Online Appendix:
The Impact of Income-Driven Repayment on Student Borrower Outcomes

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APPENDIX A Additional Tables and Figures

TABLE A1—FIRST STAGE: AGENT SCORE

	(1) IDR	(2) IDR
Agent Score	0.9824785***	0.9793459***
	(0.0758968)	(0.0763022)
Female		0.0216661***
		(0.0033447)
Amount Borrowed		0.0000781
		(0.0001706)
Age		−0.0007174***
		(0.0001447)
Lag Log Zip Median Income		−0.0112589***
		(0.0040471)
Lag Days Delinquent		−0.0003153***
		(0.0000571)
Lag Minimum Payment		−0.0120256
		(0.0130567)
Lag Remaining Balance		0.0002075
		(0.0001370)
Lag Credit Score		0.0002943***
		(0.0000322)
Lag Credit Card Balances		−0.0000165
		(0.0004440)
Lag Any Auto Trade		−0.0021182**
		(0.0008802)
Lag Any Mortgage		−0.0117710**
		(0.0054946)
Lag Mortgage Balances		−0.0001023***
		(0.0000266)
Lag Number of Credit Cards		0.0024366***
		(0.0006036)
Lag Credit Card Limits		−0.0009426***
		(0.0001886)
Mean Dep.	0.101	0.101
F-stat	167.57	164.74
P-value	0.0000	0.0000
R-squared	0.029	0.035
N	49775	49775

Note: This table reports first-stage results. The regressions are estimated on the analysis sample described in the notes to Table 1. Columns 1 and 2 report estimated coefficients from an OLS regression of IDR take-up within four months of a delinquency calls against the variables listed, as well as agent modeling propensity and call year, month, and hour fixed effects. Agent score and modeling propensity are estimated using data from other phone calls placed by the same agent following the procedure described in Section III. Robust standard errors two-way clustered at the borrower and agent level are reported in parentheses. *** = significant at 1 percent level, ** = significant at 5 percent level, * = significant at 10 percent level.

	(1) IDR*100	(2) Agent Score*100	(3) E-sign Agent*100
Female	2.205695***	0.039912	0.135737
	(0.338451)	(0.042871)	(0.425478)
Amount Borrowed	0.007380	−0.000435	−0.001996
	(0.017185)	(0.001973)	(0.017111)
Age	−0.072056***	−0.000326	−0.004072
	(0.014794)	(0.001779)	(0.011607)
Lag Log Zip Median Income	−1.131933***	−0.006176	0.141749
	(0.401661)	(0.034544)	(0.402885)
Lag Days Delinquent	−0.030383***	0.001167	0.011680
	(0.005705)	(0.001020)	(0.009861)
Lag Minimum Payment	−1.079749	0.125400	−0.734388
	(1.306655)	(0.161310)	(1.651780)
Lag Remaining Balance	0.019308	−0.001476	−0.002276
	(0.013742)	(0.001356)	(0.017757)
Lag Credit Score	0.029467***	0.000043	0.004579
	(0.003242)	(0.000266)	(0.002998)
Lag Credit Card Balances	−0.000565	0.001102	0.062486
	(0.044063)	(0.005749)	(0.043517)
Lag Any Auto Trade	−0.228004**	−0.016527**	−0.052896
	(0.088646)	(0.007289)	(0.083494)
Lag Any Mortgage	−1.124525**	0.053680	0.851403
	(0.558120)	(0.069546)	(0.760712)
Lag Mortgage Balances	−0.010640***	−0.000417	−0.006184
	(0.002653)	(0.000378)	(0.003781)
Lag Number of Credit Cards	0.234775***	−0.009072	0.001224
	(0.060184)	(0.007980)	(0.068911)
Lag Credit Card Limits	−0.095446***	−0.001207	−0.046662***
	(0.018858)	(0.002144)	(0.017151)
Mean Dep.	10.114	0.113	12.247
F-stat	22.08	1.11	1.04
P-value	0.0000	0.3494	0.4108
R-squared	0.022	0.017	0.066
N	49775	49775	49775

Note: This table reports balance test results. The regressions are estimated on the analysis sample described in the notes to Table 1. Column 1 reports the estimated coefficients from an OLS regression of agent score multiplied by 100 against the variables listed, as well as agent modeling propensity and call year, month, and hour fixed effects. Agent score and modeling propensity are estimated using data from other phone calls placed by the same agent following the procedure described in Section III. Column 2 reports estimates from an identical regression, except with the dependent variable equal to realized IDR take-up as of six months after the call, multiplied by 100. Robust standard errors two-way clustered at the borrower and agent level are reported in parentheses. The p-value reported at the bottom of columns 1-2 is for an F-test of the joint significance of the variables listed on the left. *** = significant at 1 percent level, ** = significant at 5 percent level, * = significant at 10 percent level.

Table A3—First Stage by Subgroup

	Gender		Age		Amount Borrowed		Credit Score	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	IDR	IDR	IDR	IDR	IDR	IDR	IDR	IDR
Agent Score	1.093***	0.708***	0.905***	1.075***	1.136***	0.970***	0.958***	0.996***
	(0.084)	(0.105)	(0.079)	(0.093)	(0.157)	(0.080)	(0.087)	(0.085)
Subsample	Women	Men	> 40	≤ 40	> 50K	≤ 50K	> 600	≤ 600
Mean Dep.	0.107	0.086	0.092	0.113	0.103	0.101	0.112	0.093
Controls?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
F-stat	167.81	45.87	132.13	134.88	52.39	147.87	120.13	137.58
P-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
R-squared	0.037	0.031	0.033	0.039	0.067	0.034	0.040	0.032
N	35326	14449	27629	22146	2961	46814	20853	28922

Note: This table reports first-stage results by subgroup. The regressions are estimated on subsamples defined by applying the criteria in the "Subsample" row to the analysis sample described in the notes to Table 1. Agent score is estimated using data from all other phone calls placed by the same agent following the procedure described in Section III. IDR is an indicator for IDR take-up as of six months after the call. Robust standard errors two-way clustered at the borrower and agent level are reported in parentheses. *** = significant at 1 percent level, ** = significant at 5 percent level, * = significant at 10 percent level.

TABLE A4—AGENT AND E-SIGN IV ESTIMATES OF THE EFFECT OF IDR ENROLLMENT ON REPAYMENT OUTCOMES

Dependent Variable	(1) Mean $t=-1$	Agent Score IV					E-Sign IV				
		(2) Mo. 6-8	(3) Mo. 9-11	(4) Mo. 12-14	(5) Mo. 15-17	(6) Mo. 18-20	(7) Mo. 6-8	(8) Mo. 9-11	(9) Mo. 12-14	(10) Mo. 15-17	(11) Mo. 18-20
Minimum Payment	0.212	−0.172***	−0.166***	−0.040***	0.022*	0.010	−0.168***	−0.158***	−0.018	0.046***	0.042***
		(0.010)	(0.011)	(0.011)	(0.011)	(0.013)	(0.008)	(0.010)	(0.013)	(0.015)	(0.014)
Remaining Balance	23.843	−0.370***	−0.529***	−0.245**	−0.259*	−0.275	−0.527***	−0.688***	−0.391***	−0.370**	−0.411**
		(0.066)	(0.090)	(0.110)	(0.133)	(0.172)	(0.072)	(0.104)	(0.129)	(0.149)	(0.177)
Δ Remaining Balance	0.004	−0.036**	0.007	0.114***	−0.011	−0.007	−0.075***	0.017	0.122***	−0.013	−0.016
		(0.015)	(0.019)	(0.020)	(0.018)	(0.025)	(0.015)	(0.024)	(0.019)	(0.018)	(0.019)
10+ Days Delinquent	0.658	−0.218***	−0.221***	0.068**	0.113**	0.051	−0.231***	−0.296***	0.012	0.021	0.029
		(0.036)	(0.041)	(0.033)	(0.050)	(0.035)	(0.036)	(0.041)	(0.037)	(0.042)	(0.042)
90+ Days Delinquent	0.045	−0.045*	−0.047**	−0.016	0.091***	0.058*	−0.043*	−0.063***	−0.060**	0.014	−0.001
		(0.026)	(0.022)	(0.025)	(0.033)	(0.032)	(0.026)	(0.024)	(0.025)	(0.034)	(0.029)
270+ Days Delinquent	0.000	0.000	0.002	−0.014	0.005	0.025**	0.000	0.001	−0.002	−0.010	0.010
		(0.001)	(0.001)	(0.010)	(0.006)	(0.012)	(0.001)	(0.002)	(0.011)	(0.007)	(0.012)
Call Time FE		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	49775	149325	149325	149325	149325	149325	149325	149325	149325	149325	149325

Note: This table reports two-stage least squares estimates of the effect of IDR enrollment on monthly loan repayment outcomes. Column 1 reports the dependent variable mean in the month prior to receiving a delinquency call. Each of columns 2-11 reports estimates from a separate 2SLS regression on outcomes in the indicated three-month period following the delinquency call. To instrument for IDR enrollment, columns 2-6 use agent score, as defined in Section III, while columns 7 - 11 use an indicator for whether the assigned agent was able to facilitate electronic IDR sign-up ("e-sign"). All regressions include fixed effects for call year, month, day-of-week, and hour-of-day, as well as controls for initial amount borrowed, number of previous calls, inferred gender, pre-call debt balance and pre-call zip-median income. Regressions also control for agent modeling propensity following the procedure described in Section III. Robust standard errors are two-way clustered at the borrower and agent levels. *** = significant at 1 percent level, ** = significant at 5 percent level, * = significant at 10 percent level.

TABLE A5—DIFFERENCE-IN-DIFFERENCES ESTIMATES OF THE EFFECT OF IDR ENROLLMENT ON REPAYMENT OUTCOMES

		Diff-in-Diff					Diff-in-Diff w/Trend				
Dependent Variable	(1) Mean $t = -1$	(2) Mo. 6-8	(3) Mo. 9-11	(4) Mo. 12-14	(5) Mo. 15-17	(6) Mo. 18-20	(7) Mo. 6-8	(8) Mo. 9-11	(9) Mo. 12-14	(10) Mo. 15-17	(11) Mo. 18-20
Minimum Payment	0.212	−0.182***	−0.176***	−0.107***	−0.028***	−0.043***	−0.182***	−0.176***	−0.107***	−0.028***	−0.043***
		(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)
Remaining Balance	23.843	−0.433***	−0.696***	−0.662***	−0.621***	−0.756***	−0.409***	−0.672***	−0.638***	−0.597***	−0.732***
		(0.010)	(0.011)	(0.016)	(0.021)	(0.024)	(0.008)	(0.009)	(0.014)	(0.019)	(0.022)
Δ Remaining Balance	0.004	−0.046***	−0.048***	0.067***	−0.008**	−0.038***	−0.049***	−0.051***	0.065***	−0.010***	−0.041***
		(0.002)	(0.002)	(0.004)	(0.003)	(0.003)	(0.002)	(0.002)	(0.004)	(0.003)	(0.002)
10+ Days Delinquent	0.658	−0.191***	−0.232***	−0.114***	−0.049***	−0.066***	−0.205***	−0.246***	−0.127***	−0.063***	−0.080***
		(0.007)	(0.007)	(0.007)	(0.008)	(0.008)	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)
90+ Days Delinquent	0.045	−0.075***	−0.060***	−0.073***	−0.040***	−0.026***	−0.083***	−0.068***	−0.081***	−0.048***	−0.034***
		(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.002)	(0.002)	(0.002)	(0.003)	(0.004)
270+ Days Delinquent	0.000	−0.000***	0.000	−0.010***	−0.008***	−0.015***	0.001	0.001**	−0.009***	−0.007***	−0.014***
		(0.000)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)

Note: This table reports difference-in-differences estimates of the effect of IDR enrollment on monthly loan repayment outcomes. Column 1 reports the dependent variable mean in the month prior to receiving a delinquency call. Columns 2-6 report coefficients on the effect of IDR enrollment in consecutive three-month periods following the delinquency call from the pooled OLS regression specified in Equation 7. Regressions are estimated on post-2016 calls from the analysis sample as described in the notes to Table 1, limited to a yearly panel with 20 leads and 10 lags. Sample size is 1,543,025 observations from 49,775 calls. All regressions include fixed effects for call year, month, day-of-week, and hour-of-day, as well as individual fixed effects. Regressions also control for initial amount borrowed, number of previous calls, inferred gender, pre-call debt balance and pre-call zip-median income. Robust standard errors are clustered at the borrower level. *** = significant at 1 percent level, ** = significant at 5 percent level, * = significant at 10 percent level.

Table A6—Difference-in-Differences and Instrumental Variables Estimates of the Effect of IDR Enrollment on Repayment Outcomes: Predicted Non-Zero Payments

Dependent Variable	(1) Mean $t = -1$	Difference-in-Differences					Instrumental Variables				
		(2) Mo. 6-8	(3) Mo. 9-11	(4) Mo. 12-14	(5) Mo. 15-17	(6) Mo. 18-20	(7) Mo. 6-8	(8) Mo. 9-11	(9) Mo. 12-14	(10) Mo. 15-17	(11) Mo. 18-20
Minimum Payment	0.579	−0.386***	−0.374***	−0.252***	−0.105***	−0.133***	−0.405***	−0.404***	−0.171*	0.040	−0.048
		(0.014)	(0.014)	(0.014)	(0.016)	(0.016)	(0.076)	(0.079)	(0.103)	(0.101)	(0.111)
Remaining Balance	49.672	−0.916***	−1.448***	−1.443***	−1.380***	−1.648***	−0.679*	−0.923	−0.053	−0.413	−0.176
		(0.047)	(0.055)	(0.080)	(0.106)	(0.123)	(0.404)	(0.577)	(0.664)	(0.795)	(0.929)
Δ Remaining Balance	0.002	−0.118***	−0.131***	0.099***	−0.018	−0.078***	−0.088	−0.070	0.333**	−0.192	0.113
		(0.009)	(0.011)	(0.021)	(0.015)	(0.012)	(0.118)	(0.130)	(0.132)	(0.119)	(0.113)
10+ Days Delinquent	0.713	−0.156***	−0.186***	−0.087***	−0.027	−0.040	−0.068	−0.286	0.157	0.128	−0.058
		(0.025)	(0.025)	(0.026)	(0.028)	(0.028)	(0.164)	(0.175)	(0.133)	(0.158)	(0.160)
90+ Days Delinquent	0.063	−0.058***	−0.050***	−0.054***	−0.022	−0.022	0.107	0.113	0.062	0.051	0.036
		(0.013)	(0.013)	(0.013)	(0.014)	(0.016)	(0.112)	(0.104)	(0.131)	(0.123)	(0.132)
270+ Days Delinquent	0.000	−0.000	−0.000	−0.005*	−0.002	−0.007**	0.000	0.000	0.030	0.011	0.027
		(.)	(.)	(0.003)	(0.003)	(0.003)	(.)	(.)	(0.046)	(0.028)	(0.057)
Call Time FE		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	4095	126945	126945	126945	126945	126945	12285	12285	12285	12285	12285

Note: This table reports difference-in-differences and two-stage least squares estimates of the effect of IDR enrollment on monthly loan repayment for those predicted to have non-zero IDR payments. Column 1 reports the dependent variable mean in the month prior to receiving a delinquency call. Columns 2-6 report coefficients on the effect of IDR enrollment in consecutive three-month periods following the delinquency call from the pooled OLS regression specified in Equation 7. Each of Columns 7 - 11 report estimates from separate two-stage least squares regressions on outcomes in the same months. Regressions are estimated on the analysis sample described in the notes to Table 1, limited to borrowers with predicted IDR payments greater than zero in a monthly panel with 20 leads and 10 lags. All regressions include fixed effects for call year, month, day-of-week, and hour-of-day, as well as controls for for initial amount borrowed, number of previous calls, inferred gender, pre-call debt balance and pre-call zip-median income. IV estimates also control for agent modeling propensity (see Section III), and difference-in-differences regressions include individual fixed effects. Robust standard errors are two-way clustered at the borrower and agent levels for IV estimates and one-way clustered at the borrower level for difference-in-differences estimates. *** = significant at 1 percent level, ** = significant at 5 percent level, * = significant at 10 percent level.

Table A7—Difference-in-Differences and Instrumental Variables Estimates of the Effect of IDR Enrollment on Repayment Outcomes, Including Non-Modeled Borrowers

		Difference-in-Differences					Instrumental Variables				
Dependent Variable	(1) Mean $t = -1$	(2) Mo. 6-8	(3) Mo. 9-11	(4) Mo. 12-14	(5) Mo. 15-17	(6) Mo. 18-20	(7) Mo. 6-8	(8) Mo. 9-11	(9) Mo. 12-14	(10) Mo. 15-17	(11) Mo. 18-20
Minimum Payment	0.197	−0.188*** (0.002)	−0.186*** (0.002)	−0.120*** (0.002)	−0.038*** (0.002)	−0.050*** (0.003)	−0.163*** (0.012)	−0.147*** (0.015)	−0.001 (0.018)	0.064*** (0.019)	0.033** (0.017)
Remaining Balance	22.450	0.043** (0.020)	−0.101*** (0.024)	0.084*** (0.031)	0.314*** (0.036)	0.329*** (0.045)	−0.244 (0.364)	−0.335 (0.435)	0.274 (0.517)	−0.021 (0.655)	−1.199 (0.995)
Δ Remaining Balance	-0.003	−0.014*** (0.002)	−0.010*** (0.002)	0.096*** (0.003)	0.034*** (0.003)	0.003 (0.002)	−0.038 (0.026)	0.001 (0.031)	0.127*** (0.027)	−0.044 (0.034)	−0.013 (0.039)
10+ Days Delinquent	0.647	−0.190*** (0.006)	−0.211*** (0.006)	−0.114*** (0.006)	−0.046*** (0.007)	−0.058*** (0.007)	−0.174*** (0.067)	−0.243*** (0.080)	0.035 (0.055)	0.202** (0.089)	0.096* (0.055)
90+ Days Delinquent	0.037	−0.059*** (0.003)	−0.056*** (0.003)	−0.065*** (0.003)	−0.038*** (0.003)	−0.021*** (0.003)	−0.005 (0.038)	−0.044 (0.050)	−0.009 (0.054)	0.107** (0.050)	0.075 (0.053)
270+ Days Delinquent	0.000	−0.001*** (0.000)	−0.001*** (0.000)	−0.006*** (0.000)	−0.007*** (0.000)	−0.011*** (0.000)	−0.004 (0.006)	−0.004 (0.006)	−0.013 (0.014)	0.009 (0.014)	0.005 (0.016)
Call Time FE		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	169467	5253477	5253477	5253477	5253477	5253477	499437	499437	499437	499437	499437

Note: This table reports difference-in-differences and two-stage least squares estimates of the effect of IDR enrollment on monthly loan repayment outcomes following both modeled and non-modeled delinquency calls. Column 1 reports the dependent variable mean in the month prior to receiving a delinquency call. Columns 2-6 report coefficients on the effect of IDR enrollment in consecutive three-month periods following the delinquency call from the pooled OLS regression specified in Equation 7. Each of Columns 7 - 11 report estimates from separate two-stage least squares regressions on outcomes in the same months. Regressions are estimated on the sample of both modeled and non-modeled calls satisfying all other selection criteria outlined in Section II, limited to a monthly panel with 20 leads and 10 lags. All regressions include fixed effects for call year, month, day-of-week, and hour-of-day, as well as controls for initial amount borrowed, number of previous calls, inferred gender, pre-call debt balance and pre-call zip-median income. *** = significant at 1 percent level, ** = significant at 5 percent level, * = significant at 10 percent level.

TABLE A8—DIFFERENCE-IN-DIFFERENCES AND INSTRUMENTAL VARIABLES ESTIMATES OF THE EFFECT OF IDR ENROLLMENT AS OF MONTH THREE ON REPAYMENT OUTCOMES

		Difference-in-Differences					Instrumental Variables				
Dependent Variable	(1) Mean $t = -1$	(2) Mo. 6-8	(3) Mo. 9-11	(4) Mo. 12-14	(5) Mo. 15-17	(6) Mo. 18-20	(7) Mo. 6-8	(8) Mo. 9-11	(9) Mo. 12-14	(10) Mo. 15-17	(11) Mo. 18-20
Minimum Payment	0.231	−0.192***	−0.187***	−0.099***	−0.018***	−0.047***	−0.186***	−0.173***	−0.030**	0.040***	0.022*
		(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.008)	(0.011)	(0.012)	(0.013)	(0.013)
Remaining Balance	26.199	−0.494***	−0.794***	−0.681***	−0.628***	−0.728***	−0.130	−0.374	0.057	−0.119	−0.718
		(0.025)	(0.032)	(0.042)	(0.048)	(0.056)	(0.203)	(0.266)	(0.289)	(0.315)	(0.457)
Δ Remaining Balance	0.005	−0.047***	−0.047***	0.086***	−0.027***	−0.037***	−0.037**	−0.005	0.121***	0.005	−0.010
		(0.002)	(0.003)	(0.004)	(0.003)	(0.003)	(0.016)	(0.020)	(0.022)	(0.019)	(0.028)
10+ Days Delinquent	0.659	−0.193***	−0.235***	−0.104***	−0.051***	−0.071***	−0.198***	−0.209***	0.071**	0.099**	0.054
		(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.034)	(0.038)	(0.031)	(0.049)	(0.039)
90+ Days Delinquent	0.045	−0.077***	−0.063***	−0.076***	−0.039***	−0.028***	−0.039	−0.046**	−0.018	0.074**	0.048
		(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.024)	(0.023)	(0.024)	(0.033)	(0.033)
270+ Days Delinquent	0.000	−0.000***	0.000	−0.011***	−0.009***	−0.015***	−0.001	0.001	−0.014	0.009	0.024*
		(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.010)	(0.007)	(0.012)
Call Time FE		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	52704	1633824	1633824	1633824	1633824	1633824	158112	158112	158112	158112	158112

Note: This table reports difference-in-differences and two-stage least squares estimates of the effect of IDR enrollment three months after a delinquency call on monthly loan repayment outcomes. Column 1 reports the dependent variable mean in the month prior to receiving a delinquency call. Columns 2-6 report coefficients on the effect of IDR enrollment in consecutive three-month periods following the delinquency call from the pooled OLS regression specified in Equation 7. Each of Columns 7 - 11 report estimates from separate two-stage least squares regressions on outcomes in the same months. Regressions are estimated on the analysis sample described in the notes to Table 1, limited to a monthly panel with 20 leads and 10 lags. All regressions include fixed effects for call year, month, day-of-week, and hour-of-day, as well as controls for for initial amount borrowed, number of previous calls, inferred gender, pre-call debt balance and pre-call zip-median income. IV estimates also control for agent modeling propensity (see Section III), and difference-in-differences regressions include individual fixed effects. Robust standard errors are two-way clustered at the borrower and agent levels for IV estimates and one-way clustered at the borrower level for difference-in-differences estimates. *** = significant at 1 percent level, ** = significant at 5 percent level, * = significant at 10 percent level.

Table A9—Difference-in-Differences and Instrumental Variables Estimates of the Effect of IDR Enrollment as of Month Five on Repayment Outcomes

		Difference-in-Differences					Instrumental Variables				
Dependent Variable	(1) Mean $t = -1$	(2) Mo. 6-8	(3) Mo. 9-11	(4) Mo. 12-14	(5) Mo. 15-17	(6) Mo. 18-20	(7) Mo. 6-8	(8) Mo. 9-11	(9) Mo. 12-14	(10) Mo. 15-17	(11) Mo. 18-20
Minimum Payment	0.231	−0.205***	−0.199***	−0.132***	−0.049***	−0.038***	−0.188***	−0.176***	−0.030**	0.043***	0.024*
		(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.009)	(0.012)	(0.013)	(0.014)	(0.014)
Remaining Balance	26.199	−0.367***	−0.678***	−0.673***	−0.569***	−0.605***	−0.090	−0.314	0.165	−0.025	−0.622
		(0.024)	(0.029)	(0.036)	(0.042)	(0.052)	(0.206)	(0.270)	(0.291)	(0.333)	(0.494)
Δ Remaining Balance	0.005	−0.047***	−0.051***	0.050***	0.018***	−0.035***	−0.043**	0.002	0.112***	0.007	−0.011
		(0.002)	(0.002)	(0.004)	(0.003)	(0.003)	(0.017)	(0.021)	(0.021)	(0.020)	(0.027)
10+ Days Delinquent	0.659	−0.186***	−0.230***	−0.126***	−0.064***	−0.054***	−0.199***	−0.209***	0.066*	0.113**	0.048
		(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.038)	(0.040)	(0.035)	(0.052)	(0.040)
90+ Days Delinquent	0.045	−0.076***	−0.061***	−0.074***	−0.046***	−0.033***	−0.029	−0.046*	−0.020	0.078**	0.047
		(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.028)	(0.024)	(0.026)	(0.033)	(0.034)
270+ Days Delinquent	0.000	−0.000***	0.000	−0.011***	−0.009***	−0.016***	−0.001	0.001	−0.016	0.008	0.023*
		(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.011)	(0.007)	(0.013)
Call Time FE		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	52704	1633824	1633824	1633824	1633824	1633824	158112	158112	158112	158112	158112

Note: This table reports difference-in-differences and two-stage least squares estimates of the effect of IDR enrollment five months after a delinquency call on monthly loan repayment outcomes. Column 1 reports the dependent variable mean in the month prior to receiving a delinquency call. Columns 2-6 report coefficients on the effect of IDR enrollment in consecutive three-month periods following the delinquency call from the pooled OLS regression specified in Equation 7. Each of Columns 7 - 11 report estimates from separate two-stage least squares regressions on outcomes in the same months. Regressions are estimated on the analysis sample described in the notes to Table 1, limited to a monthly panel with 20 leads and 10 lags. All regressions include fixed effects for call year, month, day-of-week, and hour-of-day, as well as controls for for initial amount borrowed, number of previous calls, inferred gender, pre-call debt balance and pre-call zip-median income. IV estimates also control for agent modeling propensity (see Section III), and difference-in-differences regressions include individual fixed effects. Robust standard errors are two-way clustered at the borrower and agent levels for IV estimates and one-way clustered at the borrower level for difference-in-differences estimates. *** = significant at 1 percent level, ** = significant at 5 percent level, * = significant at 10 percent level.

Dependent Variable	(1) Mean $t = -1$	Difference-in-Differences					Instrumental Variables				
		(2) Mo. 6-8	(3) Mo. 9-11	(4) Mo. 12-14	(5) Mo. 15-17	(6) Mo. 18-20	(7) Mo. 6-8	(8) Mo. 9-11	(9) Mo. 12-14	(10) Mo. 15-17	(11) Mo. 18-20
Minimum Payment	0.217	−0.189***	−0.184***	−0.112***	−0.020***	−0.034***	−0.180***	−0.172***	−0.062***	0.009	0.005
		(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.009)	(0.010)	(0.012)	(0.012)	(0.013)
Remaining Balance	25.795	−0.334***	−0.584***	−0.535***	−0.475***	−0.585***	−0.361***	−0.555***	−0.345***	−0.383***	−0.438***
		(0.007)	(0.009)	(0.012)	(0.016)	(0.018)	(0.061)	(0.090)	(0.110)	(0.139)	(0.169)
Δ Remaining Balance	0.012	−0.044***	−0.040***	0.075***	−0.003	−0.032***	−0.045***	0.010	0.091***	−0.019	−0.007
		(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.014)	(0.019)	(0.018)	(0.019)	(0.020)
10+ Days Delinquent	0.785	−0.232***	−0.229***	−0.132***	−0.061***	−0.086***	−0.187***	−0.218***	0.072*	0.111**	0.074*
		(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.041)	(0.036)	(0.037)	(0.044)	(0.041)
90+ Days Delinquent	0.056	−0.088***	−0.066***	−0.068***	−0.044***	−0.029***	−0.013	−0.019	0.011	0.114***	0.092***
		(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.033)	(0.026)	(0.025)	(0.030)	(0.032)
270+ Days Delinquent	0.000	−0.001***	−0.002***	−0.008***	−0.007***	−0.012***	0.008***	0.008**	−0.003	0.001	0.029***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.003)	(0.003)	(0.010)	(0.006)	(0.011)
Call Time FE		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	134170	4159270	4159270	4159270	4159270	4159270	402510	402510	402510	402510	402510

Note: This table reports difference-in-differences and two-stage least squares estimates of the effect of IDR enrollment on monthly loan repayment, including pre-2016 calls. Column 1 reports the dependent variable mean in the month prior to receiving a delinquency call. Columns 2-6 report coefficients on the effect of IDR enrollment in consecutive three-month periods following the delinquency call from the pooled OLS regression specified in Equation 7. Each of Columns 7 - 11 report estimates from separate two-stage least squares regressions on outcomes in the same months. Regressions are estimated on the analysis sample described in the notes to Table 1, expanded to include pre-2016 calls and limited to a monthly panel with 20 leads and 10 lags. All regressions include fixed effects for call year, month, day-of-week, and hour-of-day, as well as controls for for initial amount borrowed, number of previous calls, inferred gender, pre-call debt balance and pre-call zip-median income. IV estimates also control for agent modeling propensity (see Section III), and difference-in-differences regressions include individual fixed effects. Robust standard errors are two-way clustered at the borrower and agent levels for IV estimates and one-way clustered at the borrower level for difference-in-differences estimates. *** = significant at 1 percent level, ** = significant at 5 percent level, * = significant at 10 percent level.

TABLE A11—INSTRUMENTAL VARIABLES ESTIMATES OF THE EFFECT OF IDR ENROLLMENT ON REPAYMENT OUTCOMES: POST-2016 INSTRUMENT CONSTRUCTION

	(1)	Agent Score IV					Late-Call Agent Score IV				
Dependent Variable	Mean $t=-1$	(2) Mo. 6-8	(3) Mo. 9-11	(4) Mo. 12-14	(5) Mo. 15-17	(6) Mo. 18-20	(7) Mo. 6-8	(8) Mo. 9-11	(9) Mo. 12-14	(10) Mo. 15-17	(11) Mo. 18-20
Minimum Payment	0.212	−0.172***	−0.166***	−0.040***	0.022*	0.010	−0.168***	−0.158***	−0.018	0.046***	0.042***
		(0.010)	(0.011)	(0.011)	(0.011)	(0.013)	(0.008)	(0.010)	(0.013)	(0.015)	(0.014)
Remaining Balance	23.843	−0.370***	−0.529***	−0.245**	−0.259*	−0.275	−0.527***	−0.688***	−0.391***	−0.370**	−0.411**
		(0.066)	(0.090)	(0.110)	(0.134)	(0.173)	(0.071)	(0.104)	(0.128)	(0.149)	(0.177)
Δ Remaining Balance	0.004	−0.036**	0.007	0.114***	−0.011	−0.007	−0.075***	0.017	0.122***	−0.013	−0.016
		(0.015)	(0.019)	(0.019)	(0.018)	(0.025)	(0.015)	(0.024)	(0.019)	(0.018)	(0.019)
10+ Days Delinquent	0.658	−0.218***	−0.221***	0.068**	0.113**	0.051	−0.231***	−0.296***	0.012	0.021	0.029
		(0.036)	(0.041)	(0.033)	(0.050)	(0.035)	(0.036)	(0.041)	(0.042)	(0.042)	(0.042)
90+ Days Delinquent	0.045	−0.045*	−0.047**	−0.016	0.091***	0.058*	−0.043*	−0.063***	−0.060**	0.014	−0.001
		(0.026)	(0.022)	(0.025)	(0.033)	(0.032)	(0.026)	(0.024)	(0.025)	(0.034)	(0.029)
270+ Days Delinquent	0.000	0.000	0.002	−0.014	0.005	0.025**	0.000	0.001	−0.002	−0.010	0.010
		(0.001)	(0.001)	(0.010)	(0.006)	(0.012)	(0.001)	(0.002)	(0.011)	(0.007)	(0.012)
Call Time FE		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	49775	149325	149325	149325	149325	149325	149325	149325	149325	149325	149325

Note: This table reports two-stage least squares estimates of the effect of IDR enrollment on monthly loan repayment outcomes. Column 1 reports the dependent variable mean in the month prior to receiving a delinquency call. Each of columns 2-11 reports estimates from a separate 2SLS regression on outcomes in the indicated three-month period following the delinquency call. To instrument for IDR enrollment, columns 2-6 use agent score, as defined in Section III, constructed using only post-2016 calls. Columns 7 - 11 use an indicator for whether the assigned agent was able to facilitate electronic IDR sign-up ("e-sign"). All regressions are estimated on the analysis sample described in the notes to Table 1, limited to a monthly panel with 20 leads and 10 lags. All regressions include fixed effects for call year, month, day-of-week, and hour-of-day, as well as controls for initial amount borrowed, number of previous calls, inferred gender, pre-call debt balance and pre-call zip-median income. Regressions also control for agent modeling propensity following the procedure described in Section III. Robust standard errors are two-way clustered at the borrower and agent levels. *** = significant at 1 percent level, ** = significant at 5 percent level, * = significant at 10 percent level.

TABLE A12—DIFFERENCE-IN-DIFFERENCES ESTIMATES OF THE EFFECT OF IDR ENROLLMENT ON CREDIT SCORE AND MORTGAGES

		Diff-in-Diff					Diff-in-Diff w/Trend				
Dependent Variable	(1) Mean $t = -1$	(2) Year 0	(3) Year 1	(4) Year 2	(5) Year 3	(6) Year 4	(7) Year 0	(8) Year 1	(9) Year 2	(10) Year 3	(11) Year 4
Credit Score	596.524	6.652*** (0.883)	7.228*** (1.131)	5.740*** (1.350)	5.591*** (1.422)	5.396*** (1.500)	7.144*** (1.297)	7.720*** (1.494)	6.232*** (1.675)	6.083*** (1.737)	5.888*** (1.813)
Any Mortgage	0.223	−0.002 (0.004)	0.011** (0.005)	0.019*** (0.006)	0.020*** (0.007)	0.019** (0.008)	−0.002 (0.005)	0.011* (0.006)	0.019** (0.007)	0.020** (0.008)	0.019** (0.008)

Note: This table reports difference-in-differences estimates of the effect of IDR enrollment on credit scores and mortgages. Column 1 reports the dependent variable mean in the year prior to receiving a delinquency call. Columns 2-6 report coefficients on the effect of IDR enrollment in consecutive years following the delinquency call from the pooled OLS regression specified in Equation 7. Columns 7 - 11 report coefficients on the same yearly effect for a regression which omits pre-call year dummies and includes a linear time trend. The regressions are estimated on the analysis sample as described in the notes to Table 1, limited to a yearly panel with 4 leads and 3 lags. All regressions include fixed effects for call year, month, day-of-week, and hour-of-day, as well as individual fixed effects. Regressions also control for initial amount borrowed, number of previous calls, inferred gender, pre-call debt balance and pre-call zip-median income. Robust standard errors are clustered at the borrower level. *** = significant at 1 percent level, ** = significant at 5 percent level, * = significant at 10 percent level.

TABLE A13—DIFFERENCE-IN-DIFFERENCES ESTIMATES OF THE EFFECT OF IDR ENROLLMENT ON ZIP-MEDIAN INCOME

		Diff-in-Diff			Diff-in-Diff w/Trend		
Dependent Variable	(1) Mean $t = -1$	(2) Year 1	(3) Year 2	(4) Year 3	(5) Year 1	(6) Year 2	(7) Year 3
Higher-Income Zip	0.000	0.014*** (0.005)	0.014** (0.005)	0.018*** (0.006)	0.014*** (0.005)	0.014** (0.006)	0.019*** (0.006)
Log Zip Median Income	3.905	0.002 (0.003)	0.003 (0.004)	0.007* (0.004)	0.002 (0.003)	0.003 (0.004)	0.007* (0.004)

Note: This table reports difference-in-differences and two-stage least squares estimates of the effect of IDR enrollment on median zip-code income. Column 1 reports the dependent variable mean in the month prior to receiving a delinquency call. Columns 2-8 report coefficients on the effect of IDR enrollment in month 18 ("Year 1"), month 30 ("Year 2"), and month 42 ("Year 3") from the pooled OLS regression specified in Equation 7. Regressions are estimated on the analysis sample as described in the notes to Table 1, limited to a monthly panel with 42 leads and 10 lags. All regressions include fixed effects for call year, month, day-of-week, and hour-of-day, as well as individual fixed effects. Regressions also control for initial amount borrowed, number of previous calls, inferred gender, pre-call debt balance and pre-call zip-median income. Robust standard errors are clustered at the borrower level. *** = significant at 1 percent level, ** = significant at 5 percent level, * = significant at 10 percent level.

TABLE A14—SUMMARY STATISTICS: LLS & NATIONALLY REPRESENTATIVE SAMPLE

	All Borrowers		IDR Eligible	
	(1) LLS	(2) B&B	(3) LLS	(4) B&B
Female	0.597	0.602	0.700	0.607
Zip Median Income	60.63	60.47	52.28	59.12
Age	31.97	29.45	34.40	29.40
Amount Borrowed	19.27	19.42	18.63	22.96
Minimum Payment	0.171	0.184	0.180	0.199
Any Mortgage	0.258	0.331	0.156	0.205
Mortgage Balances	48.31	49.70	23.50	25.90
N	271850	8760	43501	2100

Note: This table reports summary statistics at the borrower level. Column 1 is a random sample of the population of borrowers in LLS's FFEL portfolio (the "Full Sample" in Table 1), limited to those who graduated in 2008. Column 2 consists of all student borrowers in the 2008/2012 Baccalaureate and Beyond Longitudinal Study–a separate, nationally representative dataset of four-year college graduates in 2008. Column 3 corresponds to the "Analysis Sample" in Table 1, limited to those who graduated in 2008. Column 4 includes all B&B borrowers whose reported 2012 incomes and loan balances would have qualified them for reduced payments under IDR. B&B data are derived from FAFSA records, the National Student Loan Database System (NSLDS), and survey responses. Variable definitions follow those from Table 1. Values for mortgage, payments, and age variables are taken as of December 2012. Number of observations for the B&B sample are rounded to the nearest ten. B&B Source: U.S. Department of Education, National Center for Education 2008/2012 Baccalaureate and Beyond Longitudinal Study.
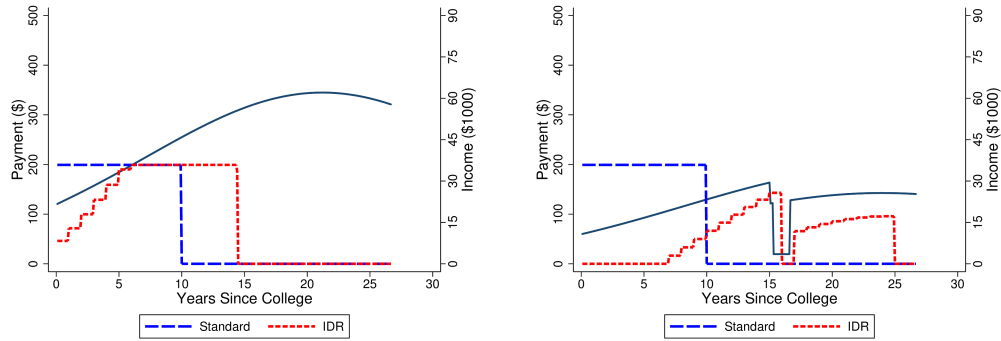
FIGURE A1. HYPOTHETICAL REPAYMENT SCENARIOS: IDR VERSUS STANDARD REPAYMENT

Note: This figure plots standard and IDR minimum payments under hypothetical income scenarios for a borrower holding $18,000 of student debt at the time she leaves college. The solid black line, plotted against the right axis, represents annual post-college income. The dashed blue and dotted red lines, plotted against the left axis, represent monthly minimum payments under standard and IDR plans, respectively. The x-axis denotes years since leaving college. Repayment paths assume a 6.0 percent interest rate, no late payments, and no switching between plans.
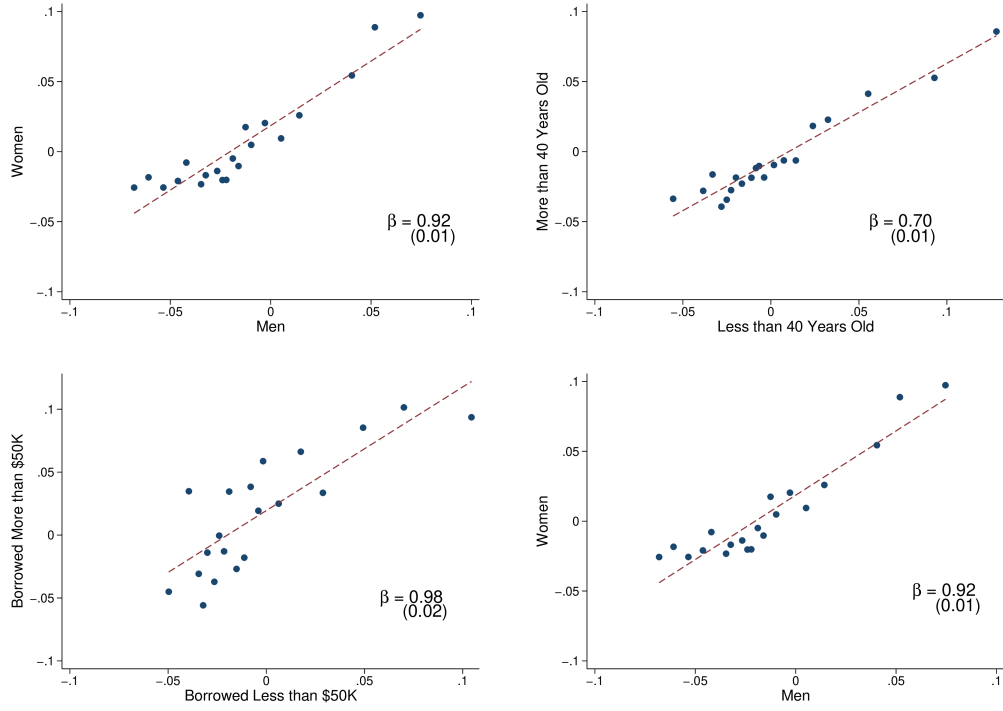
FIGURE A2. GROUP-SPECIFIC INSTRUMENT CORRELATIONS

Note: This figure plots binned correlations between group-specific instruments Z_{icj}^g. Each axis measures the residualized, leave-one-out propensity of every call's assigned agent to induce IDR take-up among individuals in the group specified by the axis label. I also plot the linear best fit line estimated using OLS and report the associated coefficients and standard errors in the upper left corner of each panel.

17
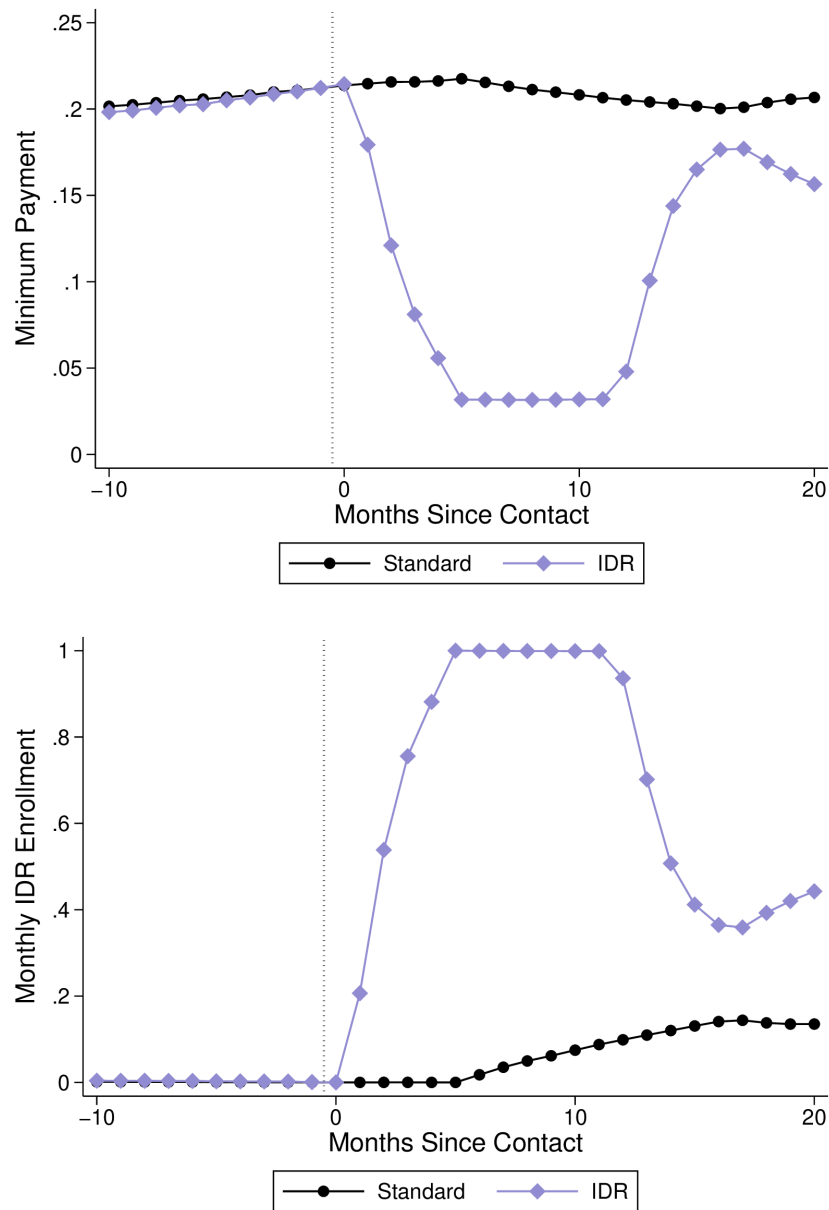
FIGURE A3. PRE/POST-CALL TRENDS IN MINIMUM PAYMENTS AND IDR ENROLLMENT

Note: This figure plots the average monthly minimum payments and monthly IDR enrollment status for treatment and control borrowers in the analysis sample. The horizontal axis denotes time, in months, relative to the month of the loan servicing call. Outcomes are normalized to the average value for control borrowers in the month prior to the call. See Table 1 notes for additional details on the outcome measures and sample.
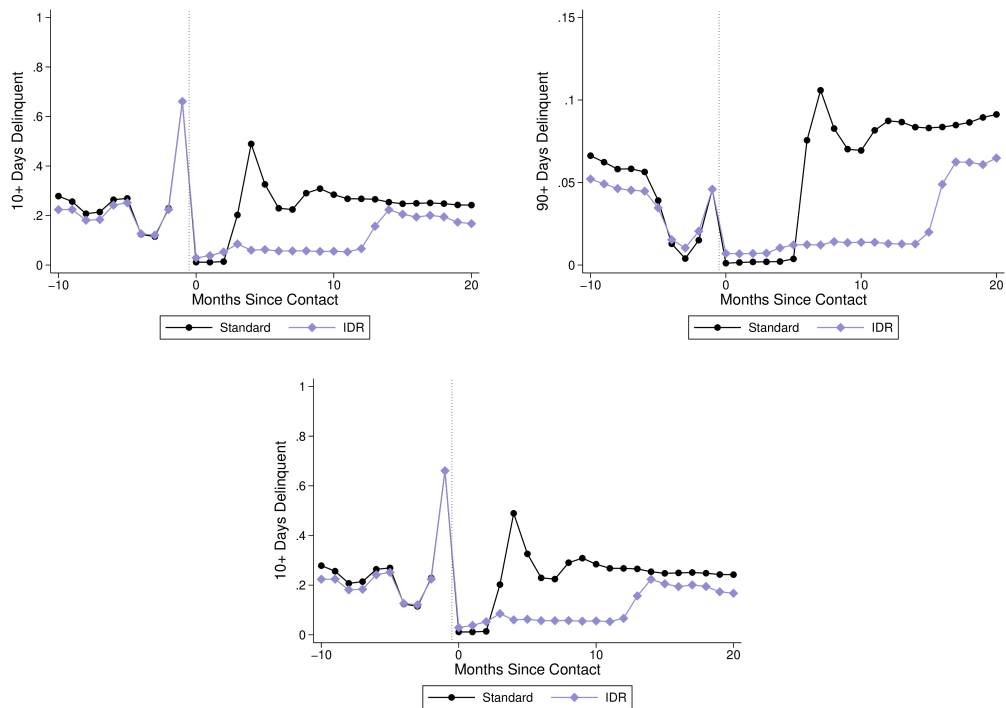
FIGURE A4. PRE/POST-CALL TRENDS IN DELINQUENCIES

Note: This figure plots the shares of treatment and control borrowers more than 10, more than 90, and more than 270 days delinquent in the analysis sample. The horizontal axis denotes time, in months, relative to the month of the loan servicing call. Outcomes are normalized to the share of delinquent control borrowers in the month prior to the call. See Table 1 notes for additional details on the outcome measures and sample.

19
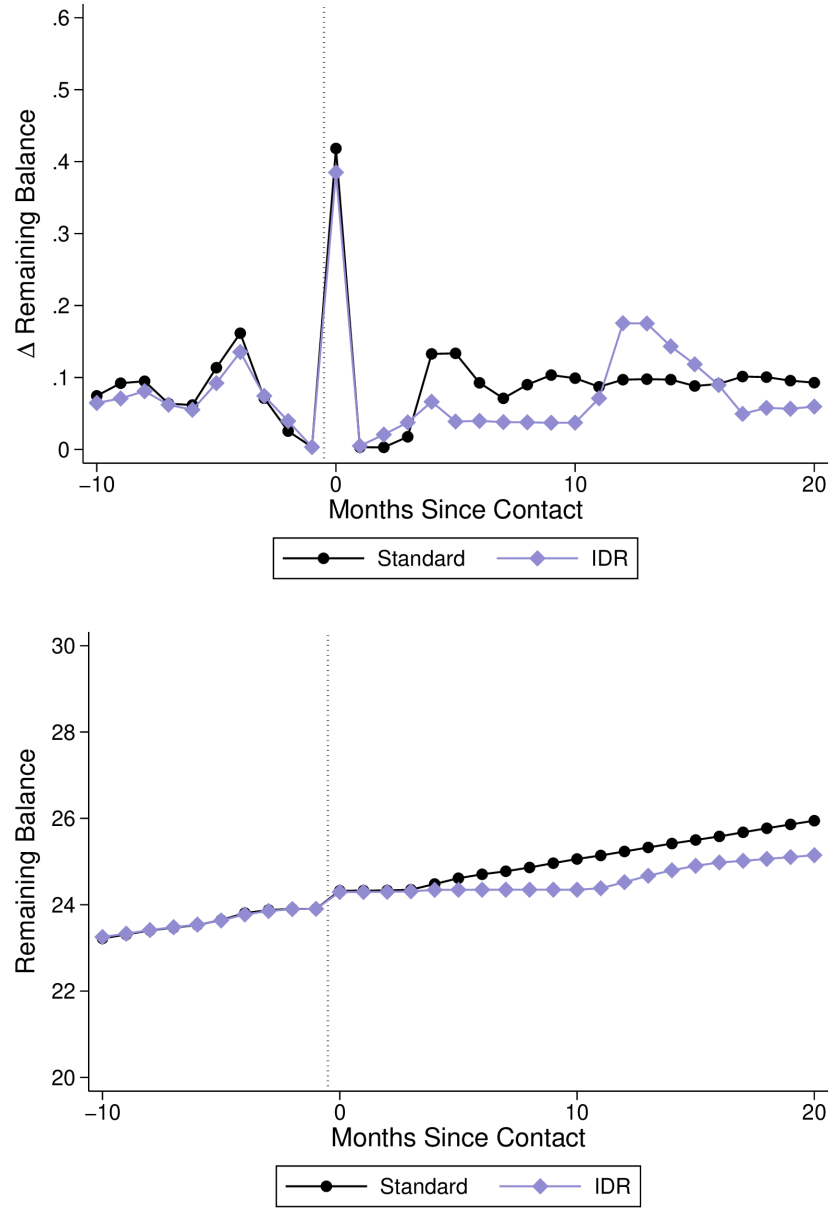
FIGURE A5. PRE/POST-CALL TRENDS IN BALANCES

Note: This figure plots the average total student loan balances and monthly changes in student loan balances, in thousands of dollars, for treatment and control borrowers in the analysis sample. The horizontal axis denotes time, in months, relative to the month of the loan servicing call. Outcomes are normalized to the average value for control borrowers in the month prior to the call. See Table 1 notes for additional details on the outcome measures and sample.
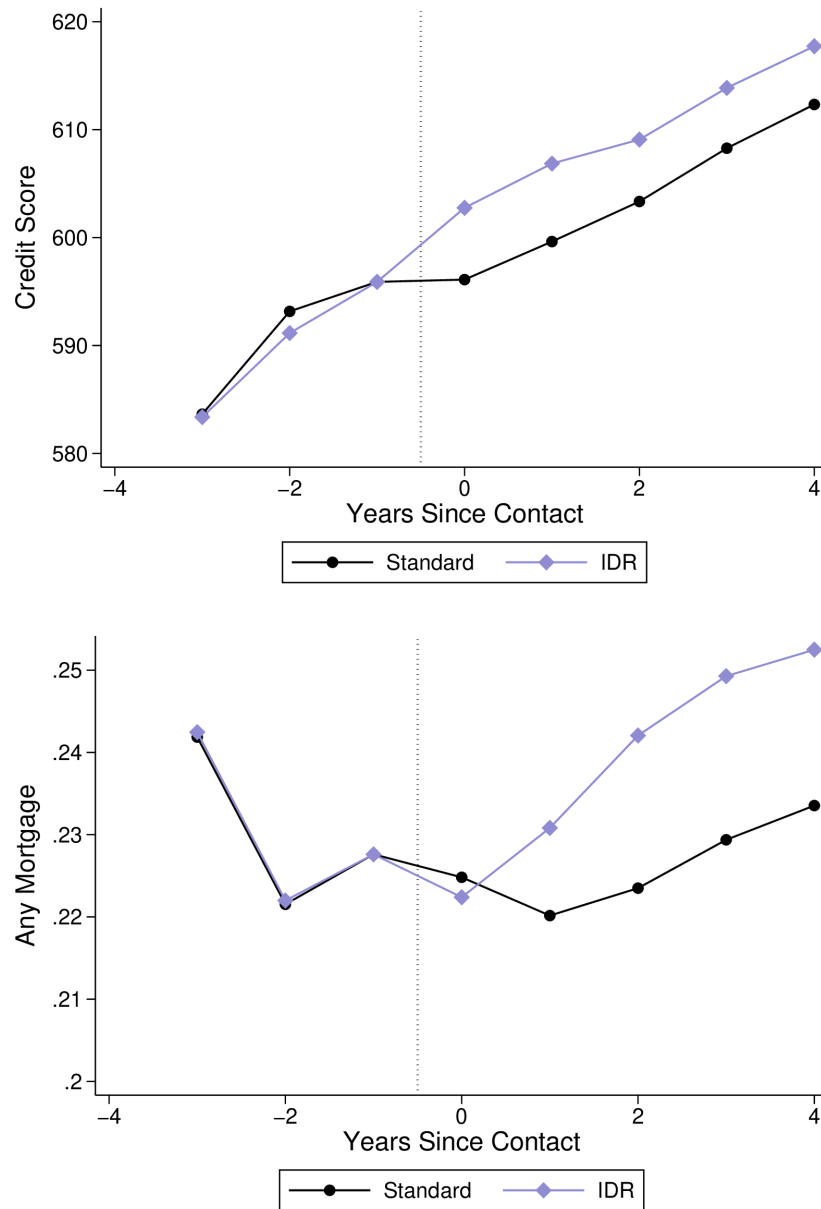
FIGURE A6. PRE/POST-CALL TRENDS IN CREDIT SCORES AND MORTGAGES

Note: This figure plots the average credit scores and mortgage-holding for treatment and control borrowers in the analysis sample. The horizontal axis denotes time, in years, relative to the year of the loan servicing call. Outcomes are normalized to the average value for control borrowers in the year prior to the call. See Table 1 notes for additional details on the outcome measures and sample.
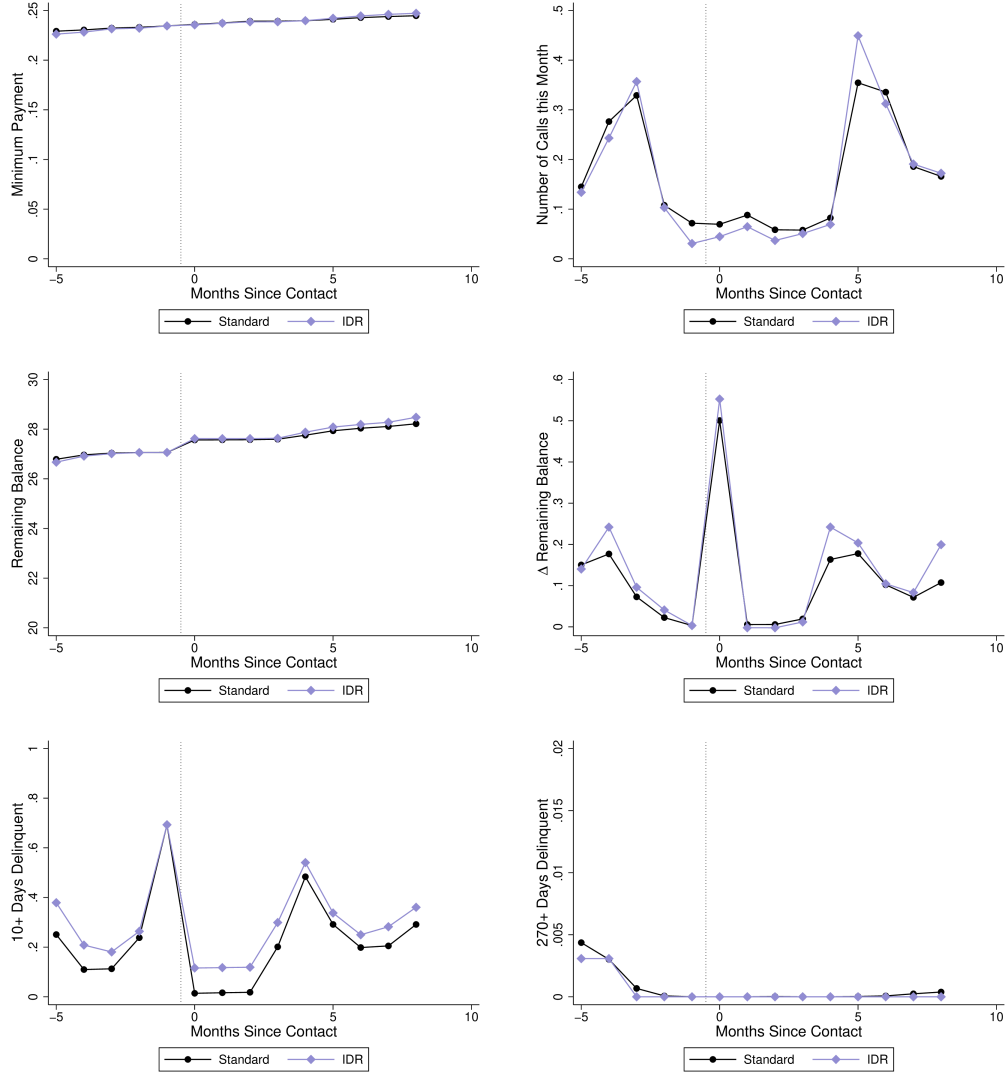
FIGURE A7. PRE/POST-CALL TRENDS IN REPAYMENT OUTCOMES: PLACEBO TEST

Note: This figure plots selected monthly LLS variables for *eventual* IDR enrollees following previous delinquency calls that did not end in enrollment versus non-enrollees in the analysis sample. The horizontal axis denotes time, in months, relative to the month of the loan servicing call. Outcomes are normalized to the average value of the outcome for non-enrollees in the month prior to the call. See Table 1 notes for additional details on the outcome measures and sample.
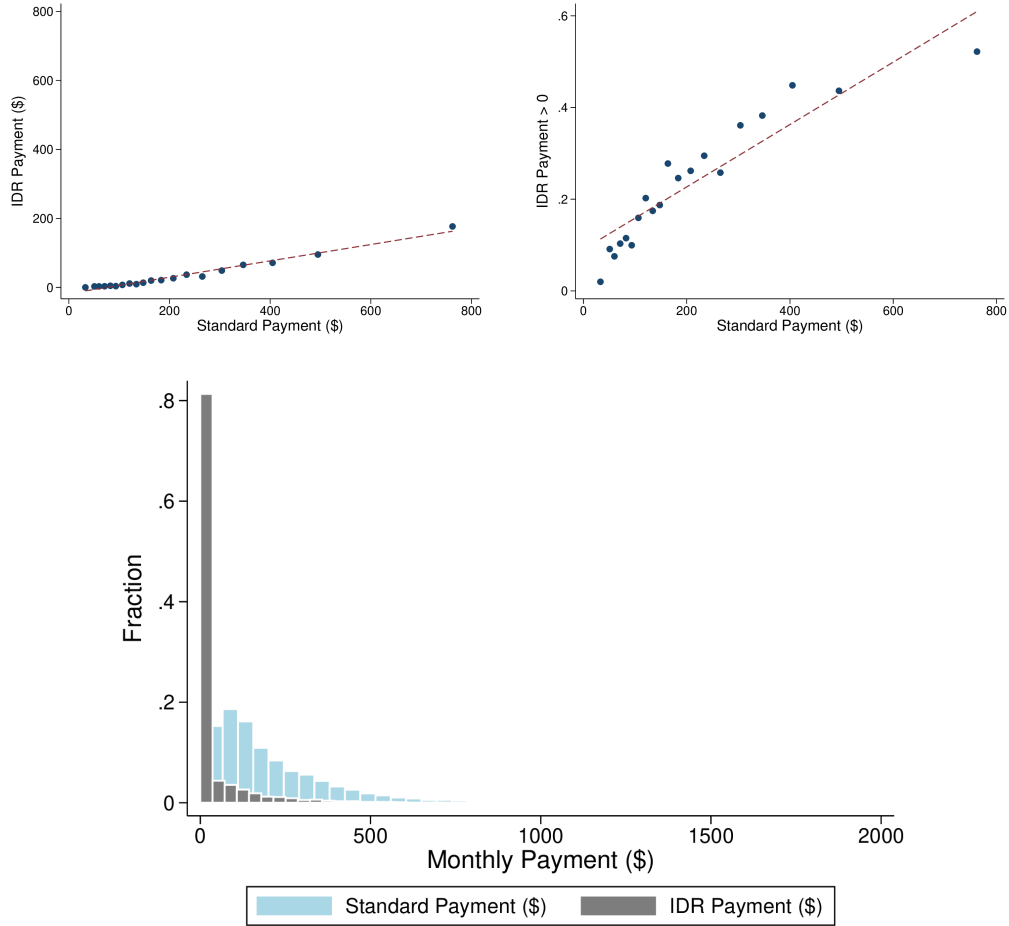
FIGURE A8. STANDARD VERSUS IDR PAYMENTS AMONG IDR ENROLLEES

Note: This figure plots the relationship between pre-call standard payments and post-call IDR payments. The binned scatter plot is constructed using payment amounts one month before and six months following the delinquency call for borrowers in the analysis sample who take up IDR. The top-left panel plots average standard payment size against average IDR payment size. The top-right panel plots average standard payment size against the share of individuals with IDR payments greater than zero. The bottom panel plots histograms for standard and IDR payments. See Table 1 notes for additional details on the sample.

23
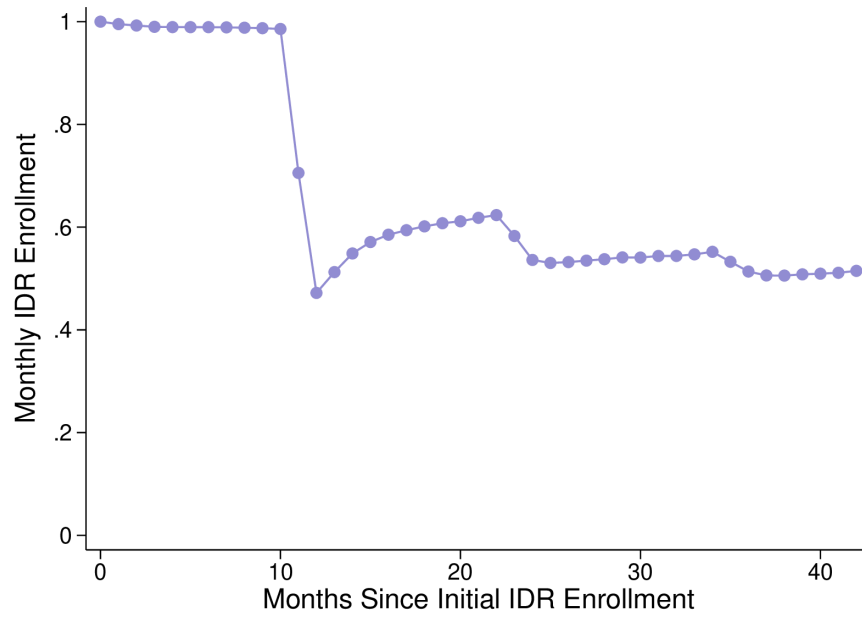
FIGURE A9. PRE/POST-CALL TRENDS IN IDR ENROLLMENT: LLS REPRESENTATIVE PANEL

Note: This figure plots the average monthly IDR enrollment status in a representative panel of LLS IDR borrowers beginning with month of their initial enrollment. The horizontal axis denotes time, in months, relative to the month of the loan-servicing call. See Table 1 notes for additional details on the sample.
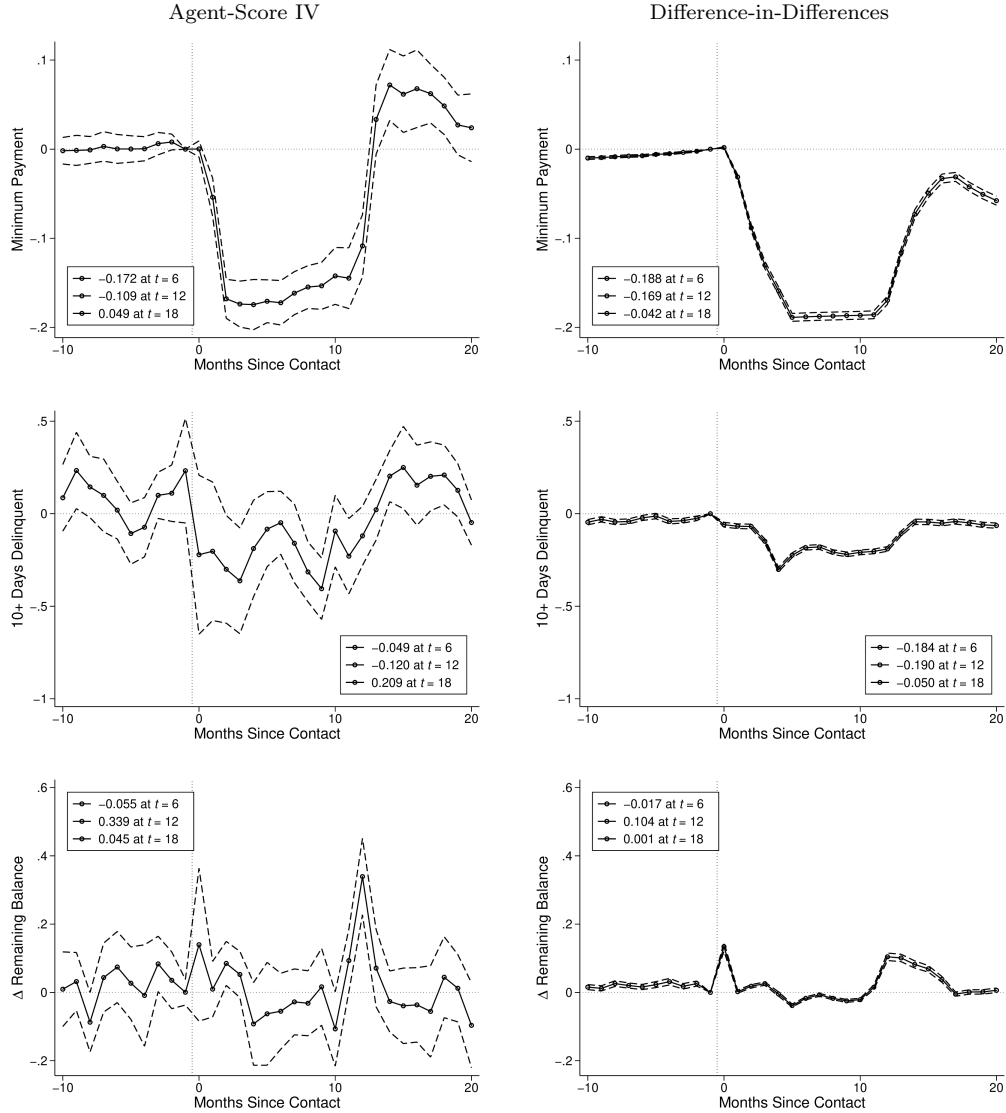
FIGURE A10. ESTIMATES OF THE EFFECT OF IDR ENROLLMENT ON DELINQUENCIES, INCLUDING NON-MODELED BORROWERS

Note: This figure reports monthly agent-score two-stage least-squares and difference-in-differences estimates for minimum payments, 10-day borrower delinquencies, and change in debt balances. Each point represents the estimated effect of post-call IDR status at a given time period relative to the date of delinquency call. Regressions are estimated on the sample of both modeled and non-modeled calls satisfying all other selection criteria outlined in Section II, limited to a monthly panel with 20 leads and 10 lags. Relative months are plotted along the x-axis. Dashed lines represent 95% confidence intervals. Boxes list point estimates at selected months. All regressions include fixed effects for call year, month, day-of-week, and hour-of-day, as well as controls for for initial amount borrowed, number of previous calls, inferred gender, pre-call debt balance and pre-call zip-median income. IV estimates also control for agent modeling propensity (see Section III), and difference-in-differences regressions include individual fixed effects. Robust standard errors are two-way clustered at the borrower and agent levels for IV estimates and one-way clustered at the borrower level for difference-in-differences estimates.

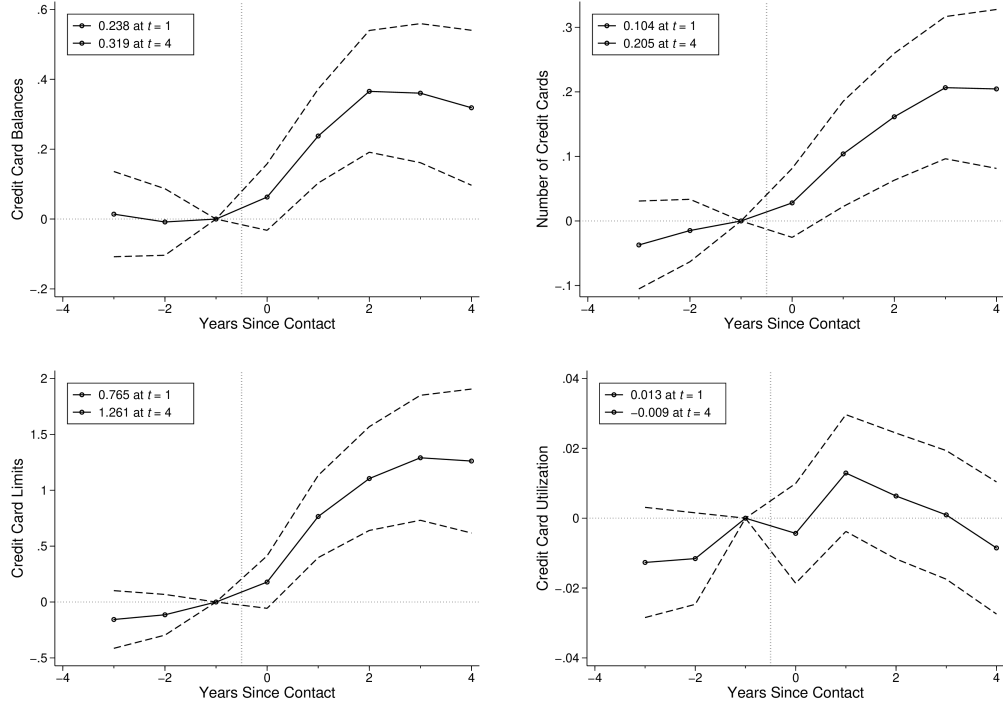Difference-in-Differences

FIGURE A11. ESTIMATES OF THE EFFECT OF IDR ENROLLMENT ON BANKRUPTCIES AND AUTO LOANS

Note: This figure reports annual difference-in-differences estimates for borrowers' bankruptcy- and auto-loan-holding rates. Each point represents the estimated effect of post-call IDR status on the propensity to hold a mortgage or auto loan at a given time period relative to the date of delinquency call. Relative years are plotted along the x-axis. Dashed lines represent 95% confidence intervals. Boxes list point estimates at selected years. All regressions include fixed effects for call year, month, day-of-week, and hour-of-day, as well as individual fixed effects. Regressions also control for initial amount borrowed, number of previous calls, inferred gender, pre-call debt balance and pre-call zip-median income. Robust standard errors are clustered at the borrower level.
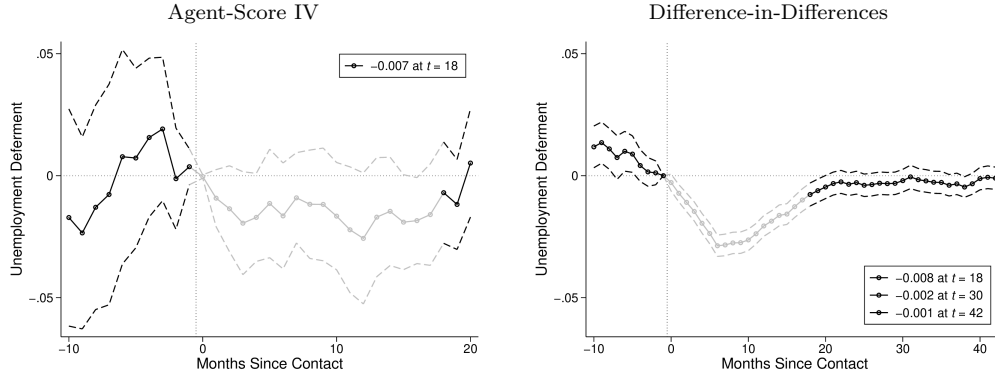
FIGURE A12. ESTIMATES OF THE EFFECT OF IDR ENROLLMENT ON CREDIT CARDS

Note: This figure reports annual difference-in-differences estimates for credit card balances, number of credit cards, total credit card limits, and utilization (balance-limit ratio). Each point represents the estimated effect of post-call IDR status on the y-axis outcome for all credit cards held by a borrower at a given time period relative to the date of delinquency call. Relative years are plotted along the x-axis. Dashed lines represent 95% confidence intervals. Boxes list point estimates at selected years. All regressions include individual and call-date/time fixed effects.All regressions include fixed effects for call year, month, day-of-week, and hour-of-day, as well as individual fixed effects. Regressions also control for initial amount borrowed, number of previous calls, inferred gender, pre-call debt balance and pre-call zip-median income. Robust standard errors are clustered at the borrower level.

FIGURE A13. ESTIMATES OF THE EFFECT OF IDR ENROLLMENT ON UNEMPLOYMENT DEFERMENTS

Note: This figure reports monthly agent-score two-stage least-squares and difference-in-differences estimates for unemployment deferments. Each point represents the estimated effect of post-call IDR status on take-up of unemployment deferments at a given time period relative to the date of delinquency call. Relative months are plotted along the x-axis. IV results are estimated using a monthly panel with 20 leads and 10 lags, while difference-in-differences results are expanded to a monthly panel of 42 leads and 10 lags. Dashed lines represent 95% confidence intervals. Grey portions of the plot represent periods during which uneven rates of contact with LLS may bias estimates (see discussion in Section IV.B). Boxes list point estimates at selected months. All regressions include fixed effects for call year, month, day-of-week, and hour-of-day, as well as controls for initial amount borrowed, number of previous calls, inferred gender, pre-call debt balance and pre-call zip-median income. IV estimates also control for agent modeling propensity (see Section III), and difference-in-differences regressions include individual fixed effects. Robust standard errors are two-way clustered at the borrower and agent levels for IV estimates and one-way clustered at the borrower level for difference-in-differences estimates.
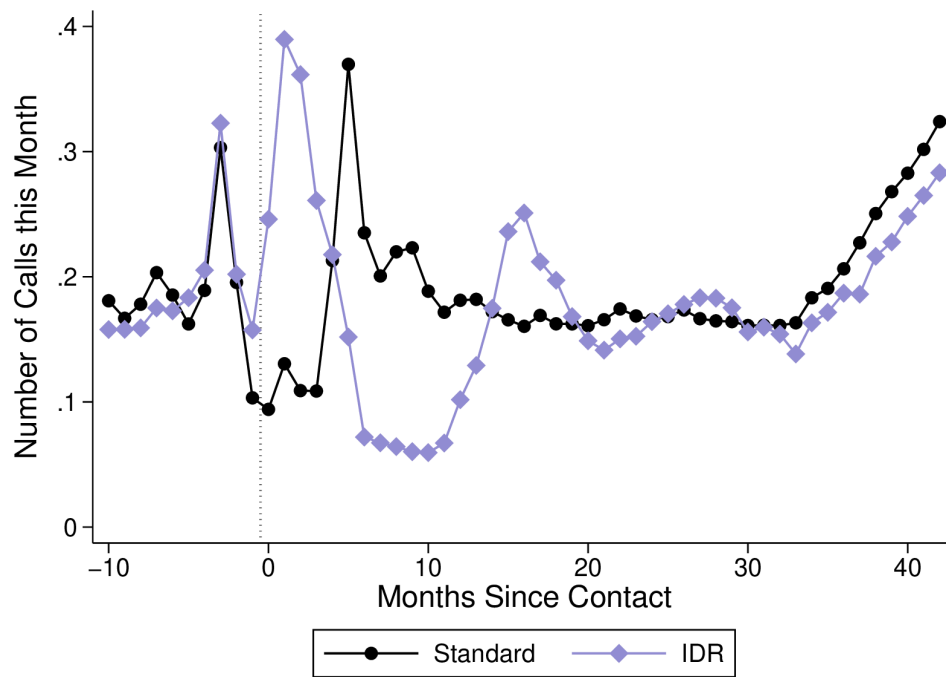
FIGURE A14. PRE/POST-CALL POINTS OF CONTACT

Note: This figure plots the average monthly points of contact (incoming calls, outgoing calls, and web chats) between borrowers and LLS for IDR enrollees and non-enrollees in the analysis sample. The horizontal axis denotes time, in months, relative to the month of the loan servicing call. See Table 1 notes for additional details on the outcome measures and sample.
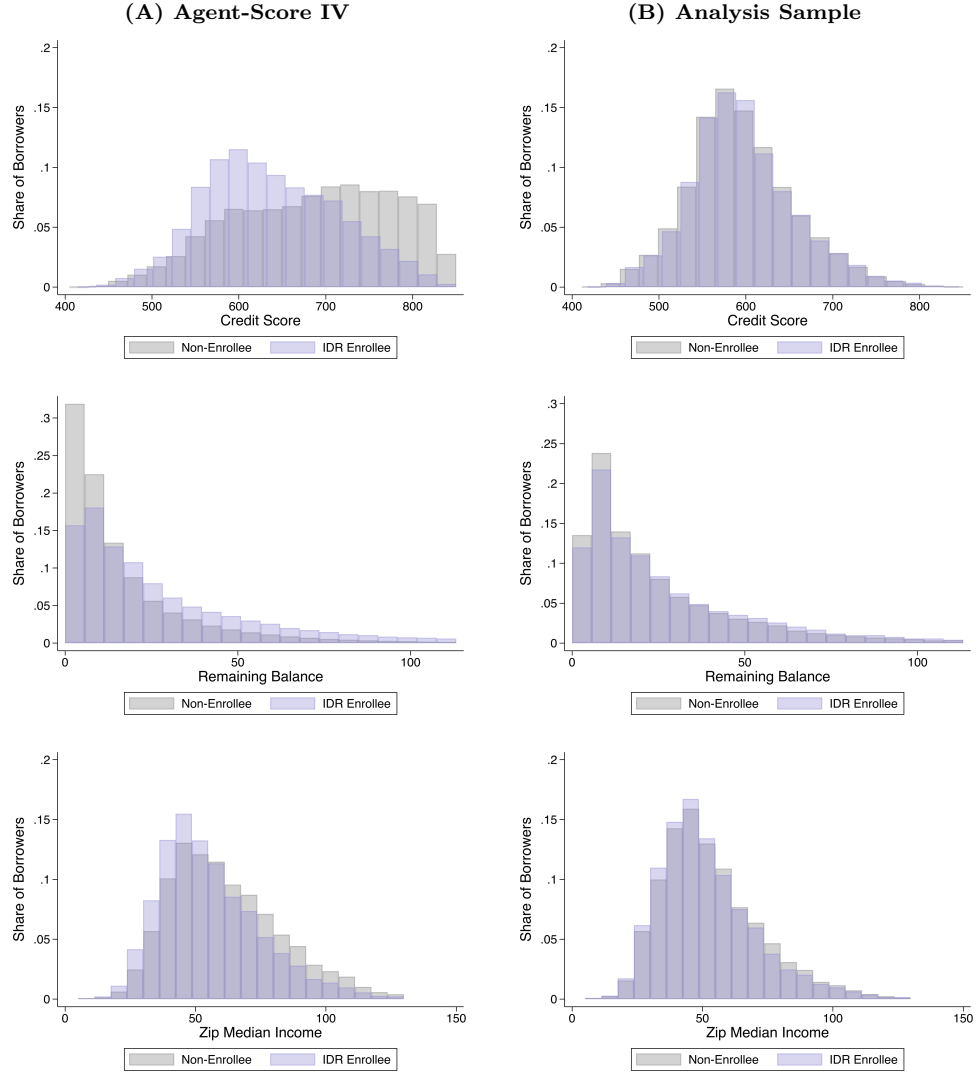
(A) Agent-Score IV   **(B) Analysis Sample**

FIGURE A15. HISTOGRAMS OF IDR VERSUS NON-IDR BORROWERS

Note: This figure plots histograms of key outcomes separately by IDR enrollees and non-enrollees. Figures in Column A plot 2013 values for credit score, loan balance, and zip-median income, respectively, for a representative sample of LLS borrowers (the "Full Sample" in Table 1). Figures in Column B plot histograms of the same outcomes for the anlaysis sample. "IDR Enrollees" and "Non-Enrollees" are defined by the borrower ever having been on IDR between 2013 and 2018.
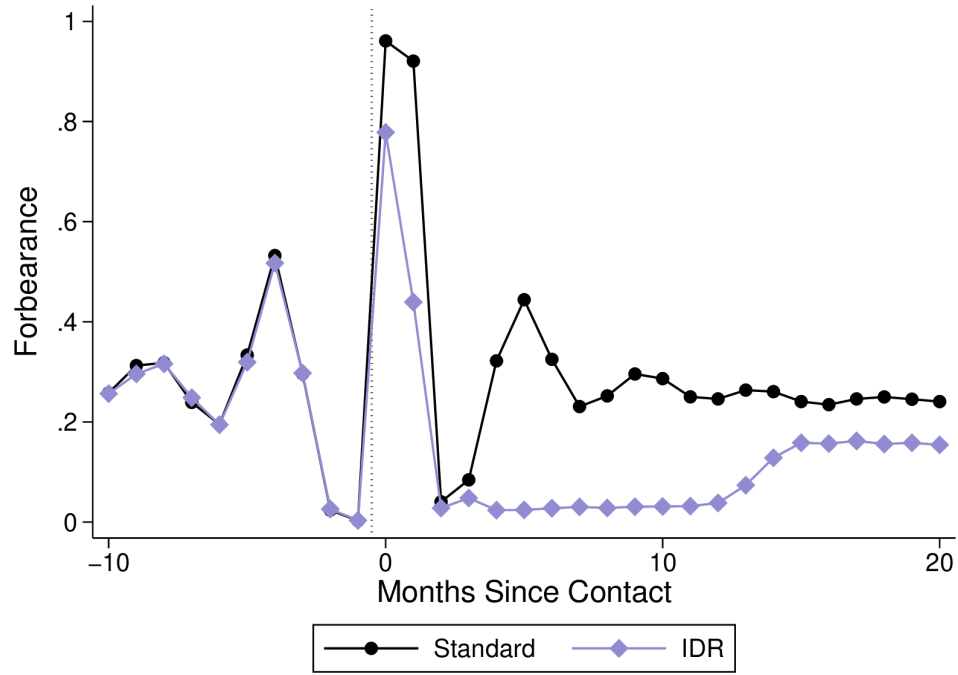
FIGURE A16. PRE/POST-CALL TRENDS IN LOAN FORBEARANCE

Note: This figure plots the average monthly forbearance status and monthly IDR enrollment status for treatment and control borrowers in the analysis sample. The horizontal axis denotes time, in months, relative to the month of the loan servicing call. Outcomes are normalized to the average value for control borrowers in the month prior to the call. See Table 1 notes for additional details on the outcome measures and sample.
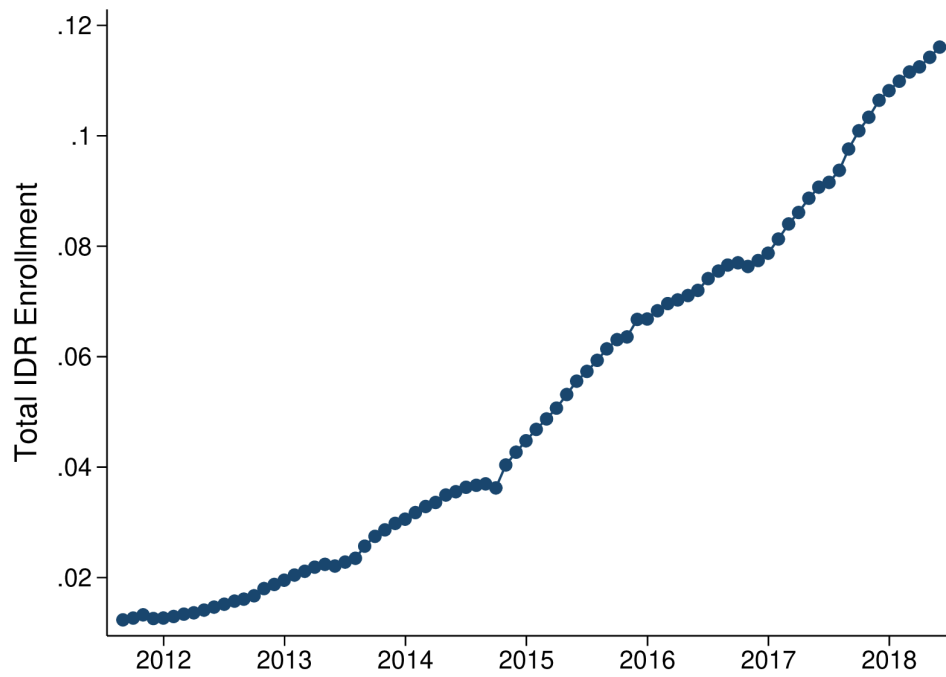
FIGURE A17. AGGREGATE IDR ENROLLMENT: LLS REPRESENTATIVE PANEL

Note: This figure plots the aggregate share of borrowers enrolled in IDR over time. The sample is a representative panel of LLS IDR borrowers in repayment.

APPENDIX B   Alternative Instrument: E-sign

In 2017 LLS received federal approval to use electronic signature or "e-sign" technology, allowing servicing agents to email pre-populated IDR applications to qualifying borrowers without the need for a separate, physical application through the Department of Education. This technology was rolled out to a subset of call agents before it was adopted company-wide, creating between-agent variability in IDR sign-up costs for an interim period of five months.

Unlike other sources of agent variation, effects through e-sign adoption can be estimated, as I observe which call agents elicited an electronic IDR application. In Figure B1, I plot IDR take-up separately by agents' e-sign status for all borrowers receiving delinquency calls in a thirty-month panel. Calls assigned to e-sign-capable agents are 11 percentage points more likely to induce borrowers into IDR.

In Table B1, I provide first-stage estimates from a modified version of my instrumental variables design, in which the instrument Z_{icj}^{Esign} is an indicator for whether a delinquency call was assigned to an e-sign-capable agent. Two-stage-least-squares estimates from this specification are reported in Figure B2, and are very similar to the agent-score IV results. Column 2 of Table B2 reports these estimates pooled by subsequent three-month periods. Column 1 reports estimates using a modified agent score instrument that conditions on each agent's e-sign status, so that estimates isolate a local-average treatment effect through agent ability holding technology constant.
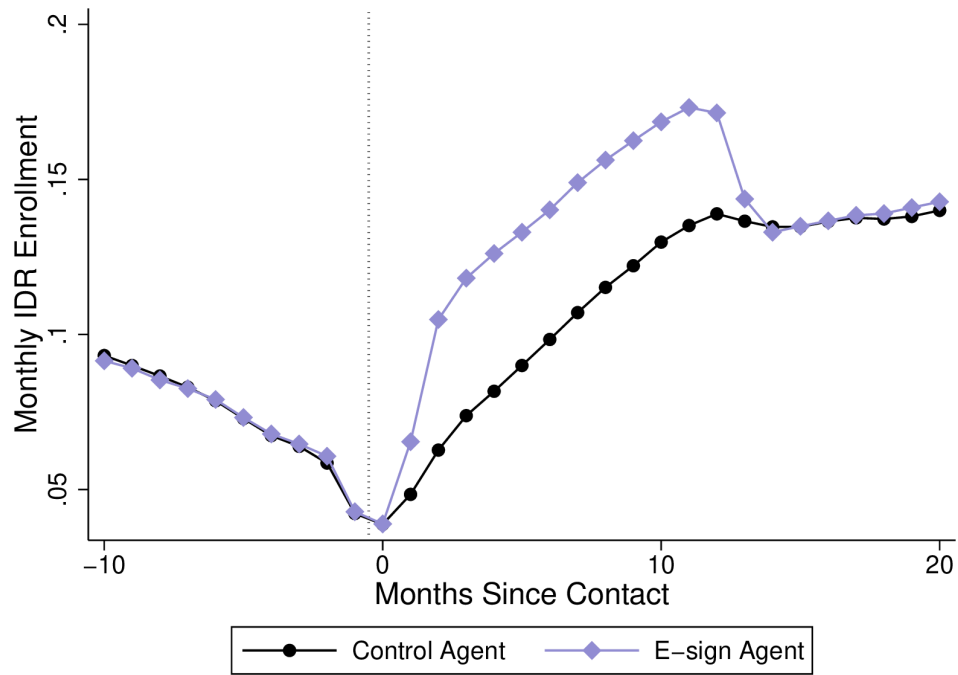
FIGURE B1. PRE/POST-CALL TRENDS IN IDR ENROLLMENT BY E-SIGN STATUS

Note: This figure plots IDR enrollment status separately by agent e-sign status for all post-2016 calls that fall within a thirty-month panel window. The horizontal axis denotes time, in months, relative to the month of the loan servicing call.

TABLE B1—FIRST STAGE: E-SIGN

	(1) IDR	(2) IDR
E-sign Agent	0.1068100***	0.1066441***
	(0.0156584)	(0.0156585)
Female		0.0219258***
		(0.0033921)
Amount Borrowed		0.0000849
		(0.0001701)
Age		−0.0007324***
		(0.0001475)
Lag Log Zip Median Income		−0.0117649***
		(0.0040453)
Lag Days Delinquent		−0.0003163***
		(0.0000568)
Lag Minimum Payment		−0.0100604
		(0.0130358)
Lag Remaining Balance		0.0001954
		(0.0001376)
Lag Credit Score		0.0002878***
		(0.0000323)
Lag Credit Card Balances		−0.0000252
		(0.0004360)
Lag Any Auto Trade		−0.0021418**
		(0.0008726)
Lag Any Mortgage		−0.0123738**
		(0.0054556)
Lag Mortgage Balances		−0.0001004***
		(0.0000259)
Lag Number of Credit Cards		0.0023141***
		(0.0005965)
Lag Credit Card Limits		−0.0008964***
		(0.0001846)
Mean Dep.	0.101	0.101
F-stat	46.53	46.38
P-value	0.0000	0.0000
R-squared	0.028	0.035
N	50120	50120

Note: This table reports first-stage results for the instrument defined by call agents' e-sign status. The regressions are estimated on the analysis sample described in the notes to Table 1. Columns 1 and 2 report estimated coefficients from an OLS regression of IDR take-up within four months of a delinquency calls against the variables listed, as well as agent modeling propensity and call year, month, and hour fixed effects. Modeling propensity are estimated using data from other phone calls placed by the same agent following the procedure described in Section III. Robust standard errors two-way clustered at the borrower and agent level are reported in parentheses. *** = significant at 1 percent level, ** = significant at 5 percent level, * = significant at 10 percent level.

TABLE B2—Agent-Only Score and E-sign IV Estimates of the Effect of IDR Enrollment on Repayment Outcomes

		Agent Score IV					E-Sign IV				
Dependent Variable	(1) Mean $t = -1$	(2) Mo. 6-8	(3) Mo. 9-11	(4) Mo. 12-14	(5) Mo. 15-17	(6) Mo. 18-20	(7) Mo. 6-8	(8) Mo. 9-11	(9) Mo. 12-14	(10) Mo. 15-17	(11) Mo. 18-20
Minimum Payment	0.212	−0.172***	−0.166***	−0.040***	0.022*	0.010	−0.168***	−0.158***	−0.018	0.046***	0.042***
		(0.010)	(0.011)	(0.011)	(0.011)	(0.013)	(0.008)	(0.010)	(0.013)	(0.015)	(0.014)
Remaining Balance	23.843	−0.370***	−0.529***	−0.245**	−0.259*	−0.275	−0.527***	−0.688***	−0.391***	−0.370**	−0.411**
		(0.066)	(0.090)	(0.110)	(0.133)	(0.172)	(0.072)	(0.104)	(0.129)	(0.149)	(0.177)
Δ Remaining Balance	0.004	−0.036**	0.007	0.114***	−0.011	−0.007	−0.075***	0.017	0.122***	−0.013	−0.016
		(0.015)	(0.019)	(0.020)	(0.018)	(0.025)	(0.015)	(0.024)	(0.019)	(0.018)	(0.019)
10+ Days Delinquent	0.658	−0.218***	−0.221***	0.068**	0.113**	0.051	−0.231***	−0.296***	0.012	0.021	0.029
		(0.036)	(0.041)	(0.033)	(0.050)	(0.035)	(0.036)	(0.041)	(0.037)	(0.042)	(0.042)
90+ Days Delinquent	0.045	−0.045*	−0.047**	−0.016	0.091***	0.058*	−0.043*	−0.063***	−0.060**	0.014	−0.001
		(0.026)	(0.022)	(0.025)	(0.033)	(0.032)	(0.026)	(0.024)	(0.025)	(0.034)	(0.029)
270+ Days Delinquent	0.000	0.000	0.002	−0.014	0.005	0.025**	0.000	0.001	−0.002	−0.010	0.010
		(0.001)	(0.001)	(0.010)	(0.006)	(0.012)	(0.001)	(0.002)	(0.011)	(0.007)	(0.012)
Call Time FE		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	49775	149325	149325	149325	149325	149325	149325	149325	149325	149325	149325

Note: This table reports two-stage least squares estimates of the effect of IDR enrollment on monthly loan repayment outcomes. Column 1 reports the dependent variable mean in the month prior to receiving a delinquency call. Each of columns 2-11 reports estimates from a separate 2SLS regression on outcomes in the indicated three-month period following the delinquency call. To instrument for IDR enrollment, columns 2-6 use agent score, as defined in Section III, but further residualized by e-sign status. Columns 7 - 11 use an indicator for whether the assigned agent was able to facilitate e-sign. All regressions are estimated on the analysis sample described in the notes to Table 1, limited to a monthly panel with 20 leads and 10 lags. All regressions include fixed effects for call year, month, day-of-week, and hour-of-day, as well as controls for initial amount borrowed, number of previous calls, inferred gender, pre-call debt balance and pre-call zip-median income. Regressions also control for agent modeling propensity following the procedure described in Section III. Robust standard errors are two-way clustered at the borrower and agent levels. *** = significant at 1 percent level, ** = significant at 5 percent level, * = significant at 10 percent level.
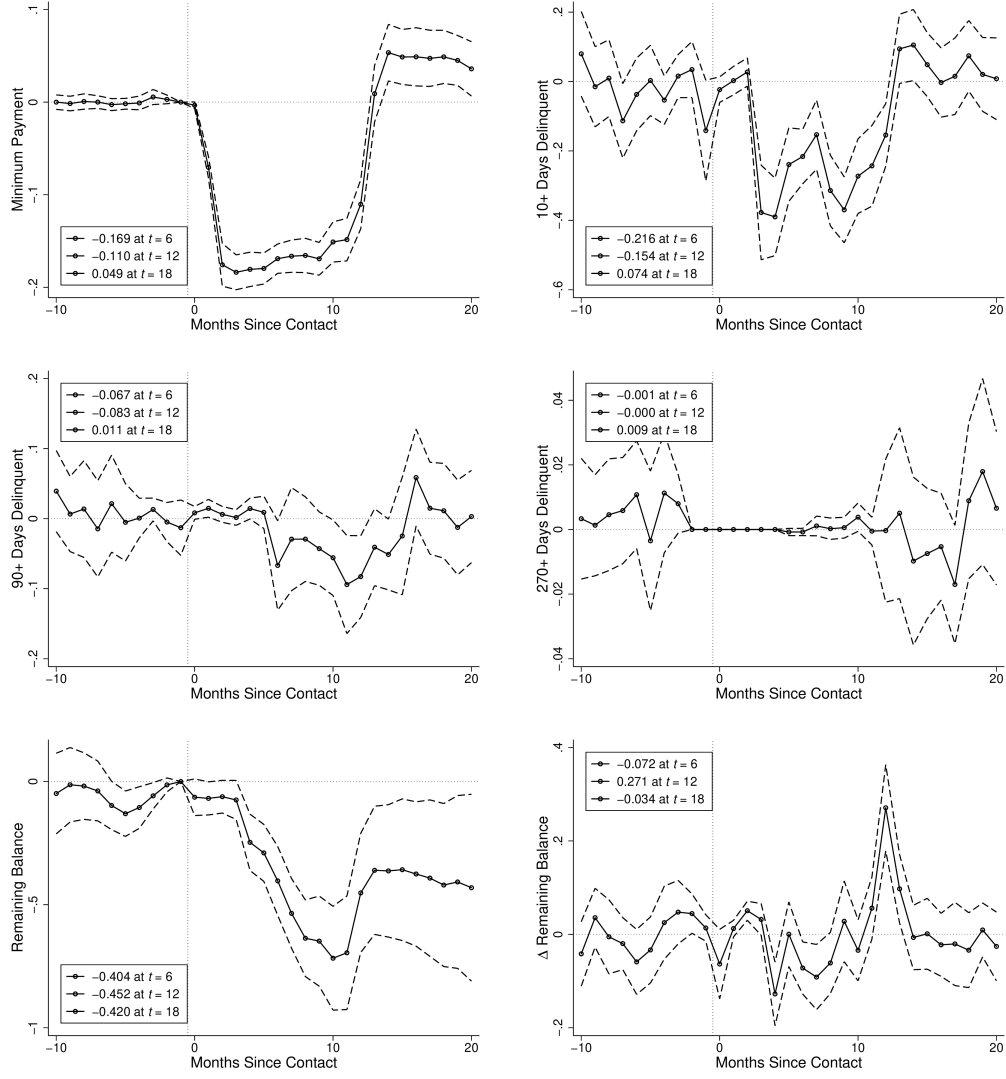
FIGURE B2. E-SIGN IV ESTIMATES OF THE EFFECT OF IDR ENROLLMENT ON MONTHLY OUTCOMES

Note: This figure reports monthly e-sign IV estimates for monthly repayment outcomes. Each point represents the estimated effect of post-call IDR status on the outcome variable at a given time period relative to the date of delinquency call. Relative months are plotted along the x-axis. Dashed lines represent 95% confidence intervals. Boxes list point estimates at selected months. All regressions include fixed effects for call year, month, day-of-week, and hour-of-day, as well as controls for initial amount borrowed, number of previous calls, inferred gender, pre-call debt balance and pre-call zip-median income. Regressions also control for agent modeling propensity following the procedure described in Section III. Robust standard errors are two-way clustered at the borrower and agent levels.

APPENDIX C   Budgetary Impacts of IDR

While my estimates suggest IDR's liquidity benefits improve the welfare of individual borrowers, they also come with important fiscal implications for the federal student loan program. In this section, I use these estimates to create some back-of-the-envelope simulations of the budgetary impacts of IDR. Importantly, these simulations account for re-enrollment and repayment effects of IDR.

In order for their loans to be forgiven, an IDR borrower must make three-hundred complete monthly loan payments and still hold an outstanding balance. Standard repayment plans pay off balances after just one-hundred-twenty payments, so a borrower must remain on IDR *and* qualify for substantially reduced payments for twenty-five years before they can have any of their loan forgiven. Neither scenario appears plausible for my sample. Projecting re-enrollment rates forward, I find that less than ten percent of borrowers in my sample would have spent enough time enrolled in IDR to reach their forgiveness eligibility threshold by age seventy-five.[1] Even if re-enrollment increased or was made automatic, borrowers would have to earn implausibly low incomes for twenty or more years in order to have any remaining balance forgiven. If every IDR-enrolled borrower in my analysis sample earned their current zip code's median income from month forty-two onward with zero earnings growth, only 18.9 percent of them would have IDR payments low enough to leave a positive forgiveness-eligible balance after twenty-five years (See Figure C2).

Even if IDR were reformed to promote re-enrollment and forgive more debt, it may be budget-neutral or even generate revenue depending on their repayment effects. In Figure C3, I use IDR's estimated effect on balances to predict total cash flows under the counterfactual scenario in which all student borrowers were enrolled in IDR starting January 2013. While constructing this counterfactual carries strong assumptions, the figure demonstrates how increased repayment rates might mitigate many of the budgetary concerns of IDR, at least in the short term. Even in the long term, IDR's repayment rates may promote cost savings, though they are harder to quantify given the high one-year attrition rate. Nonetheless, a more widespread adoption of IDR might reduce student-loan recovery costs by reducing the number of defaulted loans that are never repaid and avoiding the administrative costs of servicing serially delinquent borrowers.[2]

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[1]Predictions are formed using estimates from a probit model where IDR enrollment is as a function of inferred gender, age, existing balances, and past recertification behavior. Note that this method overestimates the likelihood of forgiveness, as it assumes IDR payments would never pay down balances. See Figure C1 notes for details.

[2]While defaulted student loans can only be discharged under rare circumstances, the Department of Education still reports a lifetime recovery rate of only 81 percent after accounting for collection costs (Department of Education, 2021).
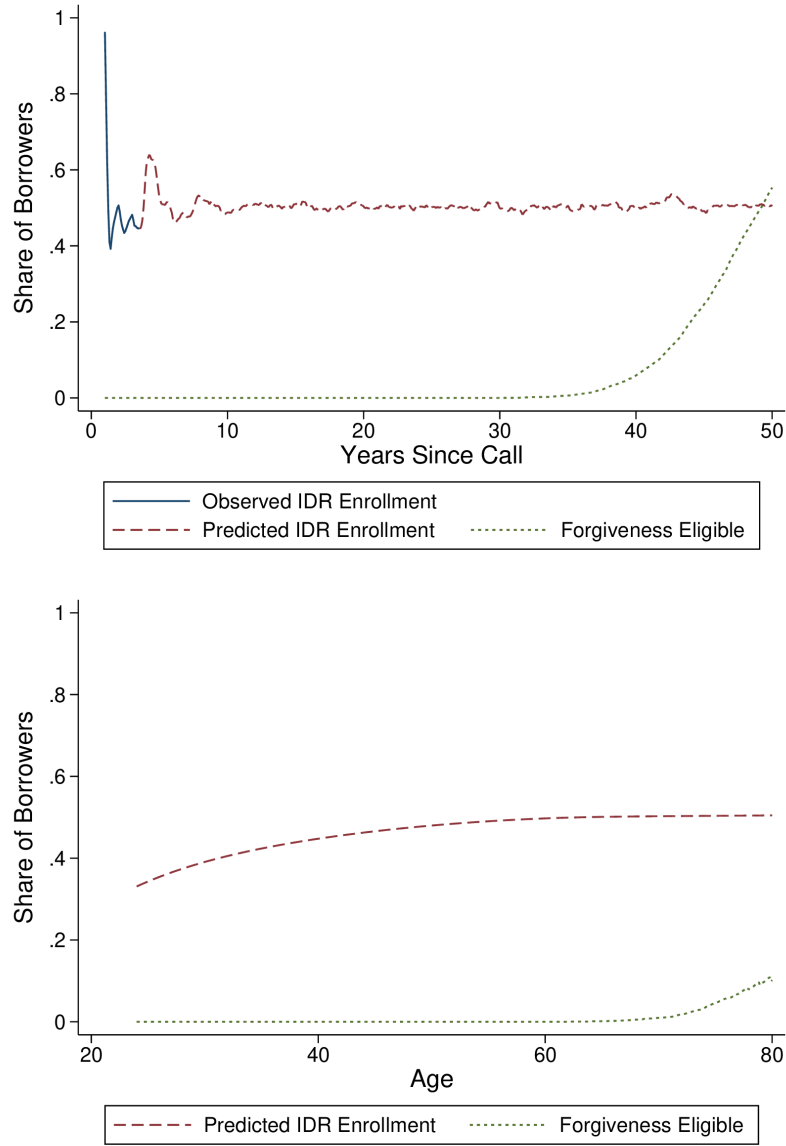
FIGURE C1. PREDICTED FORGIVENESS ELIGIBILITY

Note: This figure plots predicted forgiveness eligibility for my analysis sample, assuming balances are never completely paid off. The blue and red lines plot the true and predicted share of borrowers enrolled in IDR. Predictions are formed from a probit model regressing recertification status against amount borrowed, call-year fixed effects, and a quartic in months since last recertification for those borrowers who have not recertified for at least twelve months. The dotted green line plots the implied share of forgiveness eligible (i.e., the share of borrowers who make at least twenty-five qualifying payments), assuming borrowers recertified at their predicted rate, made all their IDR payments, and never completely paid off their balances. The x-axis denotes years since delinquency call and age of borrower in the top and bottom panels, respectively.
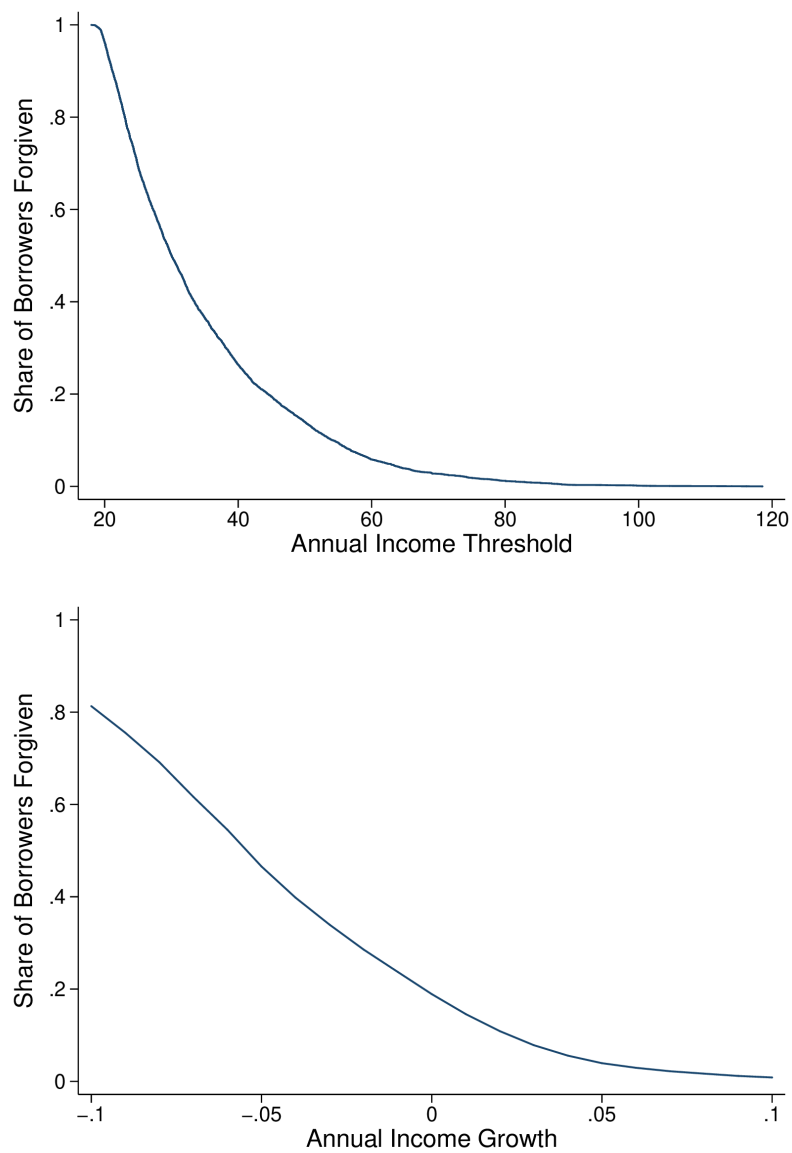
FIGURE C2. MAXIMUM QUALIFYING INCOME

Note: This figure plots the share of borrowers in my analysis sample who would have their loans forgiven under different income scenarios, assuming perfect recertification. In the top panel, the y-axis plots the forgiveness rate if everyone in the sample earned the annual income denoted by the corresponding point on the x-axis in every year following month 42. In the bottom panel, the y-axis plots the forgiveness rate if everyone's income started at their current zip code's median in month 42 and grew at the rate denoted by the corresponding point on the x-axis.
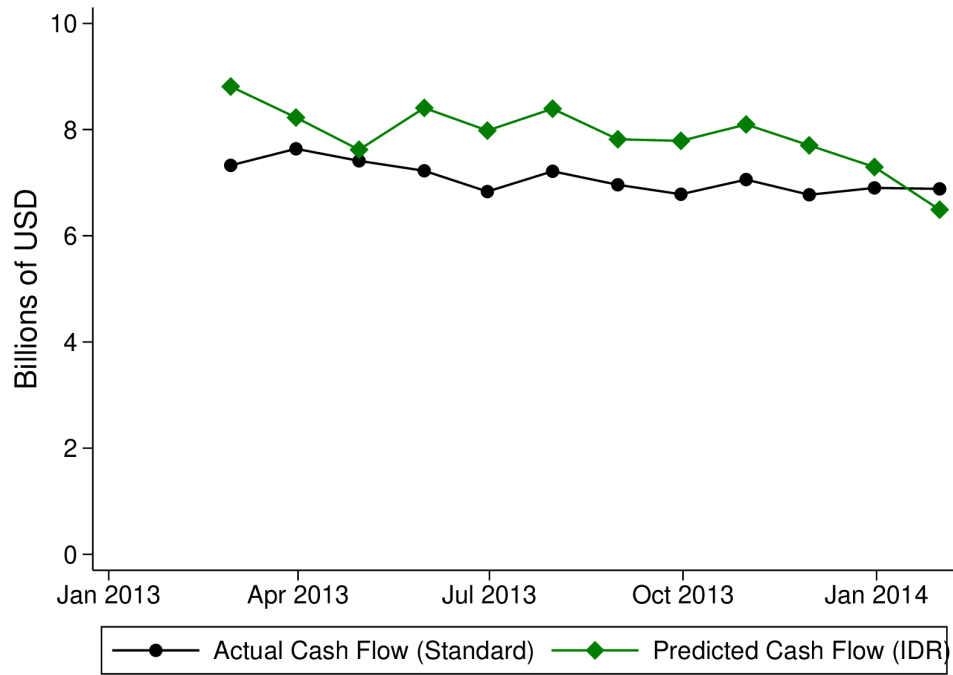
Figure C3. Predicted Cash Flows to Government Under IDR

Note: This figure plots actual total cash flows versus predicted total cash flows for the counterfactual scenario in which all student borrowers enrolled in IDR in January 2013. Predictions are generated using monthly difference-in-difference estimates for the analysis sample re-weighted so that the joint distribution of pre-call observables matches that of the full representative sample from Table 1. Values are scaled to reflect total national student loan balances as of December 2012.

REFERENCES

Department of Education. 2021. "FY 2021 Cohort Lifetime Dollar Default and Recovery Rates." *Website*, `https://www2.ed.gov/about/overview/budget/budget19/justifications/q-sloverview.pdf` Accessed: 2021-09-16.