Online Appendix A for "Borrowing to Save? The Impact of Automatic Enrollment on Debt"

John Beshears, James J. Choi, David Laibson, Brigitte C. Madrian, William L. Skimmyhorn
July 16, 2019

In this appendix, we estimate the automatic enrollment effect on TSP contributions and debt using a regression discontinuity design with hire month as the assignment variable. In our baseline estimate, we find that automatic enrollment causes cumulative TSP contributions to increase by 5.8% of first-year pay at 47 months of tenure.[1] The 95% confidence interval for this estimate is [4.8%, 6.7%], which does not contain the 4.1% estimate we obtain in the main text of the paper. Thus, the estimate in the main text of the paper is on the conservative end of estimates of the effect of automatic enrollment on TSP contributions. At the same horizon, we detect no statistically significant automatic enrollment effect on debt excluding auto loans and first mortgages or on auto loans. We do find a statistically significant increase in first mortgage balances of 12.5% of first-year pay. We also estimate that automatic enrollment causes a negligible change in Vantage score. The confidence intervals of the estimates for the debt and credit score outcome measures include the point estimates in the main text, except in the case of first mortgage balances, where the regression discontinuity design yields a larger positive treatment effect estimate.

We prefer the empirical methodology in the main text for two reasons. First, the main text's methodology yields smaller standard errors than the regression discontinuity design. Second, when we subject the regression discontinuity design to placebo tests by estimating effects of automatic enrollment on debt *prior* to hire, we find some significant results three years prior to hire, which might indicate that even after controlling for observables, employees hired in the month before the implementation of automatic enrollment differ unobservably from employees hired in the month of the implementation. For example, there might be cyclical patterns in hiring at the annual frequency that make July new hires unobservably different from

[1] Intuitively, the regression discontinuity design compares individuals hired immediately before versus immediately after August 1, 2010, when automatic enrollment was implemented. We observe credit variables at the end of June and at the end of December in each year, so the regression discontinuity design estimates the effect of automatic enrollment at the end of December 2010 (5 months of tenure), at the end of June 2011 (11 months of tenure), etc. We focus on estimates at 43-48 months of tenure in the main text of the paper, so in this appendix we focus on estimates at 47 months of tenure.

August new hires, and this cyclicality need not make a full 12 months of new hires differ on average from the next 12 months of new hires.

A.I. Methodology

Individuals in our sample were subject to automatic enrollment if and only if they were hired on or after August 1, 2010. We run a separate ordinary least squares regression for each date *t* on which an outcome is measured:

$$y_{it} = \alpha + \beta_1 post_i + \beta_2 hiremonth_i + \beta_3 (post_i \times hiremonth_i) + \gamma X_i + \epsilon_i, \qquad (A.1)$$

where i indexes individuals, y_{it} is the outcome for person i as of date *t*, $post_i$ indicates whether person *i* was hired in August 2010 or later, $hiremonth_i$ is the signed number of months between person *i*'s hire month and August 2010, and X_i is a vector of individual characteristics measured as of hire (log deflated salary, geographic location, education, college major, job type, gender, race, and age).

Our data contain the employee's month of hire but not the day of hire, so we assume that employees were hired in the middle of each month. For example, August 2010 hires are coded as having $hiremonth_i = 0.5$, and July 2010 hires are coded as having $hiremonth_i = -0.5$. The coefficient of interest is β_1, the extrapolated difference in y between those hired an instant before August 1, 2010, and those hired at the very beginning of August 1, 2010. Because all outcomes in the regression are measured as of the same calendar date, there is no need to control separately for calendar time effects. Also, on a given calendar date, those hired an instant before August 1, 2010, have the same tenure as those hired at the beginning of August 1, 2010, so there is no need to control separately for tenure effects. We present our results under several bandwidths (4, 8, and 12 months on each side of the hire date threshold) to illustrate that they are not particularly sensitive to bandwidth choice. Due to the small number of running variable values, we do not cluster standard errors by the assignment variable.

In order for β_1 to be an unbiased estimate of the treatment effect of automatic enrollment, month of hire around August 2010 must be as-if randomized, conditional on observables. Since employees can easily implement the automatic enrollment defaults themselves, there is little incentive to self-sort across the August 2010 hire threshold, so as-if conditional randomization is plausible. Appendix Table A1 shows that controlling for observables is important. Compared to the cohort hired during the month before the implementation of automatic enrollment, the cohort

hired during the first month of automatic enrollment is lower-income, less educated, and less likely to hold a professional position. The magnitudes of the differences are larger for the one-month cohorts than for the one-year cohorts analyzed in the main text, suggesting that month-to-month variation is smoothed out when averaging over more months.

When analyzing credit outcomes, we use as our outcome variable the change relative to the June 2009 level. This within-individual differencing purges time-invariant individual differences in credit levels from the outcome.

A.II. Results

Appendix Table A2 presents the results from the regression discontinuity analysis. When describing the results, we focus on those obtained from the 12-month bandwidth, but the findings are qualitatively similar using the other bandwidths.

At 47 months of tenure (corresponding to the 43-48 month tenure bucket that is our preferred long-run horizon in the main text), automatic enrollment increases cumulative total TSP contributions by 5.8% of first-year income (95% confidence interval = [4.8%, 6.7%]). There is no significant effect on debt excluding auto loans and first mortgages at the same horizon; the point estimate is 1.1% of first-year income (95% confidence interval = [-1.1%, 3.2%]). There is a statistically significant increase in auto debt of 1.6% of income at 35 months of tenure, but the statistical significance disappears at later horizons, and the point estimate at 47 months is 1.1% (95% confidence interval = [-0.4%, 2.6%]). First mortgage debt shows a significant increase starting at 17 months of tenure, and by 47 months, automatic enrollment increases first mortgage debt balances by 12.5% of first-year income (95% confidence interval = [3.6%, 21.4%]). There is an economically negligible effect on Vantage score at 47 months of 0.2 points (95% confidence interval = [-2.7, 3.1]).

Appendix Figures A1-A5 present visual analogues of the above analysis using the 12-month bandwidth. The vertical axes represent the residual values $\tilde{y}_{it}$ from regressions of the outcome variable y_{it} on the covariates X_i. The fitted lines are from regressions of the form:

$$\tilde{y}_{it} = a + b_1 post_i + b_2 hiremonth_i + b_3(post_i \times hiremonth_i) + u_i. \qquad (A.2)$$

The data points plotted are the average residualized value of the outcome for people with that hire month.[2]

If our identifying assumptions are valid, we should estimate no effect of automatic enrollment on outcomes *prior* to hire. Appendix Table A3 shows the results of these placebo tests. There are no estimates for outcomes at tenure month -13, since this tenure corresponds to June 2009, the baseline date from which we compute differences. We also do not use bandwidths of 8 and 12 months for tenure month -7 (December 2009), since the wider bandwidths cause both individuals hired and individuals not hired as of December 2009 to be included in the pre-AE cohort sample, and the assumption of local linearity may not hold across a sample of both hired and not-yet-hired individuals.

We find no significant pre-hire effects on auto debt and credit score through tenure month -37. For first mortgage debt, there are significant positive effects at tenure months -25, -31, and -37, but only when using a 12-month bandwidth. More concerning are the pre-hire estimates for debt excluding auto loans and first mortgages. There are significant positive effects at tenure months -25, -31, and -37 when using a 12-month bandwidth, and there are significant positive effects at tenure months -31 and -37 when using an 8-month bandwidth. Moreover, looking across the three different bandwidths, the point estimates at tenure months -25, -31, and -37 consistently occupy a narrow range (1.1% to 2.1% of first-year income). On the one hand, these significant differences appear only at a point fairly distant in the past, and with *t*-statistics hovering around 2, their statistical significance is not overwhelming given the large number of tests we have run in Appendix Table A3. On the other hand, the fact that there are any significant placebo results at all casts some doubt on the validity of the regression discontinuity specification.

[2] The b coefficients are close but not identical to the β coefficients in Appendix Table A2. Per the Frisch-Waugh-Lovell Theorem, we could produce identical estimates by residualizing the regressors in a similar way, but at the cost of visual clarity.

Appendix Table A1. Comparison of employees hired in month before versus month of automatic enrollment implementation

	Pre-AE (Jul '10 hires)	Post-AE (Aug '10 hires)	Difference	*p*-value of difference
Avg. starting salary	$56,981	$53,849	-3,132	0.000
Avg. age at hire	39.0	38.9	0.0	0.918
Male	63.2%	65.2%	2.0%	0.109
White	52.4%	57.8%	5.5%	0.000
Black	10.9%	10.3%	-0.5%	0.533
Hispanic	2.8%	3.4%	0.6%	0.197
Asian	2.8%	3.9%	1.1%	0.029
Native American	0.7%	0.9%	0.1%	0.636
Missing race	30.4%	23.7%	-6.7%	0.000
High school only	42.1%	47.3%	5.3%	0.000
Some college, no degree	12.3%	12.6%	0.3%	0.744
Associate degree	5.1%	5.1%	0.1%	0.882
Bachelor's degree	21.8%	18.1%	-3.6%	0.001
Graduate degree	17.7%	15.8%	-1.9%	0.057
Unknown education	1.1%	1.0%	-0.1%	0.601
STEM major | college	30.8%	28.2%	-2.6%	0.165
Business major | college	25.4%	27.3%	2.0%	0.279
Other major | college	43.8%	44.4%	0.6%	0.755
Administrative position	29.5%	31.7%	2.2%	0.076
Blue collar position	8.6%	7.4%	-1.2%	0.107
Clerical position	7.6%	6.8%	-0.8%	0.250
Professional position	25.5%	19.4%	-6.2%	0.000
Technical position	16.6%	16.2%	-0.4%	0.651
Other position	12.2%	18.5%	6.4%	0.000
Has credit report in six months before hire	82.8%	83.2%	0.4%	0.677
Avg. Vantage Score in six months before hire, conditional on having Vantage Score	689.3	688.1	-1.2	0.671
# of obs. (*N*)	2,432	3,402		

Appendix Table A2. The effect of automatic enrollment on cumulative TSP contributions and debt changes since June 2009

Each cell shows the treatment effect estimated from a separate regression for which the specification is found in equation (A.1). All dependent variables except Vantage credit score are normalized by first-year income. Bandwidth refers to the number of hire months on either side of August 2010 that are included in the regression. The regressions include all people who remain employed as of that calendar date. Standard errors robust to heteroskedasticity are in parentheses below point estimates.

		Tenure (months)								
	Bandwidth	5	11	17	23	29	35	41	47	53
Cumulative total TSP contributions	4 months	0.012**	0.021**	0.028**	0.030**	0.038**	0.041**	0.045**	0.048**	0.047**
		(0.001)	(0.001)	(0.002)	(0.003)	(0.004)	(0.006)	(0.007)	(0.008)	(0.010)
	8 months	0.013**	0.023**	0.032**	0.035**	0.045**	0.049**	0.055**	0.061**	0.061**
		(0.001)	(0.001)	(0.002)	(0.002)	(0.003)	(0.004)	(0.005)	(0.006)	(0.007)
	12 months	0.013**	0.021**	0.031**	0.033**	0.043**	0.046**	0.052**	0.058**	0.059**
		(0.001)	(0.001)	(0.001)	(0.002)	(0.003)	(0.003)	(0.004)	(0.005)	(0.006)
Debt excluding auto, first mortgage (D1)	4 months	0.005	-0.010	-0.010	0.001	0.010	-0.001	0.013	0.023	0.025
		(0.011)	(0.012)	(0.013)	(0.014)	(0.015)	(0.016)	(0.018)	(0.019)	(0.020)
	8 months	0.005	-0.004	-0.001	0.002	0.002	0.006	0.009	0.015	0.009
		(0.008)	(0.008)	(0.010)	(0.010)	(0.011)	(0.011)	(0.013)	(0.013)	(0.014)
	12 months	0.007	-0.003	-0.004	0.001	0.000	0.005	0.007	0.011	0.010
		(0.006)	(0.007)	(0.008)	(0.008)	(0.009)	(0.009)	(0.011)	(0.011)	(0.012)
Auto debt	4 months	0.012	0.008	0.006	0.005	0.017	0.024*	0.009	0.011	0.004
		(0.007)	(0.008)	(0.010)	(0.010)	(0.011)	(0.012)	(0.012)	(0.013)	(0.014)
	8 months	0.009	0.011	0.006	0.008	0.015	0.018*	0.010	0.009	0.004
		(0.005)	(0.006)	(0.007)	(0.007)	(0.008)	(0.008)	(0.009)	(0.009)	(0.010)
	12 months	0.003	0.010*	0.007	0.008	0.012	0.016*	0.009	0.011	0.009
		(0.004)	(0.005)	(0.005)	(0.006)	(0.006)	(0.007)	(0.007)	(0.008)	(0.008)
First mortgage debt	4 months	0.063	0.056	0.165**	0.166**	0.036	0.102	0.088	0.162*	0.089
		(0.045)	(0.049)	(0.057)	(0.060)	(0.067)	(0.070)	(0.076)	(0.078)	(0.083)
	8 months	0.065*	0.077*	0.140**	0.131**	0.089	0.117*	0.094	0.169**	0.118*
		(0.032)	(0.035)	(0.040)	(0.043)	(0.047)	(0.050)	(0.054)	(0.056)	(0.059)
	12 months	0.024	0.042	0.091**	0.076*	0.069	0.096*	0.050	0.125**	0.080
		(0.026)	(0.028)	(0.032)	(0.034)	(0.038)	(0.041)	(0.044)	(0.045)	(0.048)
Vantage credit score	4 months	1.05	0.35	0.16	0.28	2.06	0.19	0.13	-1.13	0.62
		(1.64)	(1.80)	(2.01)	(2.11)	(2.27)	(2.39)	(2.49)	(2.59)	(2.75)
	8 months	-0.65	0.46	1.11	0.00	0.70	0.49	0.95	1.48	1.89
		(1.16)	(1.27)	(1.42)	(1.50)	(1.61)	(1.69)	(1.78)	(1.83)	(1.94)
	12 months	-1.27	0.33	0.26	-0.42	-0.16	0.02	-0.53	0.21	-0.12
		(0.95)	(1.04)	(1.16)	(1.22)	(1.31)	(1.37)	(1.45)	(1.50)	(1.58)

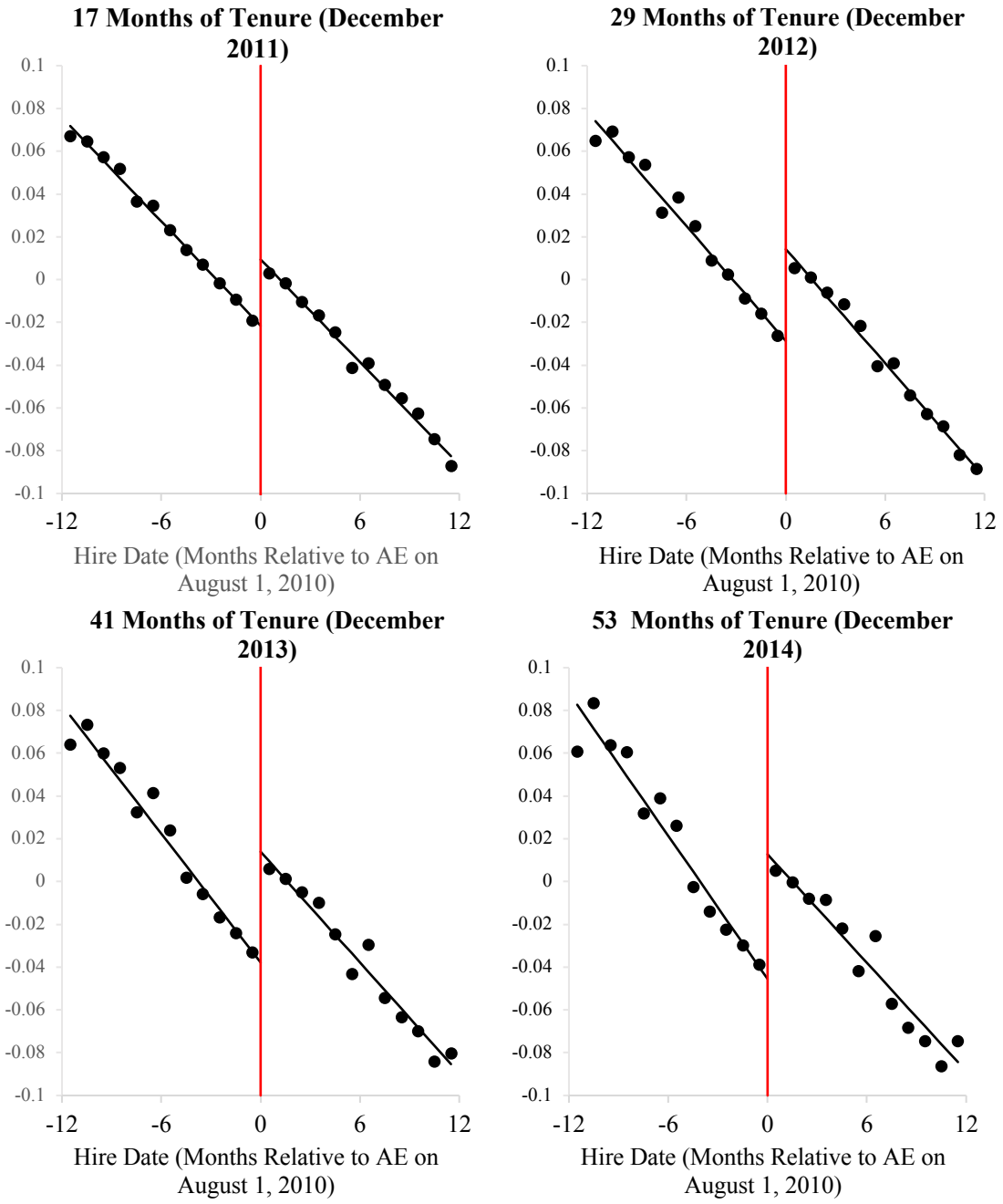
* Significant at 5% level. ** Significant at 1% level.

Appendix Table A3. Placebo tests: The effect of automatic enrollment on debt changes relative to June 2009, prior to hire

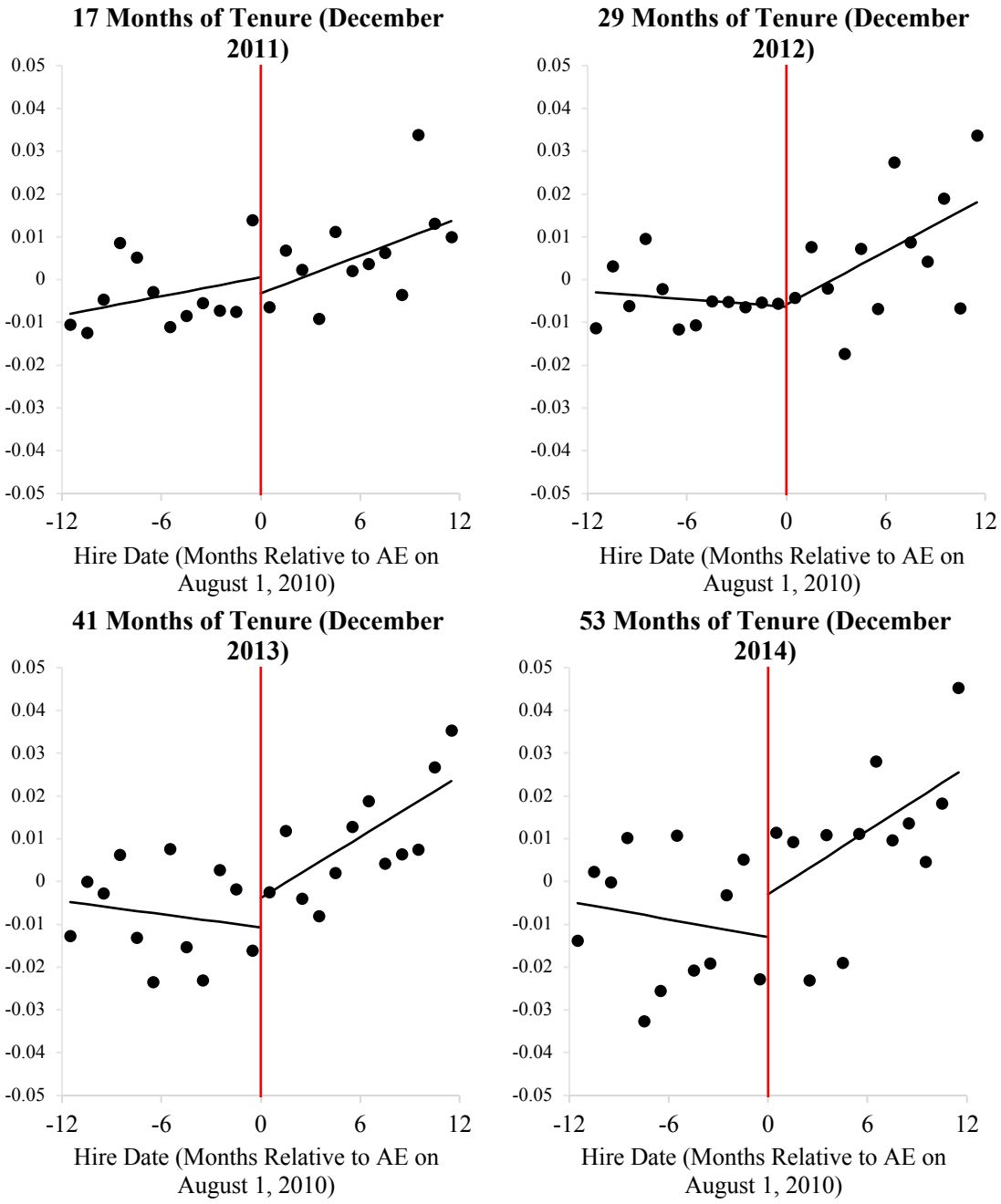
Each cell shows the treatment effect estimated from a separate regression for which the specification is found in equation (A.1). All dependent variables except Vantage credit score are normalized by first-year income. All variables are changes relative to June 2009. Bandwidth refers to the number of hire months on either side of August 2010 that are included in the regression. The regressions include all people who ever appear in our data with a positive tenure. Standard errors robust to heteroskedasticity are in parentheses below point estimates.

		Tenure (months)					
	Bandwidth	-37	-31	-25	-19	-13	-7
Debt excluding auto, first mortgage (D1)	4 months	0.012	0.021	0.013	0.009	--	-0.005
		(0.012)	(0.011)	(0.009)	(0.007)		(0.007)
	8 months	0.020*	0.020*	0.012	0.007	--	--
		(0.009)	(0.008)	(0.006)	(0.005)		
	12 months	0.017*	0.017**	0.011*	0.004	--	--
		(0.007)	(0.007)	(0.005)	(0.004)		
Auto debt	4 months	-0.007	-0.008	-0.004	-0.003	--	0.003
		(0.007)	(0.006)	(0.005)	(0.004)		(0.004)
	8 months	0.000	-0.003	-0.003	-0.003	--	--
		(0.005)	(0.004)	(0.004)	(0.003)		
	12 months	0.003	-0.001	-0.001	-0.003	--	--
		(0.004)	(0.004)	(0.003)	(0.002)		
First mortgage debt	4 months	-0.040	-0.028	-0.056	-0.045	--	0.013
		(0.044)	(0.040)	(0.034)	(0.028)		(0.031)
	8 months	0.044	0.054	0.028	0.002	--	--
		(0.031)	(0.028)	(0.024)	(0.019)		
	12 months	0.054*	0.050*	0.046*	0.014	--	--
		(0.026)	(0.023)	(0.019)	(0.016)		
Vantage credit score	4 months	-1.32	-1.86	-1.46	-0.36	--	0.69
		(1.83)	(1.69)	(1.46)	(1.16)		(1.16)
	8 months	-1.23	-0.92	-0.57	0.04	--	--
		(1.30)	(1.20)	(1.03)	(0.82)		
	12 months	-1.20	-0.78	-0.26	0.46	--	--
		(1.07)	(0.98)	(0.85)	(0.67)		

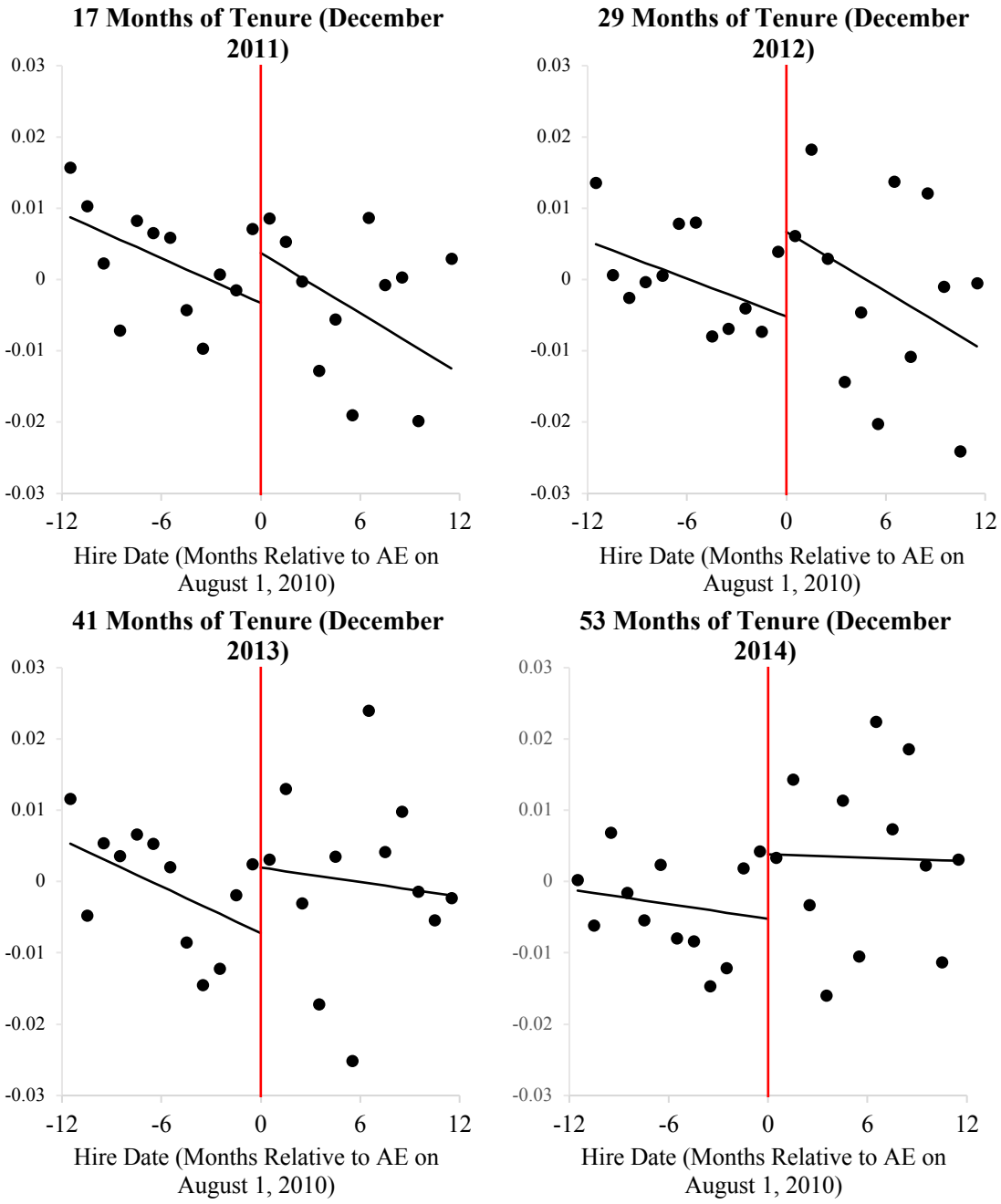
* Significant at 5% level. ** Significant at 1% level.



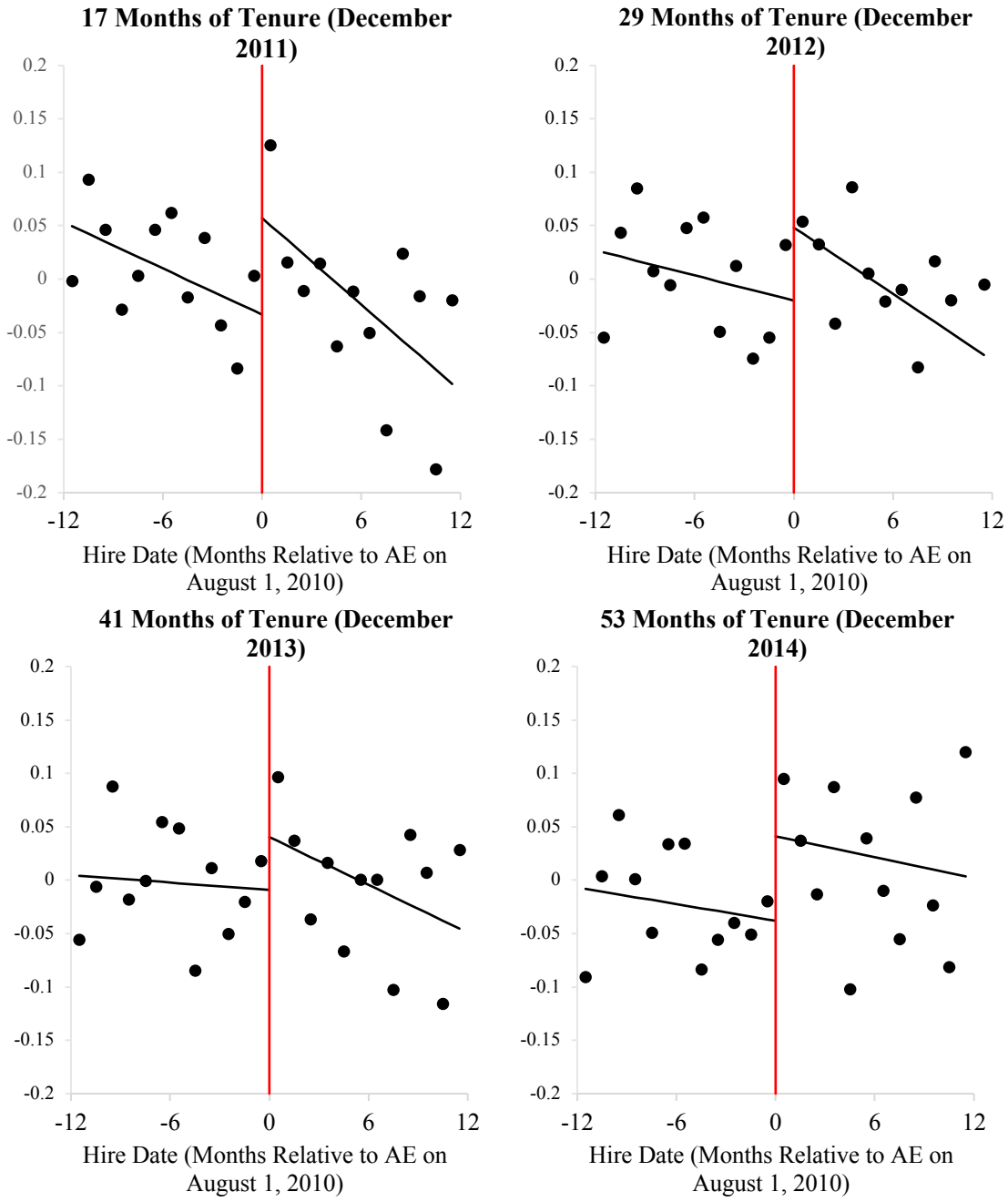
Appendix Figure A1. The effect of automatic enrollment on cumulative total TSP contributions to annualized first-year pay ratio, 12-month bandwidth. The plotted data points are average residualized values of the outcome variable measured at the date in each chart's title for those hired in the month indicated in the horizontal axis. The lines are fitted lines from the regression in equation (A.2).



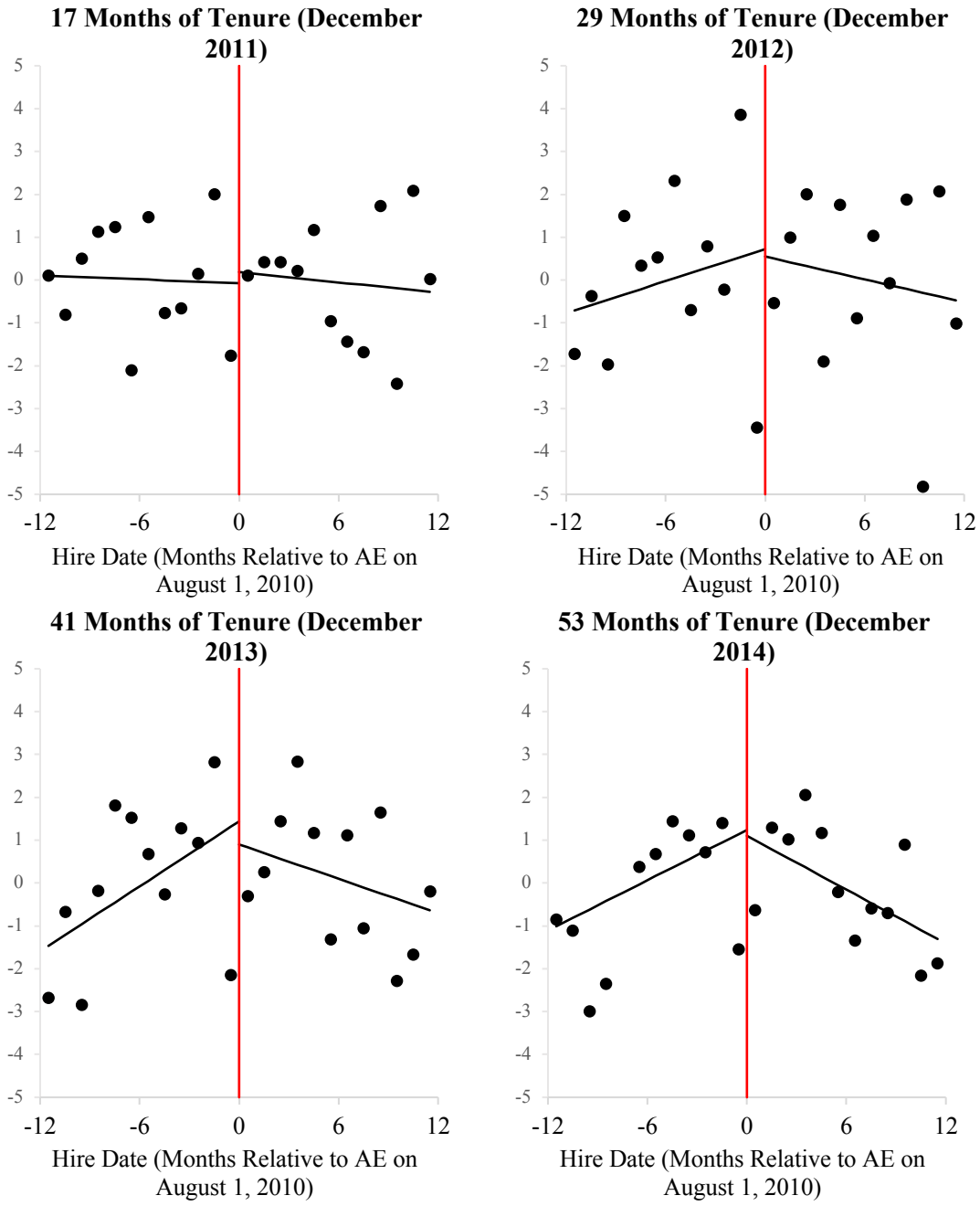
Appendix Figure A2. The effect of automatic enrollment on change since June 2009 in debt excluding auto and first mortgage debt (D1) to first-year pay, 12-month bandwidth. The plotted data points are average residualized values of the outcome variable measured at the date in each chart's title for those hired in the month indicated in the horizontal axis. The lines are fitted lines from the regression in equation (A.2).



Appendix Figure A3. The effect of automatic enrollment on change since June 2009 in auto debt to first-year pay, 12-month bandwidth. The plotted data points are average residualized values of the outcome variable measured at the date in each chart's title for those hired in the month indicated in the horizontal axis. The lines are fitted lines from the regression in equation (A.2).



Appendix Figure A4. The effect of automatic enrollment on change since June 2009 in first mortgage debt to first-year pay, 12-month bandwidth. The plotted data points are average residualized values of the outcome variable measured at the date in each chart's title for those hired in the month indicated in the horizontal axis. The lines are fitted lines from the regression in equation (A.2).



Appendix Figure A5. The effect of automatic enrollment on change since June 2009 in Vantage score, 12-month bandwidth. The plotted data points are average residualized values of the outcome variable measured at the date in each chart's title for those hired in the month indicated in the horizontal axis. The lines are fitted lines from the regression in equation (A.2).

Online Appendix B for
"Borrowing to Save? The Impact of Automatic Enrollment on Debt"

John Beshears, James J. Choi, David Laibson, Brigitte C. Madrian, William L. Skimmyhorn
July 16, 2019

In this appendix, we report analyses that supplement the analyses presented in the main text of the paper.

In Tables 2-5, the regression sample includes individuals as long as they remain employed by the Army, so the sample composition changes as tenure increases and individuals terminate employment. Appendix Tables B1-B4 conduct the same analysis holding the sample fixed as tenure increases. Appendix Tables B1 and B2 examine the sample of employees who remain employed at least until they reach 43-48 months of tenure. Appendix Tables B3 and B4 examine the sample of employees who were ever hired, setting their contribution flows to zero after separation from employment.

Appendix Tables B5, B6, and B7 conduct the same analysis as in Tables 4, 6, and 7, respectively, except with an alternative regression specification that does not control for the interaction of tenure and demographics.

Appendix Figure B1 shows participation rates in the TSP for the pre-AE and post-AE cohorts. Participation is defined as making a positive employee contribution to the TSP. Appendix Figure B2 shows the distributions of employee contribution rates in the TSP for the pre-AE and post-AE cohorts.

Appendix Table B1. Effect of automatic enrollment on cumulative TSP contributions and debt components: Constant sample of employees who remain at least 43-48 months

Each column reports regression-adjusted effects of automatic enrollment on the dependent variable in the column heading. The contribution regressions are estimated according to equation (2), and the credit regressions are estimated according to equation (4). The coefficients correspond to the treatment effect of automatic enrollment at the tenure months indicated. All dependent variables except for Vantage credit score are normalized by first-year annualized salary. Standard errors clustered at the employee level are in parentheses. The last row shows the number of person-months in each regression. The sample contains only people who remain employed at 43-48 months of tenure.

	Cumulative total TSP contributions	Cumulative employee TSP contributions	Vantage credit score	Debt excluding auto, first mortgage	Auto debt	First mortgage debt
Tenure ≤ -18	--	--	-1.5	0.009	-0.005	0.010
			(1.0)	(0.007)	(0.004)	(0.026)
Tenure -17 to -12	--	--	-0.9	-0.003	-0.005	-0.025
			(0.8)	(0.005)	(0.003)	(0.020)
Tenure -11 to -6	--	--	-0.5	-0.003	-0.001	-0.011
			(0.6)	(0.004)	(0.002)	(0.014)
Tenure 1 to 6	0.003**	0.000	0.6	0.001	0.001	0.031*
	(0.001)	(0.000)	(0.6)	(0.004)	(0.002)	(0.015)
Tenure 7 to 12	0.009**	0.003**	0.1	-0.002	0.003	0.021
	(0.001)	(0.001)	(0.8)	(0.006)	(0.004)	(0.023)
Tenure 13 to 18	0.015**	0.005**	0.7	-0.001	0.005	0.037
	(0.002)	(0.001)	(1.0)	(0.007)	(0.005)	(0.028)
Tenure 19 to 24	0.022**	0.008**	0.3	-0.002	0.003	0.000
	(0.002)	(0.002)	(1.1)	(0.007)	(0.005)	(0.031)
Tenure 25 to 30	0.029**	0.011**	-0.1	0.002	0.003	0.008
	(0.003)	(0.002)	(1.2)	(0.008)	(0.006)	(0.034)
Tenure 31 to 36	0.034**	0.013**	-0.8	0.004	0.004	0.028
	(0.004)	(0.003)	(1.2)	(0.009)	(0.006)	(0.036)
Tenure 37 to 42	0.040**	0.016**	-0.2	0.008	0.006	0.027
	(0.004)	(0.003)	(1.3)	(0.009)	(0.006)	(0.039)
Tenure 43 to 48	0.046**	0.018**	-0.5	0.004	0.007	0.038
	(0.005)	(0.004)	(1.3)	(0.010)	(0.007)	(0.041)
Tenure 49 to 53	0.051**	0.021**	0.7	-0.004	0.004	0.043
	(0.006)	(0.005)	(1.5)	(0.011)	(0.008)	(0.047)
Calendar time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Person fixed effects	No	No	Yes	Yes	Yes	Yes
Demographic × tenure controls	Yes	Yes	Yes	Yes	Yes	Yes
# of obs. (*N*)	344,208	344,208	478,067	574,313	574,313	574,313

* Significant at 5% level. ** Significant at 1% level.

Appendix Table B2. Effect of automatic enrollment on debt subcomponents: Constant sample of employees who remain at least 43-48 months

Each column reports coefficients from a regression estimated according to equation (4) whose dependent variable is in the column heading. All dependent variables are normalized by first-year annualized salary. The coefficients correspond to the treatment effect of automatic enrollment at the tenure months indicated. Standard errors clustered at the employee level are in parentheses. The last row shows the number of person-months in each regression. The sample contains only people who remain employed at 43-48 months of tenure.

	HELOC revolving	Non-HELOC revolving	Other installment loans	Second mortgages	Student loans	External collections	Residual debt
Tenure ≤ -18	0.002	0.005	0.000	0.006	-0.003	-0.001	0.000
	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.001)	(0.001)
Tenure -17 to -12	-0.001	0.001	-0.002	0.001	-0.002	-0.001	0.000
	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.001)	(0.000)
Tenure -11 to -6	-0.001	0.001	-0.003	0.000	-0.001	0.000	0.000
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.000)	(0.000)
Tenure 1 to 6	0.000	0.000	-0.001	0.001	0.001	0.000	0.000
	(0.001)	(0.001)	(0.003)	(0.002)	(0.001)	(0.000)	(0.000)
Tenure 7 to 12	0.000	0.002	-0.005	-0.001	0.001	0.000	0.000
	(0.002)	(0.002)	(0.004)	(0.003)	(0.002)	(0.001)	(0.000)
Tenure 13 to 18	0.000	0.003	-0.005	0.001	0.000	0.000	0.000
	(0.002)	(0.002)	(0.004)	(0.003)	(0.003)	(0.001)	(0.001)
Tenure 19 to 24	-0.002	0.004	-0.004	0.000	-0.001	0.000	0.000
	(0.003)	(0.003)	(0.005)	(0.003)	(0.003)	(0.001)	(0.001)
Tenure 25 to 30	-0.002	0.004	-0.003	0.001	0.000	0.000	0.001
	(0.003)	(0.003)	(0.005)	(0.004)	(0.004)	(0.001)	(0.001)
Tenure 31 to 36	-0.003	0.004	-0.001	0.002	0.001	0.000	0.001
	(0.003)	(0.003)	(0.005)	(0.004)	(0.004)	(0.001)	(0.001)
Tenure 37 to 42	-0.002	0.005	-0.004	0.003	0.004	-0.001	0.001
	(0.004)	(0.004)	(0.005)	(0.004)	(0.005)	(0.001)	(0.001)
Tenure 43 to 48	-0.003	0.005	-0.004	0.003	0.003	-0.001	0.001
	(0.004)	(0.004)	(0.005)	(0.004)	(0.005)	(0.001)	(0.001)
Tenure 49 to 53	-0.003	0.003	-0.008	0.006	-0.002	0.000	0.001
	(0.004)	(0.004)	(0.005)	(0.005)	(0.006)	(0.001)	(0.001)
Calendar time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Person fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Demographic × tenure controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
# of obs. (*N*)	574,313	574,313	574,313	574,313	574,313	574,313	574,313

* Significant at 5% level. ** Significant at 1% level

Appendix Table B3. Effect of automatic enrollment on cumulative TSP contributions and debt components: Constant sample of employees who were ever hired

Each column reports regression-adjusted effects of automatic enrollment on the dependent variable in the column heading. The contribution regressions are estimated according to equation (2), and the credit regressions are estimated according to equation (4). The coefficients correspond to the treatment effect of automatic enrollment at the tenure months indicated. All dependent variables except for Vantage credit score are normalized by first-year annualized salary. Standard errors clustered at the employee level are in parentheses. The last row shows the number of person-months in each regression. The constant sample contains all employees who were ever hired, setting their contribution flows to zero after separation.

	Cumulative total TSP contributions	Cumulative employee TSP contributions	Vantage credit score	Debt excluding auto, first mortgage	Auto debt	First mortgage debt
Tenure	--	--	-0.5	0.003	-0.001	0.021
≤ -18			(0.8)	(0.006)	(0.003)	(0.020)
Tenure	--	--	0.0	-0.003	-0.001	-0.008
-17 to -12			(0.6)	(0.004)	(0.003)	(0.016)
Tenure	--	--	-0.1	-0.003	0.000	-0.011
-11 to -6			(0.4)	(0.003)	(0.002)	(0.011)
Tenure	0.005**	0.002**	0.3	-0.001	0.001	0.021
1 to 6	(0.000)	(0.000)	(0.5)	(0.003)	(0.002)	(0.012)
Tenure	0.010**	0.004**	0.1	-0.006	0.000	0.006
7 to 12	(0.001)	(0.001)	(0.6)	(0.004)	(0.003)	(0.017)
Tenure	0.015**	0.005**	0.4	-0.008	0.001	0.013
13 to 18	(0.001)	(0.001)	(0.8)	(0.005)	(0.004)	(0.021)
Tenure	0.021**	0.008**	0.3	-0.014*	-0.001	-0.005
19 to 24	(0.002)	(0.001)	(0.9)	(0.006)	(0.004)	(0.024)
Tenure	0.027**	0.010**	0.4	-0.014*	0.001	-0.001
25 to 30	(0.002)	(0.002)	(0.9)	(0.006)	(0.005)	(0.026)
Tenure	0.031**	0.012**	-0.1	-0.017*	0.002	-0.005
31 to 36	(0.003)	(0.002)	(1.0)	(0.007)	(0.005)	(0.029)
Tenure	0.036**	0.014**	0.4	-0.018*	0.004	-0.006
37 to 42	(0.003)	(0.002)	(1.0)	(0.008)	(0.005)	(0.031)
Tenure	0.041**	0.016**	-0.1	-0.023**	0.006	-0.002
43 to 48	(0.004)	(0.003)	(1.1)	(0.008)	(0.005)	(0.033)
Tenure	0.046**	0.018**	0.3	-0.029**	0.002	0.010
49 to 53	(0.004)	(0.003)	(1.2)	(0.009)	(0.006)	(0.037)
Calendar time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Person fixed effects	No	No	Yes	Yes	Yes	Yes
Demographic × tenure controls	Yes	Yes	Yes	Yes	Yes	Yes
# of obs. (*N*)	560,223	560,223	779,283	941,984	941,984	941,984

* Significant at 5% level. ** Significant at 1% level.

Appendix Table B4. Effect of automatic enrollment on debt subcomponents: Constant sample of employees who were ever hired

Each column reports coefficients from a regression estimated according to equation (4) whose dependent variable is in the column heading. All dependent variables are normalized by first-year annualized salary. The coefficients correspond to the treatment effect of automatic enrollment at the tenure months indicated. Standard errors clustered at the employee level are in parentheses. The last row shows the number of person-months in each regression. The constant sample contains all employees who were ever hired, setting their contribution flows to zero after separation.

	HELOC revolving	Non-HELOC revolving	Other installment loans	Second mortgages	Student loans	External collections	Residual debt
Tenure ≤ -18	0.005	0.002	-0.003	0.003	-0.004	-0.001	0.001
	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)	(0.001)	(0.001)
Tenure -17 to -12	0.001	0.000	-0.003	0.000	-0.001	-0.001	0.000
	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.001)	(0.000)
Tenure -11 to -6	0.000	0.001	-0.003	-0.001	0.001	-0.001*	0.000
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.000)	(0.000)
Tenure 1 to 6	0.000	0.000	-0.003	0.002	0.000	0.000	0.000
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.000)	(0.000)
Tenure 7 to 12	0.000	-0.001	-0.005*	0.001	-0.002	0.000	0.001
	(0.002)	(0.001)	(0.003)	(0.002)	(0.002)	(0.001)	(0.000)
Tenure 13 to 18	-0.001	0.000	-0.006	0.001	-0.003	-0.001	0.001
	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.001)	(0.001)
Tenure 19 to 24	-0.001	0.000	-0.006	-0.001	-0.006*	-0.001	0.001
	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.001)	(0.001)
Tenure 25 to 30	-0.002	0.000	-0.005	-0.001	-0.007*	-0.001	0.002*
	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.001)	(0.001)
Tenure 31 to 36	-0.003	-0.001	-0.004	-0.001	-0.009*	-0.001	0.002*
	(0.003)	(0.003)	(0.004)	(0.003)	(0.004)	(0.001)	(0.001)
Tenure 37 to 42	-0.003	-0.001	-0.005	0.000	-0.009*	-0.001	0.002*
	(0.003)	(0.003)	(0.004)	(0.003)	(0.004)	(0.001)	(0.001)
Tenure 43 to 48	-0.005	-0.002	-0.006	-0.001	-0.011*	-0.001	0.001
	(0.003)	(0.003)	(0.004)	(0.003)	(0.005)	(0.001)	(0.001)
Tenure 49 to 53	-0.003	-0.003	-0.008*	0.000	-0.015**	-0.001	0.001
	(0.004)	(0.003)	(0.004)	(0.003)	(0.005)	(0.001)	(0.001)
Calendar time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Person fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Demographic × tenure controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
# of obs. (*N*)	941,984	941,984	941,984	941,984	941,984	941,984	941,984

* Significant at 5% level. ** Significant at 1% level.

Appendix Table B5. Effect of automatic enrollment on D1 subcomponents: Alternative specification

Each column reports coefficients from a regression whose dependent variable is in the column heading. The regressions are estimated according to equation (3), which omits controls for the interaction of demographics with tenure. The coefficients correspond to the treatment effect of automatic enrollment at the tenure months indicated. All dependent variables are normalized by first-year annualized salary. Standard errors clustered at the employee level are in parentheses. The last row shows the number of person-months in each regression.

	HELOC revolving	Non-HELOC revolving	Other installment loans	Second mortgages	Student loans	External collections	Residual debt
Tenure ≤ -18	0.005	0.002	-0.003	0.004	-0.005	-0.001	0.001
	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.001)	(0.001)
Tenure -17 to -12	0.001	0.000	-0.003	0.000	-0.003	-0.001	0.000
	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.001)	(0.000)
Tenure -11 to -6	-0.001	0.001	-0.003*	0.000	-0.001	-0.001*	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)
Tenure 1 to 6	0.000	0.000	-0.003*	0.002	0.002	0.000	0.000
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.000)	(0.000)
Tenure 7 to 12	0.001	-0.001	-0.006*	0.002	0.001	0.000	0.001
	(0.002)	(0.001)	(0.003)	(0.002)	(0.002)	(0.001)	(0.000)
Tenure 13 to 18	0.000	0.001	-0.006	0.002	0.001	-0.001	0.001
	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.001)	(0.001)
Tenure 19 to 24	0.000	0.002	-0.005	0.000	-0.001	0.000	0.001
	(0.002)	(0.002)	(0.004)	(0.003)	(0.003)	(0.001)	(0.001)
Tenure 25 to 30	-0.001	0.003	-0.005	0.002	0.001	0.000	0.001*
	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.001)	(0.001)
Tenure 31 to 36	-0.002	0.004	-0.002	0.002	0.001	-0.001	0.002*
	(0.003)	(0.003)	(0.004)	(0.003)	(0.004)	(0.001)	(0.001)
Tenure 37 to 42	-0.001	0.004	-0.004	0.004	0.004	-0.001	0.002*
	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.001)	(0.001)
Tenure 43 to 48	-0.002	0.005	-0.002	0.003	0.004	-0.002	0.002**
	(0.004)	(0.003)	(0.004)	(0.004)	(0.005)	(0.001)	(0.001)
Tenure 49 to 53	-0.001	0.004	-0.006	0.005	0.000	0.000	0.002
	(0.004)	(0.004)	(0.005)	(0.004)	(0.006)	(0.001)	(0.001)
Calendar time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Person fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Demographic × tenure controls	No	No	No	No	No	No	No
# of obs. (*N*)	809,385	809,385	809,385	809,385	809,385	809,385	809,385

* Significant at 5% level. ** Significant at 1% level.

Appendix Table B6. Effect of automatic enrollment on debt aggregates and cumulative TSP contributions net of debt aggregates: Alternative specification

The first three columns report coefficients from regressions estimated according to equation (4), where the dependent variable is in the column heading. D1 is debt excluding auto loans and first mortgages, D2 is auto loans plus D1, and D3 is first mortgages plus D2. The last three columns report the estimated treatment effects on cumulative TSP contributions minus the D1, D2, or D3 effect estimates, where the contribution effect estimates are taken from Table 2. All dependent variables are normalized by first-year annualized salary. Standard errors clustered at the employee level are in parentheses. The last row shows the number of person-months in the debt regressions. The NET1-NET3 results are derived from the 809,385 person-months used in the debt regressions and the 427,624 person-months used in the contribution regressions.

	D1	D2	D3	NET1	NET2	NET3
Tenure ≤ -18	0.002 (0.006)	0.002 (0.007)	0.010 (0.022)	--	--	--
Tenure -17 to -12	-0.005 (0.004)	-0.006 (0.005)	-0.022 (0.017)	--	--	--
Tenure -11 to -6	-0.005 (0.003)	-0.004 (0.003)	-0.021 (0.012)	--	--	--
Tenure 1 to 6	0.001 (0.003)	0.002 (0.004)	0.024 (0.013)	0.004 (0.003)	0.003 (0.004)	-0.019 (0.013)
Tenure 7 to 12	-0.002 (0.004)	0.000 (0.005)	0.015 (0.019)	0.012** (0.004)	0.010 (0.005)	-0.005 (0.019)
Tenure 13 to 18	-0.002 (0.005)	0.004 (0.007)	0.031 (0.024)	0.017** (0.006)	0.011 (0.007)	-0.016 (0.024)
Tenure 19 to 24	-0.004 (0.006)	0.003 (0.008)	0.017 (0.027)	0.024** (0.006)	0.018* (0.008)	0.003 (0.027)
Tenure 25 to 30	0.001 (0.007)	0.010 (0.009)	0.040 (0.031)	0.026** (0.007)	0.016 (0.009)	-0.013 (0.031)
Tenure 31 to 36	0.004 (0.008)	0.018 (0.010)	0.069* (0.034)	0.027** (0.008)	0.012 (0.010)	-0.038 (0.035)
Tenure 37 to 42	0.007 (0.008)	0.023* (0.011)	0.076* (0.038)	0.029** (0.009)	0.013 (0.011)	-0.040 (0.038)
Tenure 43 to 48	0.009 (0.009)	0.028* (0.011)	0.102* (0.041)	0.032** (0.010)	0.012 (0.012)	-0.061 (0.041)
Tenure 49 to 53	0.003 (0.010)	0.020 (0.013)	0.114* (0.047)	0.042** (0.011)	0.025 (0.014)	-0.069 (0.047)
Calendar time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Person fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Demographic × tenure controls	No	No	No	No	No	No
# of obs. (*N*)	809,385	809,385	809,385	--	--	--

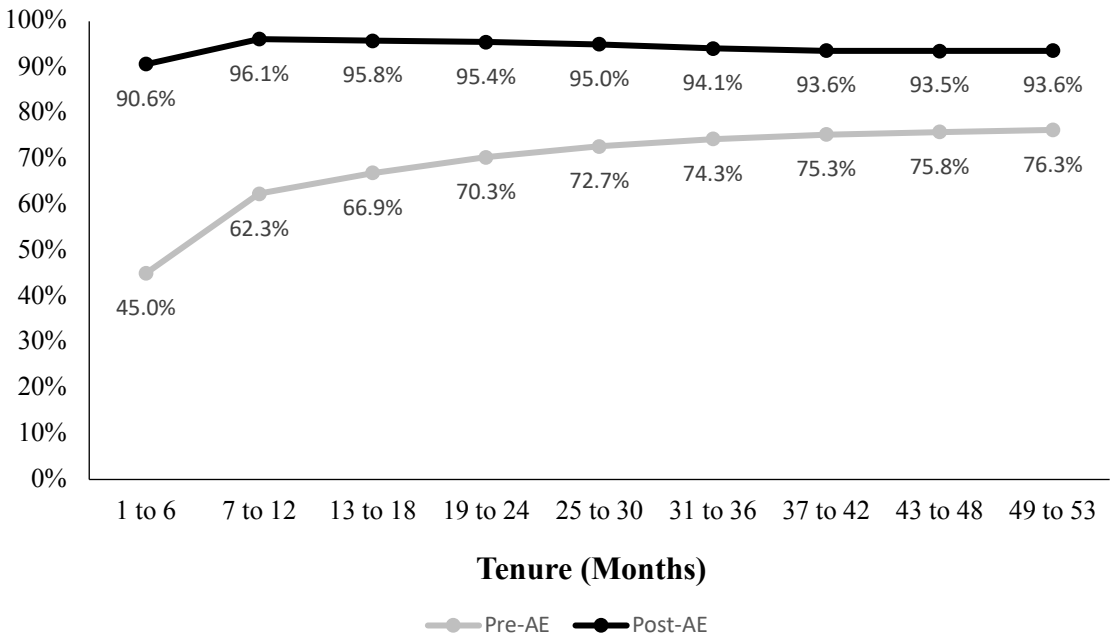
* Significant at 5% level. ** Significant at 1% level.

Appendix Table B7. Effect of automatic enrollment on subpopulations at 43-48 months of tenure: Alternative specification

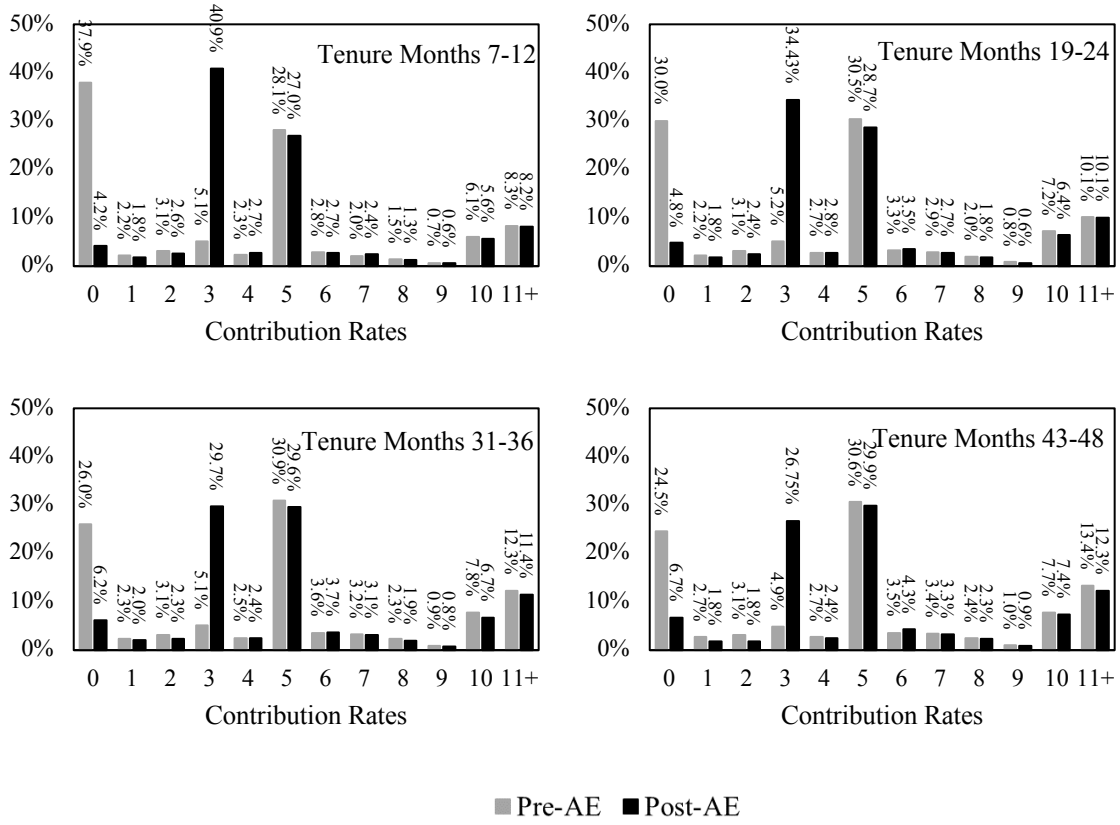
Each cell except those in the rows labeled NET1-NET3 contains an estimate from its own separate regression representing the treatment effect of automatic enrollment on the variable indicated in the row label at 43-48 months of tenure for the group in the column header. The contribution regressions are estimated according to equation (1), and the credit regressions are estimated according to equation (3), both of which omit controls for interactions between demographics and tenure. The cells in the NET1-NET3 rows show the difference between the automatic enrollment effect on cumulative total TSP contributions and its effect on D1-D3, respectively. D1 is debt excluding auto loans and first mortgages, D2 is auto loans plus D1, and D3 is first mortgages plus D2. All dependent variables except for Vantage credit score are normalized by first-year annualized salary. Standard errors clustered at the employee level are in parentheses.

	Salary < $34K	Age < 30	High school only	Baseline Vantage < 620	Black	Hispanic
Cumulative total TSP contributions	0.076**	0.043**	0.055**	0.075**	0.066**	0.057**
	(0.009)	(0.008)	(0.006)	(0.007)	(0.012)	(0.020)
Cumulative employee TSP contributions	0.030**	0.015*	0.021**	0.034**	0.025**	0.029
	(0.007)	(0.006)	(0.005)	(0.005)	(0.009)	(0.016)
Vantage credit score	2.2	-4.0	0.5	4.6	-0.5	1.5
	(3.4)	(2.9)	(1.9)	(3.1)	(4.1)	(7.4)
Auto loans and leases	0.049*	0.021	0.037**	0.037*	-0.002	0.007
	(0.022)	(0.014)	(0.011)	(0.018)	(0.022)	(0.035)
First mortgages	0.181	-0.058	0.170**	0.010	0.031	0.100
	(0.117)	(0.086)	(0.059)	(0.091)	(0.122)	(0.197)
D1 (debt excl. auto and first mortgages)	0.000	-0.015	0.021	0.048	-0.007	0.045
	(0.031)	(0.017)	(0.014)	(0.029)	(0.033)	(0.043)
D2	0.049	0.006	0.058**	0.085*	-0.009	0.052
	(0.040)	(0.024)	(0.018)	(0.036)	(0.041)	(0.056)
D3	0.229	-0.052	0.228**	0.095	0.022	0.152
	(0.129)	(0.092)	(0.065)	(0.105)	(0.135)	(0.214)
NET1	0.076*	0.058**	0.034*	0.027	0.074*	0.012
	(0.032)	(0.020)	(0.016)	(0.030)	(0.036)	(0.046)
NET2	0.027	0.037	-0.003	-0.010	0.075	0.004
	(0.041)	(0.026)	(0.019)	(0.037)	(0.044)	(0.059)
NET3	-0.154	0.095	-0.173*	-0.020	0.044	-0.095
	(0.128)	(0.092)	(0.066)	(0.108)	(0.136)	(0.213)
# of employees at 43-48 months	5,882	7,358	15,576	6,572	4,009	1,448

* Significant at 5% level. ** Significant at 1% level.



Appendix Figure B1. Participation rates in the TSP by cohort. Participation is defined as making a positive employee contribution to the TSP in the June or December when an individual reached the tenure level indicated on the horizontal axis. The pre-AE cohort consists of August 2009 – July 2010 hires, and the post-AE cohort consists of August 2010 – July 2011 hires. The sample at each tenure level consists of all those employed by the Army at that time.



Appendix Figure B2. Distributions of employee contribution rates by cohort. The employee contribution rate is the sum of employee before-tax and Roth contribution rates, expressed as percentages of pay, and is measured over the entirety of the June or the December when the employee reached the tenure level indicated. Contribution rates are rounded to whole numbers, and rates at or above 11% are grouped together. The pre-AE cohort consists of August 2009 – July 2010 hires, and the post-AE cohort consists of August 2010 – July 2011 hires. The sample at each tenure level consists of all those employed by the Army at that time.