Household Financial Behavior After Hurricane Harvey

Alejandro del Valle[1]   Therese Scharlemann[2]   Stephen Shore[1,3]

Georgia State University[1]   Federal Reserve Board[2]   Office of Financial Research[3]

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How do households use credit markets to mitigate idiosyncratic shocks?

Unexpected financial shocks are difficult to observe at the household level.

- ► Unexpected shocks difficult to differentiate from expected shocks.
- ► Data limitations.

Weather can be used as a clean exogenous shock to need for funds, where timing is known precisely.

- ► Can separate less- and more-affected using measurable storm impact (flooding).
- ► Increasingly relevant shock in the context of climate change (Emanuel, 2017)

What we know

Literature looking at natural disasters is a bit puzzling

Recent literature finds limited borrowing response to major storms. Why?

- ▶ Storm too small to see response? (Unlikely - Katrina is focal)
- ▶ Data incomplete: cannot see relevant margin of response?
- ▶ Federal aid/insurance sufficient?

This paper: focus on borrowing costs

Treat hurricane as financial shock, where timing known precisely and borrowing need correlates with flood depth. Explore margins of response:

- ▶ Borrowing on existing cards.
- ▶ Borrowing on new cards.
- ▶ Borrowing using mortgage forbearance.

What we find

Households appear attentive to cost of borrowing.

- ► No change in revolving balances for standard credit cards outstanding at the time of the flood (estimated precisely).
- ► Large increases in credit cards with introductory rates, high balances (paid off quickly)
- ► Increased mortgage delinquency in flooded and non-flooded areas, as bank forbearance policies were broad.
- ► Mortgage delinquency rates normalize within a year, overwhelmingly through cures/mods; mortgage delinquency with forbearance functions as a short-term, low-interest loan.

Preparation/insurance lowers need for credit.

- ► Credit needs less pronounced in designated floodplain areas that were flooded.

Hurricane Harvey presents some advantages for researchers

Harvey is the largest rainfall event recorded in US history (Emanuel, 2017)

Harvey flooded coastal Texas with more than a **trillion gallons** of water in late August 2017, with parts of Houston receiving more than four feet (1.2 meters) of rain over just a few days (HCFCD, 2018). NOAA estimates > $125 billion in damages.

Offers important variation within treatment categories

- ▶ Variation in socioeconomic status (small average difference between affected and unaffected population)
- ▶ Variation in floodplain status (insurance, construction and flooding expectations).

Approach: Difference in difference estimator

▶ Compare credit use in areas more-and-less affected by Hurricane Harvey before and after the hurricane
  ▶ "0-2 months after": September - November
  ▶ "3-5 months after": December - February
▶ All regressions include month-year time dummies.
▶ Robustness tests for zip fe, zip-month fe, zip+4 fe, clustering at zip+4, zip, additional regressors.

$$y_{i,t} = \alpha + \beta_1 \times \textit{flood depth}_z + \beta_2 \times \textit{shortly after}_t \times \textit{flood depth}_z$$
$$+ \beta_3 \times \textit{well after}_t \times \textit{flood depth}_z + \gamma \times M_t + \varepsilon_{i,t}$$

(1)

Where $y_{i,t}$ is a particular outcome in time period t for loan (card) i located in zip+4 z.

Credit card and mortgage data

Data are from regulatory collection used for the Comprehensive Capital Analysis and Review (CCAR). (Also known as the Y14-monthly data.)

- ► Banks with >$50 billion in assets submit to CCAR.
- ► Cover 90% of outstanding credit card accounts and half of mortgages.

Data include detailed monthly account information, including:

- ► 9-digit zip code of the mailing address of the card-holder or the property address.
- ► Borrowing terms and payment flows.
- ► Information is at the card/mortgage level, not the household. We cannot link cards/mortgages to individuals or households.

Flooding in Houston

A flooded residential neighborhood near interstate 10 in Houston, Texas (Marcus Yam / Los Angeles Times)
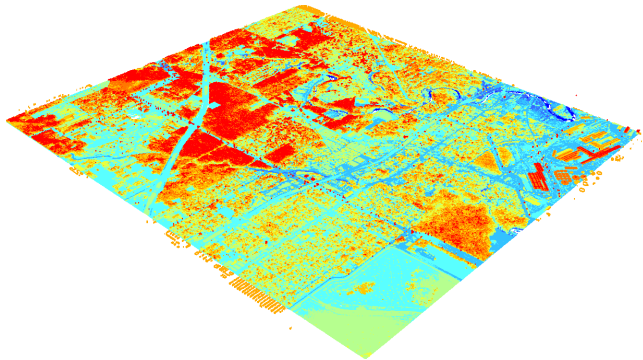
Measuring severity of Harvey (Illustration Jacinto City, Harris, TX)

LiDAR data is used to map elevation (3 meter resolution)

(a) Jacinto City, TX

(b) Neighborhood in Jacinto City
(Los Angeles Times photo)
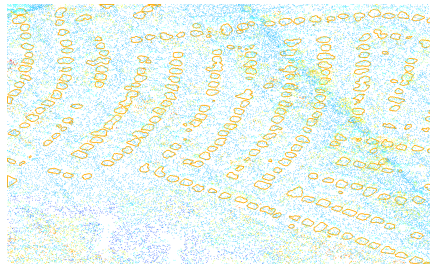
Measuring severity of Harvey (Illustration Jacinto City, Harris, TX)

FEMA's Harvey depth grids, High watermark surface (2755 input measurements) minus elevation

(c) Jacinto City, TX

(d) Neighborhood in Jacinto City (Los Angeles Times photo)

Flooding and ex-ante flood risk: Flooding severity in floodplain and non-floodplain areas
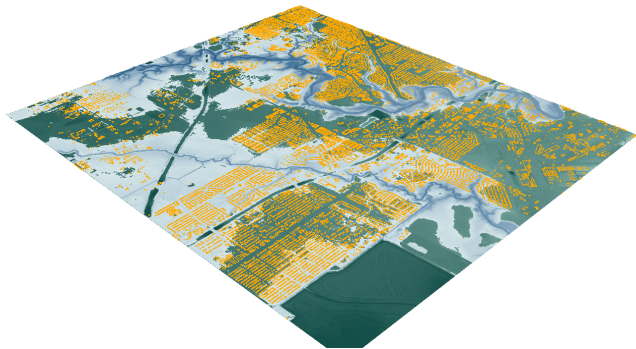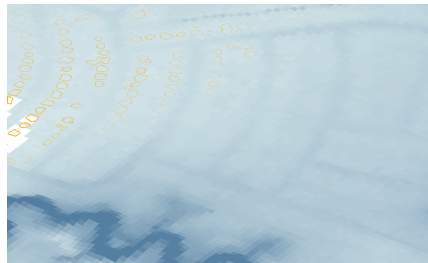
	Flooding			
	Less than 0.1 ft	0.1 to 1 ft	1 to 3 ft	More than 3 ft
Flood Plain	177,987	78,547	76,211	33,399
	4.7 %	30.8 %	41.2%	43.6%
Not flood plain	3,619,222	176,286	108,930	43,207
	95.3 %	69.2 %	58.8 %	56.4 %
Total	3,797,209	254,833	185,141	76,606
	100.0 %	100.0 %	100.0 %	100.0 %

Note: This table shows the count and the share of credit cards in the Y-14 data observed during our sample period (June 2016 - April 2018) by ex-ante exposure to flooding (floodplain and not floodplain) and observed flooding intensity. Columns add to 100%.

Means by flooding intensity, 3 months before Hurricane Harvey (June-August 2017)

	Flooding			
	Less than 0.1 ft	0.1 to 1 ft	1 to 3 ft	More than 3 ft
Charges ($)	305	349	342	396
Payments ($)	329	381	360	411
Cycle ending balance ($)	1,506	1,515	1,446	1,632
Revolving balance ($)	1,218	1,196	1,136	1,261
Fees ($)	21	21	20	21
Delinquency	1.4%	1.3%	1.4%	1.5%
Updated credit score	717	719	721	723
Current credit limit ($)	5,506	5,809	5,826	6,315

Note: All values are nominal dollars. Counts are unweighted and reflect unique card-months in the data.

Credit card charges (purchase volume) by flood depth

Those in affected areas saw relative increase in purchase volume.

Purchases on credit cards outstanding as off August 2017
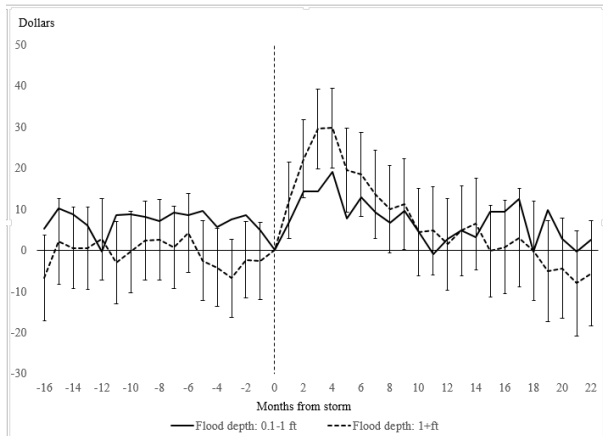
Credit card payments by flood depth

Payments in flooded areas increased relative to payments in unaffected areas.

Payments on credit cards outstanding as of August 2017

Dollars

Months from storm

—— Flood depth: 0.1-1 ft   ---- Flood depth: 1+ft
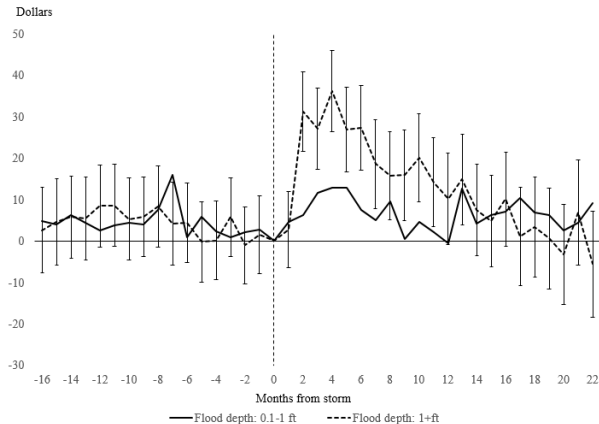
Balances (revolving)

Revolving balances in flooded areas did not show relative increases.

Revolving balances on credit cards outstanding as of August 2017

Dollars

Months from storm

—— Flood depth: 0.1-1 ft   ---- Flood depth: 1+ ft

Charges and payments move up in lock-step due to storm, balances remain unaffected

	Charges	Payments	Cycle ending balance	Revolving balance	Fees	Delinquency (logit)
Mean	302.57	334.98	1,488.25	1,204.87	20.44	0.014
0-2 mo after × flooding (ft)	13.10***	10.21***	9.844*	1.662	-0.0738	-0.020***
	(1.342)	(1.354)	(4.063)	(3.824)	(0.0528)	(0.006)
3-5 mo after × flooding (ft)	12.84***	16.21***	3.327	-3.944	-0.189***	0.000
	(3.049)	(2.997)	(3.802)	(3.459)	(0.0543)	(0.005)
6-8 mo after × flooding (ft)	9.114**	10.55**	-0.424	-3.942	-0.196**	0.006
	(3.468)	(3.401)	(4.255)	(3.947)	(0.0611)	(0.006)
9-11 mo after × flooding(ft)	6.205*	9.854**	-7.830	-9.576*	-0.258***	0.008
	(2.810)	(3.020)	(4.454)	(4.059)	(0.061)	(0.007)
Flooding (ft)	10.40***	10.77***	9.844*	1.662	-0.0738	-0.0203***
	(1.342)	(1.354)	(4.063)	(3.824)	(0.0528)	(0.006)
Card-months (millions)	17.1	17.1	17.1	17.1	17.1	17.1
R-squared	0.0003	0.0003	0.0006	0.0004	0.0009	0.0015

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Extensive margin: new card origination.

Origination characteristics for new cards originated in 3 months before Hurricane Harvey, by flooding intensity

|	Flooding			
	Less than 0.1 ft	0.1 to 1 ft	1 to 3 ft	More than 3 ft
Borrower income	87,343	83,341	75,837	82,998
Original credit score	704	705	707	707
Cobrand	0.1	0.1	0.1	0.1
Promotion	0.4	0.4	0.4	0.4
Credit limit	3,992	4,041	4,158	4,364
Retail APR	20.13	20.04	20.06	20.18
Effective APR	13.09	13.10	12.84	13.05

Note: All values are nominal dollars.

Extensive margin: New promotional cards

Large increase in originations of teaser cards (low interest promotional cards) ≈ 10% per foot of flooding

Table

Originations of new promotional cards, per thousand outstanding cards

Flood depth > 1 ft.

Feb.

Flood depth < 1 ft.
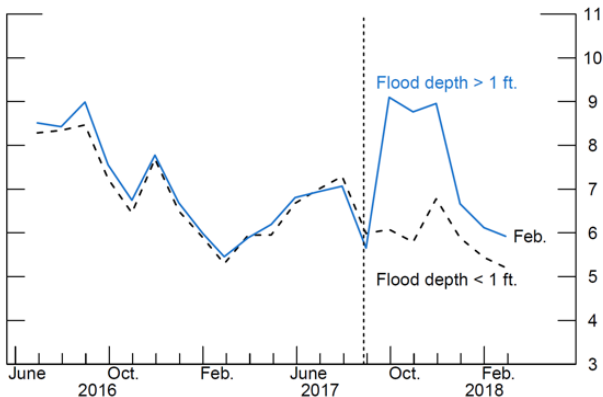
Source: Author's calculations based on CCAR Y14m data.
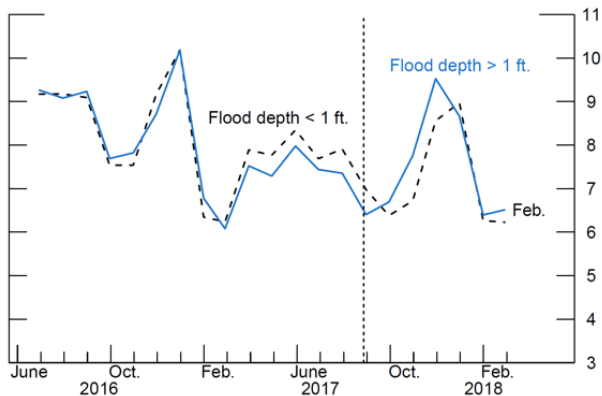
Extensive margin: New standard-rate cards

Muted differential response among standard cards (average APR: 20 percent) Table

Originations of standard credit cards, per thousand outstanding cards

Flood depth > 1 ft.

Flood depth < 1 ft.

Feb.

June | Oct. | Feb. | June | Oct. | Feb.
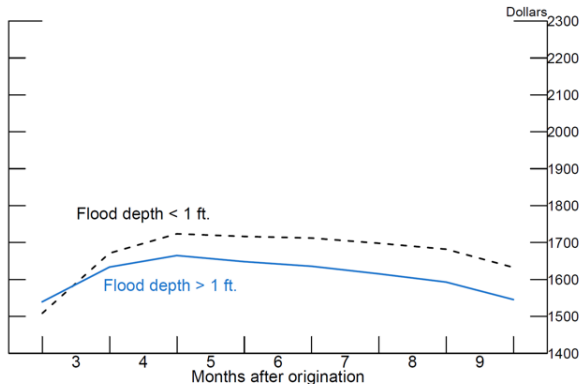2016 | | | 2017 | | 2018

Source: Author's calculations based on CCAR Y14m data.

Extensive margin: pre-storm revolving balances on promotional cards

Cards issued in the 3 months before the storm in flooded and unflooded areas have similar balance patterns over time

Revolving balance, promotional cards issued May-Jul 2017

Source: Author's calculations based on CCAR Y14m data.

Extensive margin: Revolving balances on promotional cards

Balances on new promotional cards issued after the storm are much higher in flooded areas. Balances are paid off unusually quickly.

Revolving balances for promotional cards issued Sept-Nov 2017
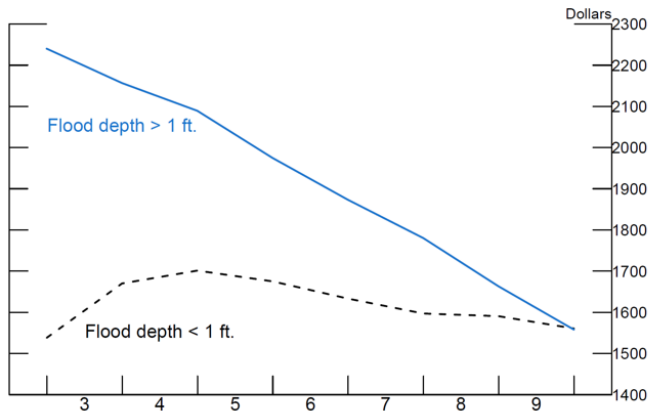
Source: Author's calculations based on CCAR Y14m data.

Role of insurance/preparation

▶ Among those in floodplains, where structures are better prepared to withstand flooding and flooding insurance required on homes with mortgages:

  ▶ Significantly fewer new promotional card originations `Table`
  ▶ Lower revolving balances on new promotional cards `Table`

Other sources of credit

Harvey damage was local; mortgage forbearance offers were widespread

We live here. We serve here.
OUR HEARTS ARE HERE.
#TexasStrong #PrayForTexas

Cornerstone
HOME LENDING, INC.

AT CORNERSTONE HOME LENDING, WE ARE STANDING WITH YOU TO FACE THE DEVASTATION OF HURRICANE HARVEY.

We are prepared to take immediate action to help you while all the details of your financial impact and obligations are being sorted out.

OFFER OF FORBEARANCE

If you have been directly impacted either due to property damage and/or financially from the recent disaster, you qualify for a forbearance of your monthly mortgage payments for a minimum of 3 months in order to recover from this difficult time. During the forbearance period, payments are not required. Also, credit reporting and late charges will be suppressed for the duration of the plan. Unpaid payments during the forbearance period will become due at the conclusion of the forbearance plan. However, towards the end of the plan period, your hardship and financial status will be reassessed to determine eligibility for further workout options, which may include an extension of the plan or a loan modification and may have additional eligibility requirements. You will receive a letter with the terms of the plan.

Forbearance for mortgages but not for credit cards

(e) 6-month change in credit score following new mortgage delinquency
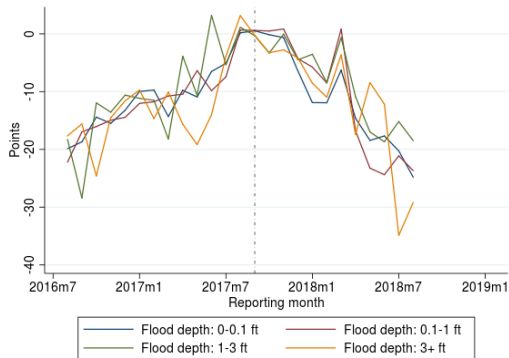
(f) 6-month change in credit score following new credit card delinquency
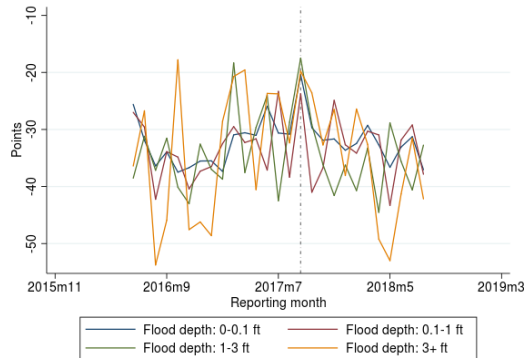
Foreclosure conditional on serious delinquency declined in all areas

(g) Share of loans in serious delinquency (90+ days) starting foreclosure
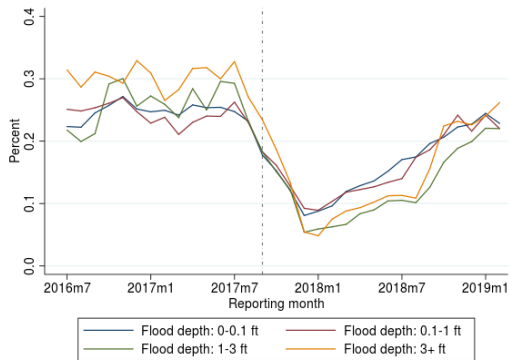
Delinquencies spiked in all areas

Most new delinquencies were in non-flooded areas

(h) Share of mortgage loans in delinquency
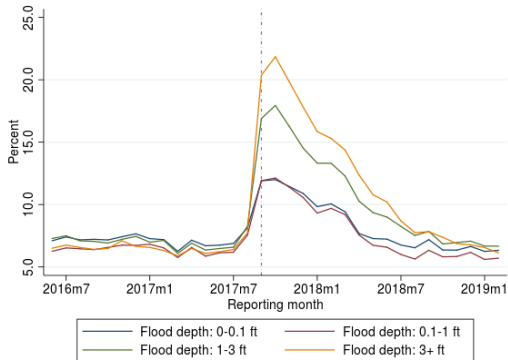
(i) Share of current loans rolling delinquent
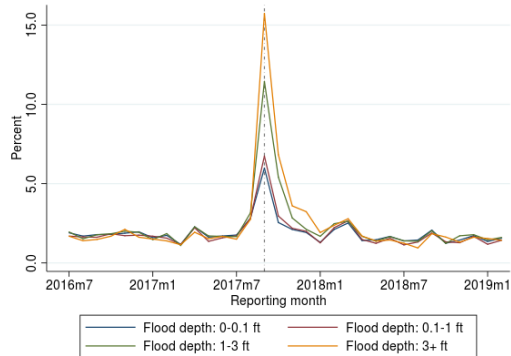
Payment history for new delinquencies in impacted areas cleaner

But all areas saw borrowers with cleaner payment histories missing payments

(j) Share of new delinquencies that were delinquent within previous 6 months
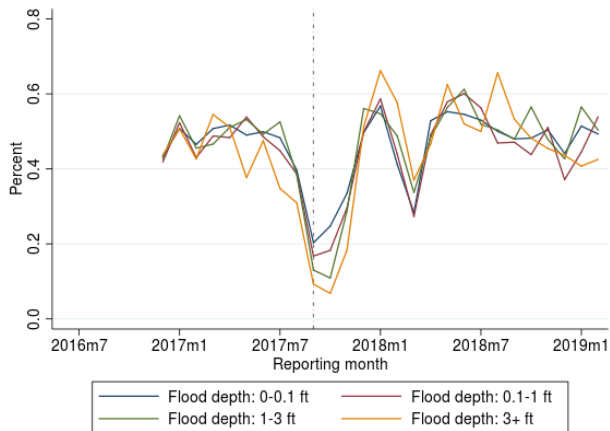
Conclusion

- ► Households appear (surprisingly?) resourceful: preferentially access inexpensive credit.
    - ► No change in revolving balances for existing, standard-APR credit cards
    - ► Large increases in new credit cards in affected areas.
        - ► Teaser cards (temporary zero) rates and high balances, paid off quickly, not carried through reset.
    - ► Servicer-sanctioned short-term delinquency used for additional borrowing at mortgage rate.
- ► Floodplain designation and bank/servicer credit policy important for determining storm impact on households.
    - ► Floodplain designation -> less intensive use of credit.
    - ► Within storm-impacted areas, forbearance flexibility the most heavily used form of borrowing.

Heterogeneity in response by floodplain (ex-ante risk)

Muted response by those in floodplain (homes better prepared to withstand flooding)

	Charges	Payments	Cycle ending balance	Revolving balance	Fees	Delinquency (logit)
0-2 months after × flooding (ft)	14.70***	12.04***	5.280	-2.736	-0.0551	0.0137
	(2.059)	(2.081)	(4.800)	(4.425)	(0.0589)	(0.008)
3-5 months after × flooding (ft)	13.85***	17.96***	9.706	1.315	-0.169*	-0.002
	(2.315)	(2.356)	(5.909)	(5.356)	(0.076)	(0.009)
6-8 months after × flooding (ft)	8.601***	10.64***	8.092	3.819	-0.091	-0.000
	(2.326)	(2.496)	(7.011)	(6.597)	(0.091)	(0.010)
9-11 months after × flooding (ft)	6.279*	10.91***	3.737	-0.925	-0.167	-0.005
	(2.704)	(2.873)	(7.456)	(6.826)	(0.095)	(0.010)
0-2 mo after × flooding (ft) × floodplain	-5.589	-5.230	-10.22	-5.536	-0.020	-0.004
	(3.781)	(3.645)	(6.754)	(6.375)	(0.095)	(0.010)
3-5 mo after × flooding (ft) × floodplain	-5.908	-8.377	-14.49	-10.31	0.0364	0.00344
	(4.637)	(4.618)	(8.089)	(7.374)	(0.118)	(0.012)
6-8 mo after × flooding (ft) × floodplain	-2.824	-3.743	-18.49*	-16.43*	-0.160	0.0107
	(5.279)	(5.301)	(8.984)	(8.361)	(0.122)	(0.013)
9-11 mo after × flooding (ft) × floodplain	-4.151	-6.555	-23.90*	-19.00*	-0.0973	0.020
	(4.777)	(5.027)	(9.456)	(8.680)	(0.129)	(0.013)
Card-months (unweighted)	16.1	16.1	16.1	16.1	16.1	16.1
R-squared	0.0003	0.0002	0.0007	0.0005	0.0010	0.0015

Back

Extensive margin: New cards

Large increase in originations of Teaser cards (zero interest promotional cards)

	All cards	Teasers	Non-teasers
Mean (new cards/month per thousand zip+4)	152.8	70.05	82.73
0-2 mo after $\times$ flooding (ft)	9.202***	7.366***	1.836***
	(0.682)	(0.479)	(0.460)
3-5 mo after $\times$ flooding (ft)	0.284	1.060**	-0.775
	(0.597)	(0.398)	(0.429)
Count (9-digit zips x months, mill)	5.7	5.7	5.7
R-squared	0.002	0.001	0.002

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R-squared	0.002	0.001	0.002

Back

Revolving balances at 2, 4, and 6 months after origination

Teaser cards are use to build large balances that are quickly paid-off

	Revolving Balance		
	2 months after origination	4 months after origination	6 months after origination
Teaser cards			
Mean	1,315.12	1,493.92	1,479.95
0-2 mo after × flooding (ft)	222.41***	125.80***	90.33***
	(24.14)	(21.09)	(19.60)
3-5 mo after × flooding (ft)	106.06***	101.65***	109.14***
	(20.63)	(23.19)	(34.92)
Flooding (ft)	20.89*	15.53	4.50
	(10.90)	(10.13)	(9.74)
Cards	393,076	436,186	407,016
R-squared	0.0081	0.0051	0.0034

Back

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Back

Characteristics of borrowers who are induced to get new cards

This group of borrowers tends to be better-off

	Borrower income (winsorized)	Credit score	Credit limit	Cobranded	Retail APR
Means	68,275.42	698	3644.32	0.13	19.9
0-2 mo after × flooding (ft)	1901.26***	3.48***	83.21***	0.01***	-0.05
	(318.59)	(0.47)	(27.20)	(0.00)	(0.04)
3-5 mo after × flooding (ft)	692.12***	0.87**	23.12	0.01***	0.07*
	(268.48)	(0.40)	(23.06)	(0.00)	(0.04)
0-2 mo after × flooding (ft) × teaser	1,704.83***	2.04***	283.00***	-0.01***	1.32***
	(433.52)	(0.63)	(37.11)	(0.00)	(0.06)
3-5 mo after × flooding (ft) × teaser	1,022.70***	1.30**	218.23***	-0.01***	0.54***
	(393.13)	(0.57)	(33.76)	(0.00)	(0.06)
Flooding (ft) × teaser	-46.97	-1.12***	-58.60***	0.00	0.08***
	(185.79)	(0.27)	(15.95)	(0.00)	(0.03)
Counts (cards)	1,009,540	913,423	1,015,721	1,015,721	1,008,670
R-squared	0.007	0.041	0.073	0.003	0.191

Back

Characteristics of borrowers who are induced to get new cards

This group of borrowers tends to be better-off

	Borrower income (winsorized)	Credit score	Credit limit	Cobranded	Retail APR
Means	68,275.42	698	3644.22	0.13	19.9
0-2 mo after × flooding (ft)	1901.26***	3.48***	83.21***	0.01***	-0.05
	(318.59)	(0.47)	(27.20)	(0.00)	(0.04)
3-5 mo after × flooding (ft)	692.12***	0.87**	23.12	0.01***	0.07*
	(268.48)	(0.40)	(23.06)	(0.00)	(0.04)
0-2 mo after × flooding (ft) × teaser	1,704.83***	2.04***	283.00***	-0.01***	1.32***
	(433.52)	(0.63)	(37.11)	(0.00)	(0.06)
3-5 mo after × flooding (ft) × teaser	1,022.70***	1.30**	218.23***	-0.01***	0.54***
	(393.13)	(0.57)	(33.76)	(0.00)	(0.06)
Flooding (ft) × teaser	-46.97	-1.12***	-58.60***	0.00	0.08***
	(185.79)	(0.27)	(15.95)	(0.00)	(0.03)
Counts (cards)	1,009,540	913,423	1,015,721	1,015,721	1,008,670
R-squared	0.007	0.041	0.073	0.003	0.191

Back

New cards in floodplains

Significantly fewer originations

	All cards	Teasers	Non-teasers
Mean (new cards/month per thousand zip+4)	152.8	70.05	82.73
0-2 mo after $\times$ flooding (ft)	15.62***	12.55***	3.067***
	(1.173)	(0.840)	(0.776)
3-5 mo after $\times$ flooding (ft)	0.876	2.178**	-1.302
	(1.014)	(0.686)	(0.717)
0-2 mo after $\times$ flooding (ft) $\times$ floodplain	-11.98***	-9.449***	-2.531*
	(1.515)	(1.060)	(1.027)
3-5 mo after $\times$ flooding (ft) $\times$ floodplain	-0.802	-1.656	0.854
	(1.331)	(0.891)	(0.954)
Month-year controls	Yes	Yes	Yes
Triple-difference interaction controls	Yes	Yes	Yes
Count (zip+4$\times$months, mil)	5.0	5.0	5.0
R-squared	0.002	0.002	0.002

Back

New cards in floodplains

Significantly fewer originations

	All cards	Teasers	Non-teasers
Mean (new cards/month per thousand zip+4)	153.8	70.95	82.79
0-2 mo after $\times$ flooding (ft)	15.62***	12.55***	3.067***
	(1.173)	(0.840)	(0.776)
3-5 mo after $\times$ flooding (ft)	0.876	2.178**	-1.302
	(1.014)	(0.686)	(0.717)
0-2 mo after $\times$ flooding (ft) $\times$ floodplain	-11.98***	-9.449***	-2.531*
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	(1.331)	(0.891)	(0.954)
Month-year controls	Yes	Yes	Yes
Triple-difference interaction controls	Yes	Yes	Yes
Count (zip+4$\times$months, mil)	5.0	5.0	5.0
R-squared	0.002	0.002	0.002

Back

New cards in floodplains

Lower revolving balances on these new cards

	Revolving Balance		
	2 months after origination	4 months after origination	6 months after origination
Teaser cards			
0-2 mo after $\times$ flooding (ft)	403.7***	251.3***	179.1***
	(51.32)	(43.15)	(40.48)
3-5 mo after $\times$ flooding (ft)	156.1**	146.7***	94.13*
	(49.77)	(44.45)	(41.59)
0-2 mo after $\times$ flooding (ft) $\times$ floodplain	-343.9***	-208.0***	-146.9*
	(72.13)	(61.35)	(57.40)
3-5 mo after $\times$ flooding (ft) $\times$ floodplain	-154.5*	-169.1**	-102.6
	(70.72)	(60.05)	(54.97)
Cards	261,835	341,283	352,012
R-squared	0.0085	0.0055	0.0038
Month-year controls	Yes	Yes	Yes
Triple-difference interaction controls	Yes	Yes	Yes

New cards in floodplains

Lower revolving balances on these new cards

| | Revolving Balance | | |
	2 months after origination	4 months after origination	6 months after origination
Teaser cards			
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	(70.72)	(60.05)	(54.97)
Cards	261,835	341,283	352,012
R-squared	0.0085	0.0055	0.0038
Month-year controls	Yes	Yes	Yes
Triple-difference interaction controls	Yes	Yes	Yes