Internet appendix for "An inconvenient cost: the effects of climate change on municipal bonds"

Marcus Painter[a,b]

[a] *Gatton College of Business and Economics, University of Kentucky, Lexington, KY 40506, USA*
[b] *Richard A. Chaifetz School of Business, Saint Louis University, St. Louis, MO 63108, USA*

Abstract

This online appendix tabulates the results of robustness checks mentioned in the paper.

Email address: marcus.painter@uky.edu (Marcus Painter)

Table A.1

Maturity: robustness.

This table presents robustness checks for the regressions reported in Table 5. Panel A drops all observations for bonds that were issued in Orleans Parish. Panel B also drops all observations for bonds issued in coastal counties that are not assigned a climate risk in Hallegatte et al. (2013). The dependent variable is the total annualized issuance cost of a municipal bond. t-statistics, based on errors clustered by county, are in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Panel A: No New Orleans

			Long-term					Short-term		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Issue maturity:	≥ 20 Years	≥ 30 Years	≥ 2036	≥ 2041	≥ 2046	< 20 Years	< 30 Years	< 2036	< 2041	< 2046
Ln(Climate risk)	0.164	0.862**	0.208	0.707*	2.091**	0.011	0.064	0.058	0.077	0.078
	(1.161)	(2.583)	(1.158)	(1.646)	(2.590)	(0.085)	(0.503)	(0.457)	(0.606)	(0.613)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	46,155	6,659	25,281	8,484	2,092	204,421	243,832	225,273	242,019	248,381
R-squared	0.368	0.232	0.339	0.222	0.160	0.227	0.309	0.293	0.320	0.322

Panel B: No unobserved coastal

			Long-term					Short-term		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Issue maturity:	≥ 20 Years	≥ 30 Years	≥ 2036	≥ 2041	≥ 2046	< 20 Years	< 30 Years	< 2036	< 2041	< 2046
Ln(Climate risk)	0.110	0.849**	0.205	1.078**	3.028***	-0.055	-0.034	-0.039	-0.027	-0.031
	(0.651)	(2.230)	(0.957)	(2.289)	(2.853)	(-0.309)	(-0.192)	(-0.218)	(-0.155)	(-0.177)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	39,592	5,735	21,776	7,267	1,828	173,518	207,304	191,320	205,774	211,198
R-squared	0.348	0.219	0.314	0.208	0.146	0.200	0.277	0.262	0.287	0.289

Table A.2

Maturity: yield and gross spread.

This table presents results for yield and gross spread separately for the regressions reported in Table 5. Panel A shows results for the long-term specifications. Panel B shows results for short-term specifications. Columns 1 through 5 report results for yield. Columns 6 through 10 report results for gross spread. t-statistics, based on errors clustered by county, are in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Panel A: Long-term specifications

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Issue maturity:	≥ 20 Years	≥ 30 Years	≥ 2036	≥ 2041	≥ 2046	≥ 20 Years	≥ 30 Years	≥ 2036	≥ 2041	≥ 2046
Dependent variable:	Yield	Yield	Yield	Yield	Yield	Spread	Spread	Spread	Spread	Spread
Ln(Climate risk)	0.231**	0.457	0.205*	0.288	0.663***	0.134*	0.203*	0.170*	0.178	0.217
	(2.215)	(1.632)	(1.640)	(1.316)	(2.805)	(1.785)	(1.691)	(1.878)	(1.258)	(0.799)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	65,248	9,108	31,107	9,998	2,458	52,623	9,430	29,285	9,954	2,599
R-squared	0.547	0.496	0.630	0.608	0.685	0.339	0.371	0.383	0.446	0.514

Panel B: Short-term specifications

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Issue maturity:	< 20 Years	< 30 Years	< 2036	< 2041	< 2046	< 20 Years	< 30 Years	< 2036	< 2041	< 2046
Dependent variable:	Yield	Yield	Yield	Yield	Yield	Spread	Spread	Spread	Spread	Spread
Ln(Climate risk)	0.061	0.087	0.078	0.094	0.093	0.021	0.040	0.023	0.037	0.041
	(0.754)	(1.024)	(0.969)	(1.159)	(1.149)	(0.224)	(0.449)	(0.257)	(0.420)	(0.470)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	253,876	309,946	287,994	309,040	316,559	206,242	249,357	229,563	248,841	256,166
R-squared	0.817	0.837	0.841	0.841	0.838	0.301	0.314	0.305	0.309	0.311

Table A.3

Placebo tests: yield and gross spread.

This table presents results for the regressions shown in Table 6 with yield and gross spread reported separately. Panel A shows results for various long-term specifications for the geographic matching placebo tests. Panel B shows results for various long-term specifications for the nearest neighbor matching placebo tests. The results for yield are reported in columns 1 through 6, and the results for gross spread are reported in columns 7 through 12. *t*-statistics, based on errors clustered by county, are in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Panel A: Geographic matching

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Issue maturity:	≥ 20Yr	≥ 25Yr	≥ 30Yr	≥2036	≥2041	≥2046	≥ 20Yr	≥ 25Yr	≥ 30Yr	≥ 2036	≥ 2041	≥ 2046
Dependent var:	Yield	Yield	Yield	Yield	Yield	Yield	Spread	Spread	Spread	Spread	Spread	Spread
Ln(Climate risk)	0.021	0.115	0.281	0.118	-0.015	-0.113	-0.044	-0.059	-0.047	-0.040	0.064	0.042
	(0.188)	(0.574)	(0.843)	(0.776)	(-0.111)	(-0.278)	(-1.381)	(-1.309)	(-0.614)	(-1.354)	(0.406)	(0.488)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	65,248	27,355	9,108	31,107	9,998	2,458	52,623	24,514	9,430	29,285	9,954	2,599
R-squared	0.553	0.503	0.479	0.630	0.595	0.667	0.358	0.368	0.400	0.403	0.358	0.545

Panel B: Nearest neighbor matching

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Issue maturity:	≥ 20Yr	≥ 25Yr	≥ 30Yr	≥2036	≥2041	≥2046	≥ 20Yr	≥ 25Yr	≥ 30Yr	≥ 2036	≥ 2041	≥ 2046
Dependent var:	Yield	Yield	Yield	Yield	Yield	Yield	Spread	Spread	Spread	Spread	Spread	Spread
Ln(Climate risk)	-0.027	-0.048	-0.189	0.029	0.049	-0.326	-0.106	-0.191*	-0.185**	-0.181	-0.144	-0.004
	(-0.422)	(-0.476)	(-1.153)	(0.335)	(0.381)	(-1.322)	(-1.628)	(-1.768)	(-2.478)	(-1.595)	(-1.438)	(-0.036)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	65,248	27,355	9,108	31,107	9,998	2,458	52,623	24,514	9,430	33,246	9,954	2,599
R-squared	0.553	0.503	0.479	0.630	0.595	0.667	0.174	0.267	0.261	0.276	0.358	0.545

Table A.4

Credit rating split: robustness.

This table presents robustness checks for the regressions reported in Table 7. Panel A drops all observations for bonds that were issued in Orleans Parish. Panel B also drops all observations for bonds issued in coastal counties that are not assigned a climate risk in Hallegatte et al. (2013). The dependent variable is the total annualized issuance cost of a municipal bond. t-statistics, based on errors clustered by county, are in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Panel A: No New Orleans

	Long-term		Short-term	
	(1)	(2)	(3)	(4)
Credit Rating:	< AA-	≥ AA-	< AA-	≥ AA-
Ln(Climate risk)	0.738	0.136	0.140	-0.007
	(1.585)	(0.594)	(0.607)	(-0.038)
Controls	Yes	Yes	Yes	Yes
State-year FE	Yes	Yes	Yes	Yes
Observations	5,327	14,092	43,570	187,423
R-squared	0.609	0.238	0.090	0.724

Panel B: No unobserved coastal

	Long-term		Short-term	
	(1)	(2)	(3)	(4)
Credit rating:	< AA-	≥ AA-	< AA-	≥ AA-
Ln(Climate risk)	0.747*	0.189	0.352	-0.135
	(1.937)	(0.707)	(1.230)	(-0.591)
Controls	Yes	Yes	Yes	Yes
State-year FE	Yes	Yes	Yes	Yes
Observations	4,583	12,078	37,185	159,107
R-squared	0.628	0.215	0.079	0.711

Table A.5

Credit rating split: yield and gross spread.

This table presents results for the regressions shown in Table 7 with yield and gross spread reported separately. Panel A reports results for the credit rating splits with yield as the dependent variable. Gross spread is the dependent variable in Panel B. t-statistics, based on errors clustered by county, are in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Panel A: Yield

	Long-term		Short-term	
	(1)	(2)	(3)	(4)
Credit rating:	< AA-	≥ AA-	< AA-	≥ AA-
Ln(Climate risk)	0.782***	0.023	0.154	0.057
	(2.700)	(0.129)	(1.505)	(0.420)
Controls	Yes	Yes	Yes	Yes
State-year FE	Yes	Yes	Yes	Yes
Observations	7,036	20,231	50,355	241,357
R-squared	0.551	0.520	0.809	0.846

Panel B: Gross spread

	Long-term		Short-term	
	(1)	(2)	(3)	(4)
Credit rating:	< AA-	≥ AA-	< AA-	≥ AA-
Ln(Climate risk)	0.188*	0.116	-0.075	0.132
	(1.762)	(1.288)	(-1.003)	(1.183)
Controls	Yes	Yes	Yes	Yes
State-year FE	Yes	Yes	Yes	Yes
Observations	6,927	17,508	54,426	189,702
R-squared	0.461	0.349	0.365	0.306

Table A.6

Difference-in-differences of annualized issuance costs around the Stern Review: robustness.

This table presents robustness checks for the regressions reported in Table 8. Panel A drops all observations for bonds that were issued in Orleans Parish. Panel B also drops all observations for bonds issued in coastal counties that are not assigned a climate risk in Hallegatte et al. (2013). *t*-statistics, based on errors clustered by county, are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Panel A: No New Orleans

		Long-term			Short-term	
	(1)	(2)	(3)	(4)	(5)	(6)
Time frame:	Full sample	Two years	One year	Full sample	Two years	One year
Ln(Climate risk)	-0.090	-0.202	-0.093	-0.313	-0.031	-0.064
	(-0.344)	(-1.022)	(-0.332)	(-1.000)	(-0.190)	(-0.243)
Ln(Climate risk) x Stern	0.663**	0.596*	0.285	0.360	-0.008	-0.138
	(2.081)	(1.938)	(0.814)	(1.118)	(-0.048)	(-0.487)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
State-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	19,546	4,998	2,404	231,045	8,577	4,142
R-squared	0.297	0.220	0.248	0.284	0.124	0.156

Panel B: No unobserved coastal

		Long-term			Short-term	
	(1)	(2)	(3)	(4)	(5)	(6)
Time frame:	Full sample	Two years	One year	Full sample	One year	Two years
Ln(Climate risk)	-0.244	-0.289	-0.267	-0.612	-0.187	-0.128
	(-0.897)	(-1.287)	(-0.997)	(-1.413)	(-0.491)	(-0.533)
Ln(Climate risk) x Stern	0.815**	0.536*	0.316	0.577	0.084	0.080
	(2.097)	(1.823)	(0.887)	(1.321)	(0.264)	(0.392)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
State-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	16,783	4,233	2,031	196,344	3,505	7,281
R-squared	0.276	0.229	0.260	0.252	0.156	0.127

Table A.7

Difference-in-differences of yield and gross spread around the Stern Review.

This table presents results for the regressions shown in Table 8 with yield and gross spread reported separately. Yield is the dependent variable in Panel A. Gross spread is the dependent variable in Panel B. *t*-statistics, based on errors clustered by county, are in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Panel A: Yield

		Long-term			Short-term	
	(1)	(2)	(3)	(4)	(5)	(6)
Time frame:	Full sample	Two years	One year	Full sample	Two years	One year
Ln(Climate risk)	0.078	-0.222	-0.179	0.001	0.298	-0.053
	(0.630)	(-1.640)	(-1.108)	(0.003)	(0.686)	(-0.211)
Ln(Climate risk) x Stern	0.293*	0.754**	0.326	0.087	-0.189	-0.159
	(1.698)	(2.424)	(1.084)	(0.346)	(-0.536)	(-0.575)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
State-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	27,379	7,033	2,406	291,750	12,795	4,142
R-squared	0.512	0.168	0.266	0.835	0.107	0.155

Panel B: Gross spread

		Long-term			Short-term	
	(1)	(2)	(3)	(4)	(5)	(6)
Time frame:	Full sample	Two years	One year	Full sample	One year	Two years
Ln(Climate risk)	-0.002	-0.025	-0.152	-0.088	0.010	0.000
	(-0.019)	(-0.196)	(-1.274)	(-0.812)	(0.097)	(0.001)
Ln(Climate risk) x Stern	0.224**	0.269	0.289*	0.128	0.205	0.217
	(2.074)	(1.404)	(1.865)	(0.884)	(0.915)	(0.550)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
State-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	24,542	5,659	3,388	231,295	9,727	4,142
R-squared	0.348	0.231	0.282	0.313	0.294	0.295

References

Hallegatte, S., Green, C., Nicholls, R. J., Corfee-Morlot, J., 2013. Future flood losses in major coastal cities. Nature Climate Change 3, 802–806.