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"Public Flood Risk Mitigation and the Homeowner's Insurance Demand Response"

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## **Appendix**

Table A1: Definitions of variables and sources of data

Variable	Description
Insurance Policies-in-force	Number of National Flood Insurance Program insurance policies-in-force. Insurance policies-in-force are measured for each community in each year. <i>Source:</i> FEMA via a Freedom of Information Act request
total points	Number of Community Rating System (CRS) points earned. <i>Source:</i> <a href="https://crsresources.org">https://crsresources.org</a> via email correspondence
RC points	Number of risk communication points earned in the CRS program. Risk communication points are earned with the following CRS activities: 310, 320, 330, 340, 350, 360, 410 and 440. <i>Source:</i> <a href="https://crsresources.org">https://crsresources.org</a> via email correspondence
HM points	Number of hazard mitigation points earned. Hazard mitigation points are earned with the following CRS activities: 420, 430, 450, 510, 520, 530, 540, 610, 620 and 630. <i>Source:</i> <a href="https://crsresources.org">https://crsresources.org</a> via email correspondence
Class	CRS class achieved. Class 9 is the entrance class into the program and class 1 is the best achievable class. Class 9 communities earn a 5% discount on their insurance premiums for properties located inside the Special Flood Hazard Area, and class 1 communities earn a 45% discount. CRS classes correspond to the number of CRS points earned. <i>Source:</i> <a href="https://crsresources.org">https://crsresources.org</a> via email correspondence
PDD disaster declaration	Dummy variable equal to 1 if a Presidential Disaster Declaration (PDD) was announced in a community's county. PDDs open the possibility for federal aid, and are declared if local disaster recovery resources are deemed insufficient for a county's recovery. <i>Source:</i> FEMA via their data portal: <a href="https://www.fema.gov/data-sets">https://www.fema.gov/data-sets</a>
Mean flood damage claim	Average flood insurance claim in a community's county. <i>Source:</i> FEMA via their data portal: <a href="https://www.fema.gov/data-sets">https://www.fema.gov/data-sets</a>
Median income	Median household income in each county. For 2009-2017, income estimates come from the American Community Survey (ACS) five-year data. For 2008, income estimates come from the ACS three-year data. Counties not present in the 2008 data are given estimates from their nearest county neighbor estimated by centroid. <i>Source:</i> U.S. Census Bureau <a href="https://data.census.gov/cedsci/">https://data.census.gov/cedsci/</a>
House value	Average single-family home value. Counties not present in the data are given estimates from their nearest county neighbor by centroid. <i>Source:</i> Zillow via <a href="https://www.zillow.com/research/data/">https://www.zillow.com/research/data/</a>
Total insurance premiums divided by total coverage less total deductibles. This is only for properties with subsidized insurance premiums and it is estimated at the county-level. <i>Source:</i> FEMA via their data portal: <a href="https://www.fema.gov/data-sets">https://www.fema.gov/data-sets</a>	
Household mortgage	Number of mortgage holders in each county. For 2009-2017, mortgage holder estimates come from the ACS five-year data. For 2008, mortgage holder estimates come from the ACS three-year data. Counties not present in the 2008 data are given estimates from their nearest county neighbor estimated by centroid. <i>Source:</i> U.S. Census Bureau <a href="https://data.census.gov/cedsci/">https://data.census.gov/cedsci/</a>
Manual2013	Dummy variable equal to 1 if a CRS community falls under the 2013 manual's scoring scheme. <i>Source:</i> <a href="https://crsresources.org">https://crsresources.org</a> via email correspondence
Sheldus damage per capita	Average dollar damage per capita according to the SHELUDS database for each county. <i>Source:</i> <a href="https://sheldus.asu.edu">https://sheldus.asu.edu</a>
Education	Percentage of population age 25-plus with at least a bachelor's degree in each county. For 2010-2017, income estimates come from the American Community Survey (ACS) five-year data. Estimates for 2008 and 2009 are linearly extrapolated. <i>Source:</i> U.S. Census Bureau <a href="https://data.census.gov/cedsci/">https://data.census.gov/cedsci/</a>
Flooding frequency	Count of PDD floods declared in the county a community is located in from 1990 to 2020. <i>Source:</i> FEMA via their data portal: <a href="https://www.fema.gov/data-sets">https://www.fema.gov/data-sets</a>
Hazard type	Dummy variable equal to 1 if a community faces coastal flood hazard; 0 if a community faces riverine flood hazard. <i>Source:</i> FEMA via CEPTCommunityData: <a href="https://www.arcgis.com/home/item.html?id=407442d5e8dc447aabe2b09fb698adad">https://www.arcgis.com/home/item.html?id=407442d5e8dc447aabe2b09fb698adad</a>

Table A2: Descriptive statistics

	Mean	Std.Dev	Min	Max
<i>Dependent Variable</i>				
Insurance policies-in-force	2,404.60	8,146.07	1	151,613.00
<i>Independent variables</i>				
RC points	485.35	186.59	53.07	1,397.25
HM points	926.62	433.10	114.90	3,824.61
Class 9	0.15	0.36	0	1
Class 8	0.36	0.48	0	1
Class 7	0.26	0.44	0	1
Class 6	0.15	0.36	0	1
Class 5 and below	0.08	0.27	0	1
PDD disaster declaration	0.18	0.38	0	1
mean flood damage claim	7,7795.51	11,766.51	0	194,406.20
house value	239,282.50	158,395.20	43,190.00	2,880,271.00
BW/HFIAA	0.01	0.00	0.00	0.02
household mortgage	114,498.30	159,632.50	531.00	1,200,858.00
median income	55,910.50	14,211.06	27,545.00	122,844.00
education	29.40	9.93	7.21	80.21
flood frequency	9.04	6.80	0	27
hazard type	0.28	0.45	0	1

Notes: Observations: 10,355. Mean flood claim in 1,000 USD.

Table A3: Different fixed effects structure

	(State-year)		(MSA-year)	
	Coef.	SE	Coef.	SE
RC points (in 100)	0.005**	(0.002)	0.008***	(0.004)
HM points (in 100)	-0.009***	(0.002)	-0.007*	(0.003)
Class 8	0.063**	(0.031)	0.054**	(0.027)
Class 7	0.062*	(0.035)	0.043	(0.030)
Class 6	0.130**	(0.063)	0.104*	(0.053)
Class 5 and below	0.206**	(0.090)	0.157*	(0.088)
Additional controls	Yes		Yes	
Community FX	Yes		Yes	
State-year FX	Yes		No	
MSA-year FX	No		Yes	
Observations	10,355		10,355	
pseudo R <sup>2</sup>	0.994		0.996	

Notes: Dependent variable is the number of insurance policies-in-force. \*, \*\*, \*\*\* indicate 10, 5, 1 % significance levels. Robust standard errors in parenthesis, clustered at the metropolitan statistical area level. Mean flood damage claim in 1,000 USD. Constant included but not reported.

Table A4: Separate regression for RC and HM variables

	RC model		HM model		Full model	
	Coef.	SE	Coef.	SE	Coef.	SE
RC points (in 100)	0.010**	(0.005)	—	—	0.008**	(0.004)
HM points (in 100)	—	—	−0.007**	(0.004)	−0.007**	(0.003)
Class 8	0.037*	(0.021)	0.066**	(0.031)	0.054**	(0.027)
Class 7	0.016	(0.031)	0.064**	(0.031)	0.043	(0.030)
Class 6	0.057	(0.040)	0.137**	(0.061)	0.104*	(0.053)
Class 5 and below	0.095	(0.063)	0.200*	(0.103)	0.157*	(0.088)
Other Controls			Yes			
Community FX			Yes			
MSA-year FX			Yes			
Observations			10,355			

Notes: Dependent variable is the the number of insurance policies-in-force. \*, \*\*, \*\*\* indicate 10, 5, 1 % significance levels. Robust standard errors in parenthesis, clustered at the metropolitan statistical area level. Mean flood damage claim in 1,000 USD. First (Second) model is based on RC (HM) information only. Full model includes both RC and HM information. Constant and other control variables included but not reported.

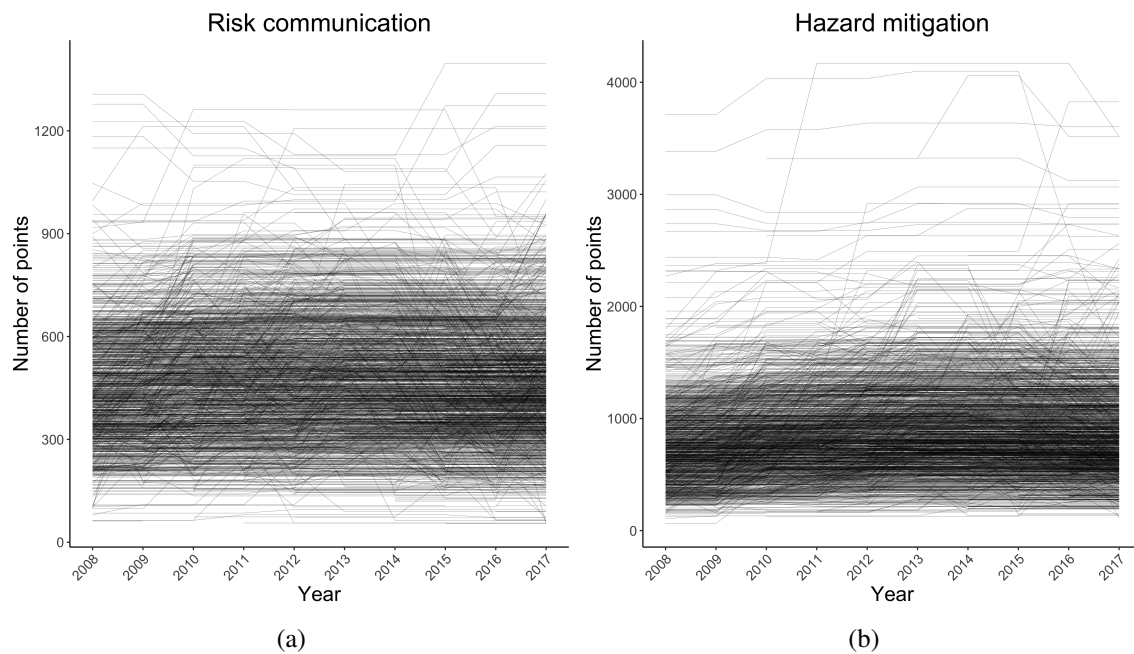


Figure 3: Within-community variation for each point type. Notes: Each line illustrates the temporal development of risk communication or hazard mitigation points for a single CRS community.

Table A5: The impact of CRS on flood insurance penetration (May data)

	(1)		(2)		(3)	
	Coef.	SE	Coef.	SE	Coef.	SE
RC points (in 100)					0.011**	(0.005)
HM points (in 100)					−0.008*	(0.004)
total points (in 100)	0.004	(0.003)	−0.003	(0.003)		
Class 8			0.077**	(0.037)	0.070**	(0.035)
Class 7			0.072*	(0.044)	0.057	(0.041)
Class 6			0.133**	(0.071)	0.113*	(0.065)
Class 5 and below			0.197*	(0.113)	0.170*	(0.099)
PDD disaster declaration year (t)	−0.074*	(0.038)	−0.068**	(0.032)	−0.065**	(0.027)
t-1 PDD	−0.019	(0.020)	−0.019	(0.016)	−0.018	(0.015)
t-2 PDD	0.030	(0.045)	0.034	(0.047)	0.033	(0.046)
t-3 PDD	0.079*	(0.049)	0.074*	(0.041)	0.065*	(0.035)
mean flood damage claim year (t)	0.001	(0.001)	0.000	(0.001)	0.000	(0.001)
t-1 flood	0.002**	(0.001)	0.001**	(0.001)	0.001**	(0.001)
t-2 flood	0.001*	(0.001)	0.001*	(0.001)	0.001*	(0.001)
t-3 flood	0.002**	(0.001)	0.002**	(0.001)	0.001**	(0.001)
(ln) median income	0.706**	(0.302)	0.672**	(0.307)	0.610*	(0.314)
(ln) house value	0.230	(0.146)	0.222	(0.141)	0.236*	(0.144)
(ln) BW/HFIAA	0.157	(0.163)	0.187	(0.172)	0.179	(0.176)
(ln) household mortgage	0.133	(0.183)	0.132	(0.172)	0.082	(0.164)
Community FX	Yes		Yes		Yes	
MSA-year FX	Yes		Yes		Yes	
Observations	10,355		10,355		10,355	
pseudo R <sup>2</sup>	0.996		0.996		0.996	

Notes: Dependent variable is the number of insurance policies-in-force. \*, \*\*, \*\*\* indicate 10, 5, 1 % significance levels. Robust standard errors in parenthesis, clustered at the metropolitan statistical area level. Mean flood damage claim in 1,000 USD. Constant included but not reported.

Table A6: Additional controls

	(1)		(2)		(3)	
	Coef.	SE	Coef.	SE	Coef.	SE
RC points (in 100)	0.005*	(0.003)	0.009***	(0.003)	0.008**	(0.003)
HM points (in 100)	−0.003*	(0.002)	−0.004*	(0.002)	−0.007**	(0.003)
Class 8	0.036	(0.030)	0.048*	(0.026)	0.056**	(0.026)
Class 7	0.017	(0.042)	0.033	(0.032)	0.047*	(0.028)
Class 6	0.073	(0.051)	0.088*	(0.050)	0.106**	(0.052)
Class 5 and below	0.103*	(0.064)	0.133*	(0.076)	0.158*	(0.085)
Median age	0.113**	(0.050)				
Male/Female			−0.029*	(0.018)		
Education					0.018	(0.167)
Additional controls	Yes		Yes		Yes	
Community FX	Yes		Yes		Yes	
MSA-year FX	Yes		Yes		Yes	
Observations	10,355		10,355		10,355	
pseudo R <sup>2</sup>	0.996		0.996		0.996	

Notes: Dependent variable is the number of insurance policies-in-force. \*, \*\*, \*\*\* indicate 10, 5, 1 % significance levels. Robust standard errors in parenthesis, clustered at the metropolitan statistical area level. Mean flood damage claim in 1,000 USD. Constant included but not reported.

Table A7: Lagged CRS effect

	(CRS effect)	
	Coef.	SE
RC points <sub>t-1</sub> (in 100)	0.009	(0.006)
HM points <sub>t-1</sub> (in 100)	-0.007***	(0.002)
Class 8 <sub>t-1</sub>	0.071**	(0.036)
Class 7 <sub>t-1</sub>	0.050	(0.035)
Class 6 <sub>t-1</sub>	0.116**	(0.060)
Class 5 and below <sub>t-1</sub>	0.161*	(0.085)
PDD disaster declaration year (t)	-0.032**	(0.015)
t-1 PDD	-0.012	(0.013)
t-2 PDD	0.020	(0.036)
t-3 PDD	0.066**	(0.038)
mean flood damage claim year (t)	0.001*	(0.000)
t-1 flood	0.002**	(0.001)
t-2 flood	0.001*	(0.001)
t-3 flood	0.001**	(0.001)
(ln) median income	0.150	(0.367)
(ln) house value	0.212	(0.272)
(ln) BW/HFIAA	0.283	(0.202)
(ln) household mortgage	0.640**	(0.287)
Community FX	Yes	
MSA-year FX	Yes	
Observations	9,467	
adj. R <sup>2</sup>	0.996	

Notes: Dependent variable is the the number of insurance policies-in-force. \*, \*\*, \*\*\* indicate 10, 5, 1 % significance levels. Robust standard errors in parenthesis, clustered at the metropolitan statistical area level. Mean flood damage claim in 1,000 USD. Constant included but not reported.

Table A8: Comparing CRS communities to non-CRS communities

	CRS		non-CRS	
	Mean	Std. Dev	Mean	Std. Dev
Insurance policies-in-force	2,404.60	8,146.07	78.89	508.20
PDD disaster declaration	0.18	0.38	0.13	0.34
mean flood damage claim	7,7795.51	11,766.51	5,661.90	10,973.34
median income	55,910.50	14,211.06	50,673.00	13,804.81
house value	239,282.50	158,395.20	160,547.00	106,902.90
BW/HFIAA	0.01	0.00	0.01	0.00
household mortgage	114,498.30	159,632.50	49,982.00	117,677.50

Notes: CRS observations: 10,355. non-CRS observations: 164,272.

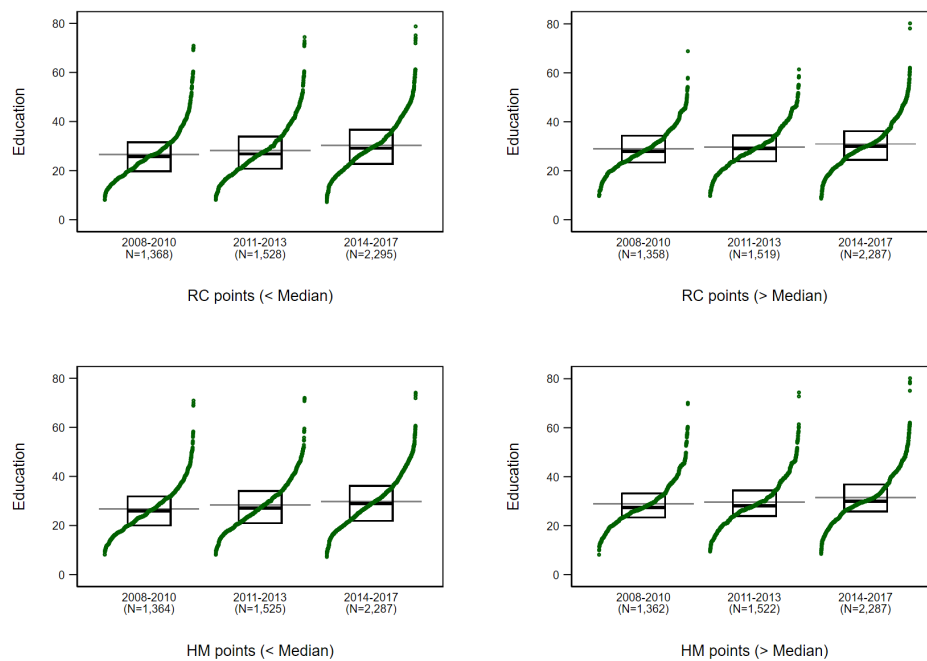


Figure 4: Group composition changes over time (Education). *Notes:* Education measured as percentage of population 25+ years old with a bachelor's degree or higher at the county level. The two panels on the left depict changes in the educational level over time for the below median group in RC points (top panel) or HM points (bottom panel), respectively. The two panels on the right show changes for the above median groups. The boxes show medians and the 25<sup>th</sup> and 75<sup>th</sup> quartiles. The added longer lines depicts the means. The dots represents the distribution of the data.



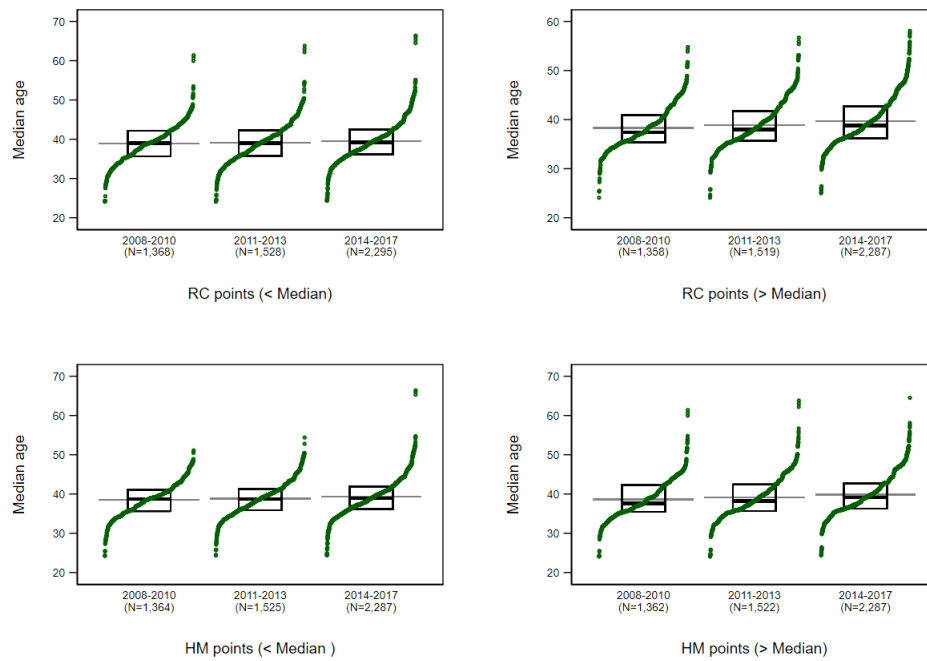


Figure 5: Group composition changes over time (Median age). *Notes:* Median age measured at the county level. Number of observations in parentheses. The two panels on the left depict changes in the median age over time for the below median group in RC points (top panel) or HM points (bottom panel), respectively. The two panels on the right show changes for the above median groups. The boxes show medians and the 25<sup>th</sup> and 75<sup>th</sup> quartiles. The added longer lines depicts the means. The dots represents the distribution of the data.

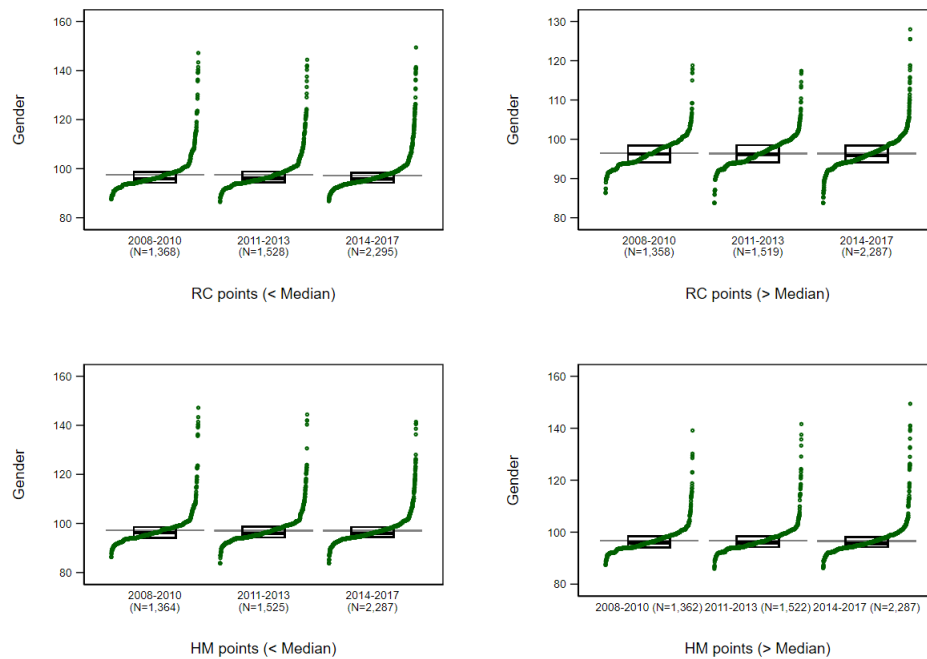


Figure 6: Group composition changes over time (Gender). *Notes:* Gender measured as the number of males per 100 females at the county level. Number of observations in parentheses. The two panels on the left depict changes in gender distribution over time for the below median group in RC points (top panel) or HM points (bottom panel), respectively. The two panels on the right show changes for the above median groups. The boxes show medians and the 25<sup>th</sup> and 75<sup>th</sup> quartiles. The added longer lines depicts the means. The dots represent the distribution of the data.