete change in the likelihood of an observation being censored around the threshold. This suggests that our results are driven primarily by individuals retiring prior to 2017-2018, which is 13 years after the passage of SB 1691.

Table 3. Response of labor supplied

Dependent Variable:	(1) Remaining Service	(2) 1(censored)
1(Run. Var. < 0)	0.251***	0.005
	(2.78)	(0.99)
Run. Var.	-0.422***	-0.034***
	(-14.58)	(-22.62)
Run. Var. x 1(Run. Var. < 0)	-0.034	0.011***
	(-0.87)	(5.47)
Polynomial	1	1
Bandwidth (yrs.)	5	5
Observations	89,801	94,299
R-squared	0.033	0.046
Unconditional Mean	9.26	0.22
Std. Dev.	7.67	0.41

This table shows OLS regressions where the dependent variable captures the duration of remaining employment spells. *Remaining Service* is the remaining years of service, while *1(censored)* is an indicator that takes on a value of one if a teacher does not retire by the end of the sample. The main variable of interest is *1(Run. Var. < 0),* an indicator that takes on a value of one if a worker does not qualify for the grandfather provision of the pension reform act. The sample consists of all workers within 5 years of the threshold determining grandfather eligibility. Reported *t*-statistics in parentheses are heteroscedasticity-robust and clustered by school district. *** p < 0.01, ** p < 0.05, * p < 0.1.

4.3. Credit usage

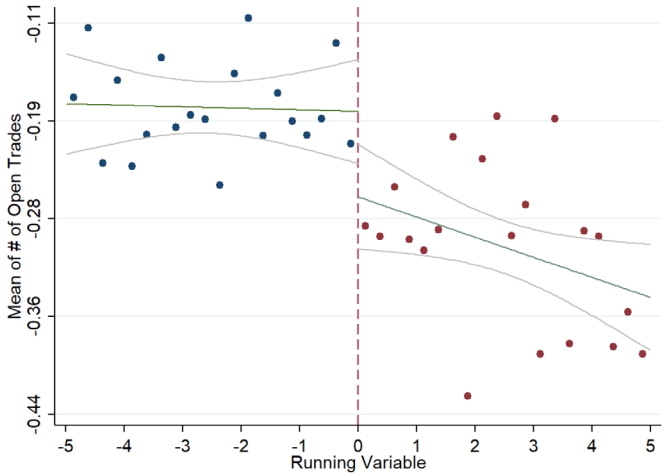
The results presented in the previous subsection suggest that workers take steps to partially offset the reduction in future expected wealth, increasing the years of labor that they supply. Absent this change in labor provision, intuition would suggest that an individual should reduce their credit demand in response to a negative wealth shock. However, it is unclear how credit demanded and labor supplied should jointly respond to this reduction in expected future wealth. While not explicitly modeled here, if a worker faces a non-monetary cost of working such as an effort cost, it is plausible that she is unable to perfectly compensate for the reduction in expected wealth with an offsetting increase in years of labor supplied. This suggests that a worker might reduce her demand for credit when facing the reduction in retirement benefits. In contrast, Aguiar and Hurst (2005) argue that traditional life-cycle models do not properly account for the change in leisure time associated with retirement and the effect that this relaxation of the time budget constraint has on an individual's utility function. Specifically, the extra leisure time afforded to an individual in retirement allows her to derive more utility from a given expenditure amount. Alternatively, if a worker faces uncertainty over future wages used to satisfy credit claims, the amount of credit demanded may decrease as a worker approaches retirement, at which point the worker is no longer able to pay down outstanding credit balances with labor income. Under either alternative, an increase in the expected time until retirement may lead to an increase in credit demand following a reduction in expected future wealth. To test these competing hypotheses, we examine the differential change in a worker's credit behavior for employees eligible for the grandfather provision relative to those who do not qualify.

We begin by examining the demand for credit on the extensive margin. Specifically, we consider the change in the number of open credit lines for an employee immediately before the passage of the law (April 2005) and 18 months later (October 2006). We start by presenting reduced form evidence in Figure 4. The

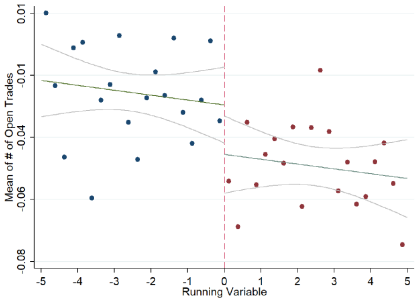
figure illustrates the conditional mean of the change in open credit lines as a function of *Running Variable*, which captures the distance of a worker to the criteria determining grandfather eligibility. Panel A of the figure plots the conditional mean across different bins when considering all types of credit together. When considering only workers that did not qualify for the grandfather provision, there does not appear to be a differential change in open credit lines for those workers far from the threshold relative to those workers who only slightly missed remaining under the previous retirement benefit policy. In contrast, workers who do not experience a decrease in expected future wealth and are instead eligible for the grandfather provision exhibit a larger decrease in open credit lines in the 18 months after the passage of the pension reform act.

Figure 4. Change in number of open credit lines at threshold for grandfather provision

Panel A: All Credit Types



Panel B: Auto



Panel C: Installment Loans

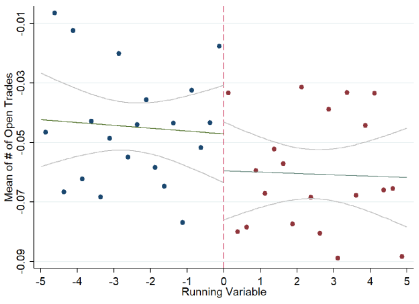
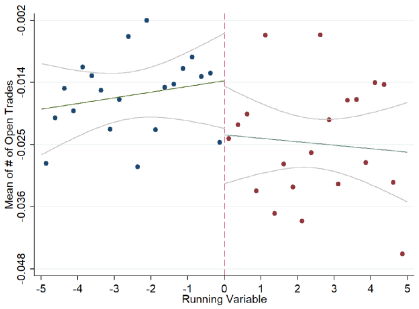
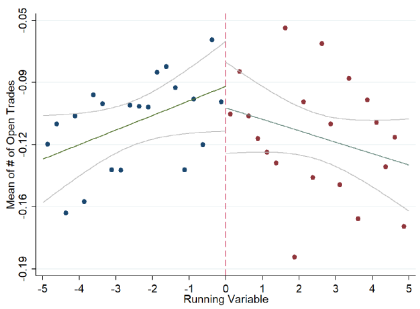


Figure 4. Change in number of open credit lines at threshold for grandfather provision (continued)

Panel D: Mortgage



Panel E: Revolving



This figure reports the change in open credit lines around the threshold used to determine eligibility for the grandfather provision. Reported are the total lines of credit open (Panel A), as well as individual credit types (Panel B – Panel E). Gray bands correspond to the 95% confidence interval.

In Panel B through Panel E, we consider the effect of the pension reform act on different types of credit products, finding mixed results. The panels suggest that workers experiencing a negative shock to expected future wealth exhibit an increase in the number of open credit lines associated with automobiles relative to workers grandfathered into the previous regime. Moreover, while a similar effect possibly exists when examining installment loans and mortgages, no effect is apparent when considering revolving lines of credit. At the same time, it is unclear why a change in the demand for revolving credit would manifest itself as an increase in the number of revolving credit lines, as opposed to a change in the usage of existing revolving lines. Figure IA.1 presents the results when instead considering the number of months since the most recent credit line was opened. The figure presents results largely consistent with those from Figure 4.

Table 4 formally tests the reduced-form evidence from the previous figure. The table presents the result of OLS regressions of the form described in Equation (1), where the dependent variable is the change in the number of open credit lines for a worker in the 18-month period following the enactment of the pension reform act. In the first column, we consider the combined effect on all types of credit. The point estimate on the independent variable of interest, $1(Run\ Var < 0)$, is 0.076 (t-stat=2.50). This estimate indicates that a worker experiencing a reduction in expected future wealth as a result of the pension reform act increases the total number of credit lines she has open by an average of 0.076 lines. To provide economic content, consider that the average change in open credit lines over the 18-month period is −0.182 lines. Thus, the point estimate represents roughly a 40% increase in the change in open lines relative to the unconditional change over the period.

Table 4. Credit demand: Extensive margin

Credit Type:	(1) All	(2) Auto	(3) Installment	(4) Mortgage	(5) Revolving
1(Run. Var. < 0)	0.076**	0.019*	0.013	0.010	0.013
	(2.50)	(1.93)	(1.26)	(1.24)	(0.69)
Run. Var.	-0.001	-0.002	-0.001	0.001	0.008**
	(-0.09)	(-0.71)	(-0.35)	(0.56)	(2.02)
Run. Var. x 1(Run. Var. < 0)	-0.016	0.000	0.001	-0.002	-0.015**
	(-1.45)	(0.01)	(0.13)	(-0.76)	(-2.30)
Polynomial	1	1	1	1	1
Bandwidth (yrs.)	5	5	5	5	5
Observations	97,304	78,204	78,204	89,093	89,093
R-squared	0.001	0.000	0.000	0.000	0.000
Unconditional Mean	-0.24	-0.03	-0.05	-0.02	-0.11
Std. Dev.	2.46	0.69	0.88	0.42	1.42

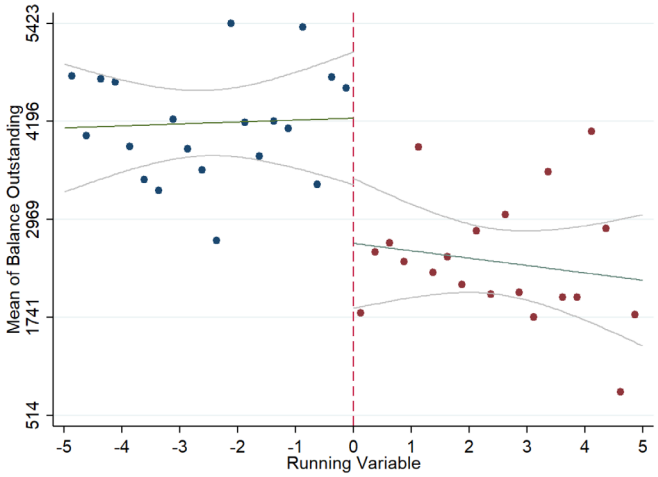
This table shows OLS regressions where the dependent variable measures the change in the number of outstanding credit lines. Considered are outcomes for all types of credit (Column 1), and individual credit types (Columns 2 – 5). The main variable of interest is *1(Run. Var. < 0)*, an indicator that takes on a value of one if a worker does not qualify for the grandfather provision of the pension reform act. The sample consists of all workers within 5 years of the threshold determining grandfather eligibility. Reported *t*-statistics in parentheses are heteroscedasticity-robust and clustered by school district. *** p < 0.01, ** p < 0.05, * p < 0.1.

The remaining specifications separately consider the effect on different credit types. In the second column, the point estimate on 1*(Run Var < 0)* of 0.019 (*t*-stat=1.93) indicates that workers not qualifying for the grandfather provision exhibit a relative increase of 0.019 automobile-related credit lines. This represents 25% of the estimate from the previous specification, which considers the combined effect across all credit lines. In the remaining specifications, we examine the effect on installment loans (Column 3), mortgage loans (Column 4), and revolving lines of credit (Column 5). We do not find statistically significant evidence for a differential change in any of these credit types when comparing those experiencing a reduction in expected future wealth and those grandfathered into the previous retirement plan.

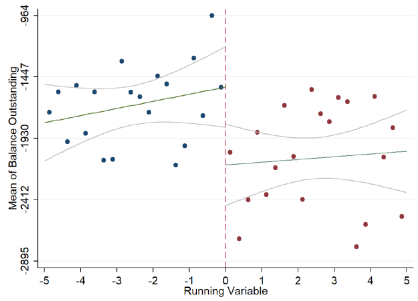
Next, we examine the change in demand for credit on the intensive margin. More precisely, we repeat the previous analysis when considering a worker's change in outstanding balances and credit limits. We begin by graphically illustrating how the change in a worker's outstanding credit balances varies with her grandfather provision status in Figure 5. Panel A considers the total change across all types of credit taken together. The panel shares many similarities to Panel A of Figure 4 above. First, the change in credit balances does not appear to vary systematically with the distance of a worker to the threshold when only considering the set of workers that did not qualify for the grandfather provision. More importantly, the change in total debt balances outstanding decreases at the threshold, the point at which an individual qualifies for the grandfather provision. The remaining four panels repeat the previous analysis for the different forms of credit. The figures exhibit signs of a similar drop in balances at the threshold for auto loans and leases (Panel B), installment loans (Panel C), and possibly mortgages (Panel D). Again similar to the previous figure, there does not appear to be a change in balances when considering revolving credit lines (Panel E).

Figure 5. Change in outstanding credit balances at threshold for grandfather provision

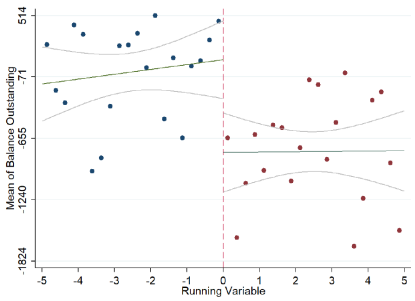
Panel A: All Credit Types



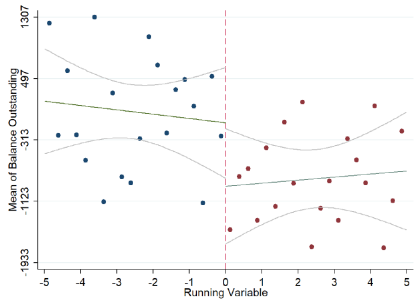
Panel B: Auto



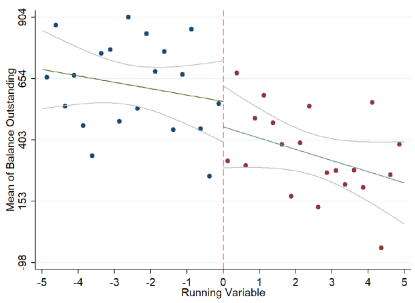
Panel C: Installment Loans



Panel D: Mortgage



Panel E: Revolving



This figure reports the change in outstanding credit balances around the threshold used to determine eligibility for the grandfather provision. Reported is the total outstanding balance (Panel A), as well as individual credit types (Panel B – Panel E). Gray bands correspond to the 95% confidence interval.

Again, we formally test for a discontinuity in outcomes at the threshold in Table 5. Panel A of the table repeats the analysis performed in the previous table, when considering the change in outstanding balances as the dependent variable. In Column 1 of the panel, we examine the combined change in all types of credit. The point estimate on 1*(Run Var < 0)* of 1,591 (*t*-stat=2.69) indicates that workers not qualifying for the grandfather provision exhibit a relative increase in their outstanding balances of almost $1,600 more than a worker who does not experience the decrease in expected future wealth. When benchmarked against the standard deviation of the dependent variable, this effect represents a 0.04 standard deviation increase in outstanding balances.

Table 5. Credit demand: Intensive margin

Panel A: Credit Balances

Credit Type:	(1) All	(2) Auto	(3) Installment	(4) Mortgage	(5) Revolving
1(Run. Var. < 0)	1,591.438***	629.141***	909.199***	811.099	101.763
	(2.69)	(3.11)	(3.48)	(1.41)	(0.93)
Run. Var.	28.194	58.533	50.065	-60.514	-26.391
	(0.18)	(1.28)	(0.83)	(-0.48)	(-0.93)
Run. Var. x 1(Run. Var. < 0)	-117.894	-34.835	-43.378	96.264	-19.701
	(-0.57)	(-0.48)	(-0.48)	(0.47)	(-0.51)
Polynomial	1	1	1	1	1
Bandwidth (yrs.)	5	5	5	5	5
Observations	94,046	43,796	43,796	56,742	56,742
R-squared	0.000	0.000	0.000	0.001	0.001
Unconditional Mean	3,340.24	-1,864.90	-379.96	-351.03	489.08
Std. Dev.	45,226.76	11,905.04	15,908.95	29,186.81	8,798.22

Panel B: Credit Limits

Credit Type:	(1) All	(2) Auto	(3) Installment	(4) Mortgage	(5) Revolving
1(Run. Var. < 0)	1,673.644**	457.010**	877.938***	689.417	160.129
	(2.44)	(2.19)	(2.99)	(1.21)	(0.79)
Run. Var.	57.083	47.468	39.306	8.651	40.585
	(0.33)	(0.94)	(0.61)	(0.07)	(0.89)
Run. Var. x 1(Run. Var. < 0)	-185.807	-57.104	-49.639	75.962	-59.143
	(-0.80)	(-0.72)	(-0.50)	(0.38)	(-0.81)
Polynomial	1	1	1	1	1
Bandwidth (yrs.)	5	5	5	5	5
Observations	94,046	43,796	43,796	56,742	56,742
R-squared	0.000	0.000	0.000	0.001	0.001
Unconditional Mean	8,031.23	928.26	1,482.74	4,119.05	2,750.35
Std. Dev.	50,277.48	12,358.19	17,551.98	27,861.40	16,011.03

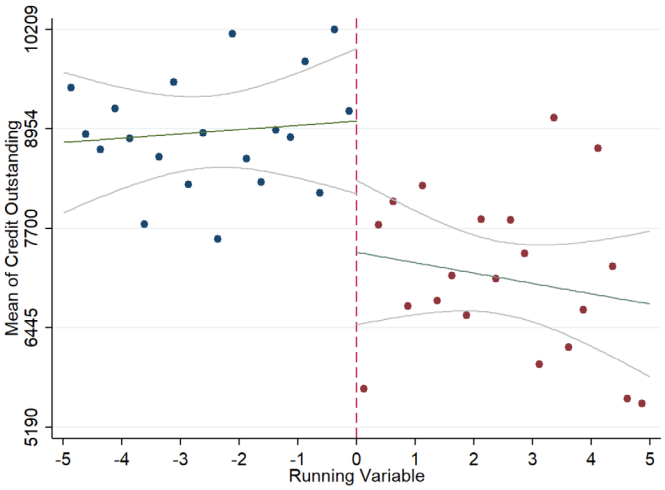
This table shows OLS regressions where the dependent variable measures the change in outstanding credit balances (Panel A), and credit limits (Panel B). Considered are outcomes for all types of credit (Column 1), and individual credit types (Columns 2 – 5). The main variable of interest is *1(Run. Var. < 0)*, an indicator that takes on a value of one if a worker does not qualify for the grandfather provision of the pension reform act. The sample consists of all workers within 5 years of the threshold determining grandfather eligibility. Reported t-statistics in parentheses are heteroscedasticity-robust and clustered by school district. *** p < 0.01, ** p < 0.05, * p < 0.1.

In the remaining specifications, we consider the effect on individual types of credit. Consistent with the previous analysis, a worker experiencing a reduction in retirement benefit generosity exhibits a relative increase in both automobile-related balances ($630, *t*-stat=3.11) and installment balances ($910, *t*-stat=3.48), but no statistically significant change in mortgage- or revolving credit-related balances.

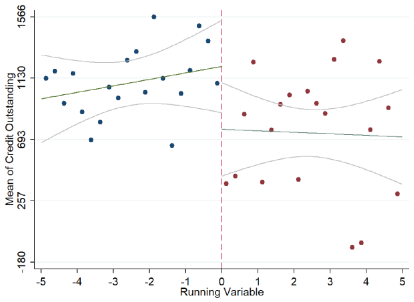
Finally, we confirm the previous findings regarding the change in credit demanded on the intensive margin by turning to the change in credit limits available. Figure 6 graphically depicts the change in available credit at the threshold determining grandfather eligibility. The figure shows patterns largely consistent with those shown in Figure 5 above. Panel B of Table 5 continues the exercise by performing OLS regressions of the form detailed in Equation (1). The results yield inferences very similar to Panel A. Specifically, workers that do not qualify for the grandfather provision exhibit an increase in overall credit limits, which is predominately concentrated in automobile- and installment loan-related credit lines.

Figure 6. Change in outstanding credit limits at threshold for grandfather provision

Panel A: All Credit Types



Panel B: Auto



Panel C: Installment Loans

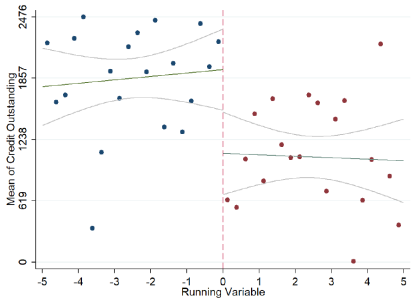
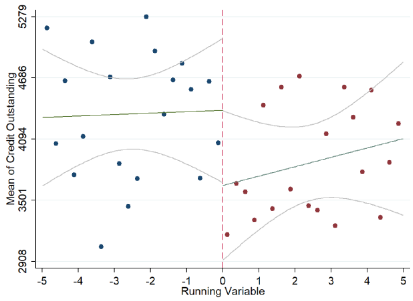
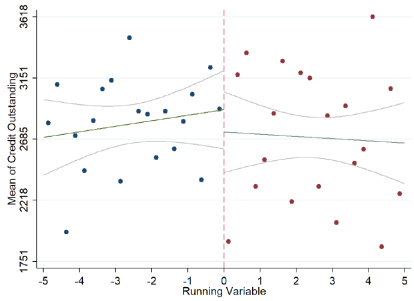


Figure 6. Change in outstanding credit limits at threshold for grandfather provision (continued)

Panel D: Mortgage



Panel E: Revolving



This figure reports the change in credit limits around the threshold used to determine eligibility for the grandfather provision. Reported is the total outstanding balance (Panel A), as well as individual credit types (Panel B – Panel E). Gray bands correspond to the 95% confidence interval.

5. Economic mechanism & next steps

In this section, we discuss the possible economic mechanism at work, which is able to explain the joint response of labor and credit. Finally, we discuss planned next steps for the project.

5.1. Possible mechanism

The results presented in 4 indicate that a worker experiencing a negative shock to future expected wealth responds in two ways. First, she adjusts her labor provision, extending the average time to retirement. Second, she also increases her credit usage in response to the negative wealth shock. While the first response represents the likely prediction of a typical life-cycle model with endogenous retirement, the second response may appear counterintuitive at first. Thus, we briefly discuss a possible explanation for the increase in credit usage following a decrease in future expected wealth.

One possible explanation for the change in credit behavior lies in the heterogeneous effects across types of credit. The results in Table 5 suggest that a worker who narrowly misses qualifying for the grandfather provision responds by increasing her total outstanding debt balance, but predominantly does so through automobile and installment loan credit types. It is plausible that these particular credit types proxy for durable consumption. One possible explanation for this response lies in the distinction between direct measures of consumption and expenditure-based measures. More precisely, Aguiar and Hurst (2005) note that upon an anticipated retirement, a household is able to increase the amount of time used to shop for and prepare food as a substitute for expenditures. Thus, if an individual now expects to spend more of their remaining life working, thus decreasing expected future leisure, they may increase expenditure-based consumption until the point of retirement. This possibility is consistent with Battistin, Brugiavini, Rettore, and Weber (2009), who find that a drop in consumption can be explained by a decrease in work-related expenses and leisure substitutes.

5.2. Next steps

While differential utility derived from consumption or the inclusion of leisure time may help explain the increase in credit usage for non-grandfathered public school employees, the current set of tests are not able to properly distinguish between the possible alternatives. For instance, a worker may respond to the drop in anticipated retirement benefits by seeking out better employment prospects (either within the public school

system or in an alternative industry). In planned analysis, we will examine the propensity of a worker to either seek out employment in a higher-paying school district or immediately depart from the public school system. Moreover, we intend to develop a structural model that incorporates the trade-off between labor and leisure to better understand the effect of a future wealth shock on the change in credit-financed consumption.

6. Conclusion

To what extent does a household's labor supply and credit decisions jointly respond to a permanent income shock? While prior literature has examined this question, it typically does so by focusing on a shock to contemporaneous wealth. However, while this realization of a sudden cash windfall constitutes a wealth shock, it may simultaneously ease the budget constraint for a credit-constrained household. For this reason, we instead focus on the effect that a change in the expected future wealth of a household has on its labor supply and credit demand decisions. To do this, we utilize an RD design which exploits a discontinuity embedded in the grandfather provision in a Texas pension reform act. Importantly, eligibility for the grandfather provision is not associated with a change in contemporaneous income. Moreover, because the law only impacts future retirement benefits, it is unlikely to affect a household's budget constraint at the time it was passed.

Our paper yields two main findings. First, a worker experiencing a decrease in expected retirement benefits responds by increasing labor provision and delaying retirement for 0.25 years. Second, in response to the reduction in benefits, the worker increases her credit usage by $1,600. We find that the change is attributed almost completely to an increase in automobile-related debt and installment loans, which plausibly represent an increase in durable consumption. This result is possibly explained by a worker's differential treatment of expenditure-based consumption while employed relative to consumption during retirement. This is consistent with Aguiar and Hurst (2005), who argue the reduction in expenditure-based consumption at retirement can be explained by a simultaneous increase in a retiree's leisure time. Specifically, the extra leisure time afforded to an individual in retirement allows her to derive more utility from a given expenditure amount. Taken together, these results underscore the importance of jointly considering the effect of a wealth shock on both the labor supply and credit demand of a household.

References

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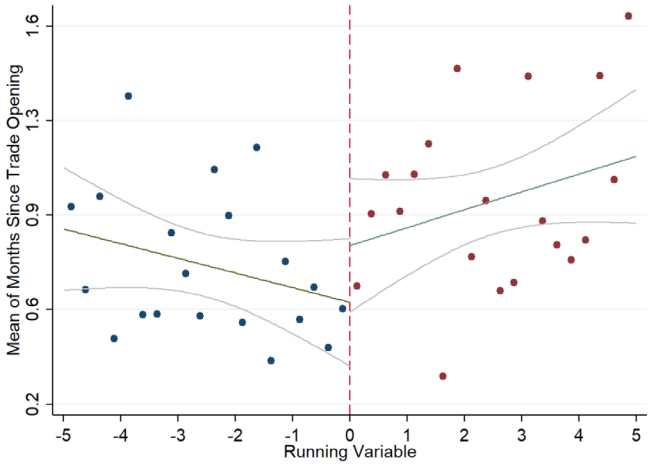
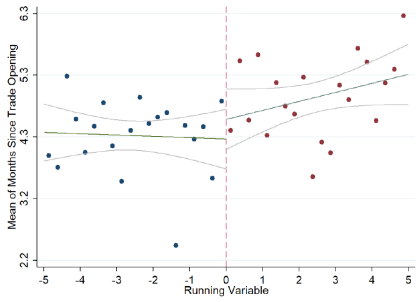
Online Appendix

Figure OA.1. Months since most recent credit line opened

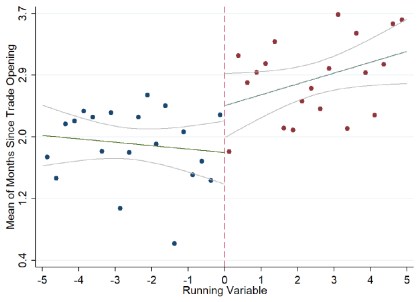
Panel A: All Credit Types



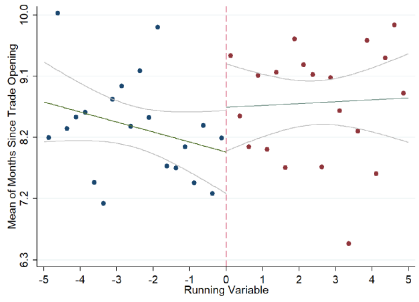
Panel B: Auto



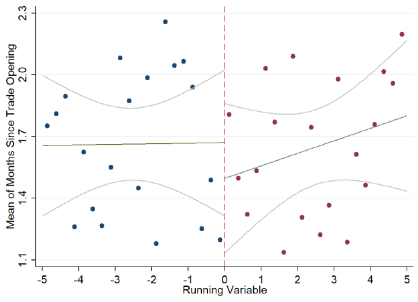
Panel C: Installment Loans



Panel D: Mortgage



Panel E: Revolving



This figure reports the change in number of months since the most recent credit line was opened. Reported is the number of months since the most recent line of any credit line was opened (Panel A), as well as individual credit types (Panel B – Panel E). Gray bands correspond to the 95% confidence interval.

About the author

Jordan Nickerson graduated in 2014 and accepted a position at Boston College as an Assistant Professor of Finance. Dr. Nickerson's research is empirical and covers a wide range of topics, including research in structured finance products, corporate finance, and household finance. His research generally makes use of unique settings, such as public school teachers, to study the behavior of households and firms. His research has been published in leading peer-reviewed journals, including the *Review of Financial Studies*, *Journal of Financial Economics*, and the *Journal of Financial and Quantitative Analysis*.

Nickerson earned both his bachelor's degree in mathematics and Ph.D. in Finance from the University of Texas in Austin.