Natural disasters and economic growth in Northeast Brazil: evidence from municipal economies of the Ceará State

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Online Appendix

Table A1. Pairwise correlations

	ln(GDP)	ln(GDPa)	ln(GDPi)	ln(GDPs)	ln(EC)	ln(ECa)	ln(ECi)	ln(ECs)	ln(FW)	ln(FWa)	ln(FWi)	ln(FWs)	ln(G)	ln(H)	ln(HB)	INFRA	WSI	ln(ND)	ln(Dr)	ln(Fl)
ln(GDP)	1																			
ln(GDPa)	-0.13***	1																		
ln(GDPi)	0.87***	-0.30***	1																	
ln(GDPs)	0.88***	-0.35***	0.74***	1																
ln(EC)	0.78***	-0.10***	0.77***	0.68***	1															
ln(ECa)	0.20***	0.51***	0.18***	0.11***	0.56***	1														
ln(ECi)	0.63***	-0.23***	0.72***	0.54***	0.71***	0.18***	1													
ln(ECs)	0.67***	-0.32***	0.63***	0.74***	0.70***	0.17***	0.56***	1												
ln(FW)	0.64***	-0.24***	0.62***	0.70***	0.66***	0.24***	0.57***	0.77***	1											
ln(FWa)	-0.32***	0.03	-0.36***	-0.26***	-0.38***	-0.22***	-0.31***	-0.30***	-0.42***	1										
ln(FWi)	-0.01	-0.01	-0.06**	0	-0.08***	-0.11***	-0.09***	-0.10***	-0.30***	0.26***	1									
ln(FWs)	0.61***	-0.24***	0.57***	0.70***	0.61***	0.21***	0.50***	0.76***	0.98***	-0.37***	-0.26***	1								
ln(G)	0.24***	0.03	0.12***	0.35***	0.16***	0.16***	-0.02	0.09***	-0.0005	0.15***	0.20***	0.01	1							
ln(HSE)	0.32***	-0.07***	0.28***	0.35***	0.26***	0.14***	0.15***	0.23***	0.21***	-0.08***	0.03	0.21***	0.28***	1						
ln(HB)	-0.14***	0.03	-0.14***	-0.14***	-0.08***	-0.0253	-0.05**	-0.14***	-0.21***	0.15***	0.16***	-0.20***	-0.02	-0.02	1					
INFRA	0.12***	-0.11***	0.17***	0.19***	0.06***	-0.08***	0.17***	0.16***	0.21***	-0.16***	-0.08***	0.23***	-0.15***	0.03	-0.09***	1				
WSI	-0.19***	0.21***	-0.26***	-0.16***	-0.13***	0.10***	-0.23***	-0.13***	-0.17***	0.23***	0.24***	-0.14***	0.25***	0.10***	0.14***	-0.14***	1			
ln(ND)	-0.12***	0.01	-0.08***	-0.10***	-0.09***	-0.01	-0.07***	-0.08***	-0.07***	-0.02	0.01	-0.05**	-0.01	0.04*	-0.07***	0.12***	0	1		
ln(Dr)	-0.16***	0.02	-0.12***	-0.16***	-0.12***	-0.04*	-0.09***	-0.11***	-0.10***	0.04	0.01	-0.09***	-0.03	0	-0.03	0.08***	0.05**	0.74***	1	
ln(Fl)	0.01	0.01	0.01	0.03	0	0.03	-0.02	0	0.01	-0.07***	0	0.02	0.01	0.05**	-0.06***	0.06***	-0.05**	0.56***	-0.09***	1

Notes. The list of variables is the following: ln(GDP) = natural log of per capita GDP; ln(GDPa) = natural log of per capita added value of agriculture; ln(GDPi) = natural log of per capita added value of industry; ln(GDPs) = natural log of per capita added value of services; ln(EC) = natural log of per capita consumption of electricity; ln(ECa) = natural log of per capita consumption of electricity of agriculture (rural area); ln(ECi) = natural log of per capita consumption of electricity of industry; ln(ECs) = natural log of per capita consumption of electricity of services and commerce; ln(FW) = natural log of formal workers normalized by population size; ln(FWa) = natural log of formal workers in agriculture normalized by population size; ln(FWi) = natural log of formal workers in industry normalized by population size; ln(FWs) = natural log of formal workers in services and commerce normalized by population size; ln(GS) = natural log of per capita public spending; ln(H) = natural log of high school enrolment normalized by population size; ln(HB) = natural log of hospital beds normalized by population size; INFRA = index of municipality infrastructure (i.e., post offices, radio stations, schools and health establishments normalized by population size); WSI = water supply infrastructure (i.e., number of water reservoirs and water piped systems); ln(ND) = natural log of per capita costs of natural disasters; ln(Dr) = natural log of per capita costs of droughts; and ln(Fl) = natural log of per capita costs of floods. ***p-value < 0.01, ** p-value < 0.05, and * p-value < 0.1.

Table A2. Effects of lagged damage from natural disasters on output growth

	Growth rate per capita GDP		Economic sectors (growth rate of per capita added value)		
			Agriculture	Industry	Service
	(1)	(2)	(3)	(4)	(5)
All natural disasters	-0.0134***				
	(0.0039)				
Droughts		-0.0117***	-0.0338**	0.0148	-0.0031
		(0.0045)	(0.0131)	(0.0103)	(0.0030)
Floods		-0.0134**	-0.0242*	-0.0016	-0.0059**
		(0.0055)	(0.0135)	(0.0105)	(0.0028)
Lagged effects					
All natural disasters	0.0009				
	(0.0017)				
Droughts		0.0002	0.0012	-0.0061	0.0002
		(0.0022)	(0.0056)	(0.0044)	(0.0014)
Floods		-0.0003	0.0011	-0.0013	-0.0004
		(0.0017)	(0.0043)	(0.0035)	(0.0013)
Lagged per capita GDP	-0.5268***	-0.5373***	-0.8217***	-0.2514***	-0.7876***
	(0.1231)	(0.1181)	(0.0973)	(0.0675)	(0.0877)
Specification tests (p-values)					
Hansen test of overidentification	0.4663	0.4523	0.1366	0.8373	0.4300
Arellano-Bond test for AR(1) in FD	0.0000	0.0000	0.0000	0.0000	0.0229
Arellano-Bond test for AR(2) in FD	0.6287	0.6846	0.9620	0.6027	0.1960
Number of Instruments	67	73	62	62	73
Observations	1,656	1,656	1,656	1,656	1,656

Notes: See the notes to table 3 for the list of control variables included in the regressions. Robust standard errors are in parentheses. All variables are in log terms. ***p-value < 0.01, ** p-value < 0.05, and * p-value < 0.1.

Table A3. Effects of direct damage from natural disasters on output growth, accounting for the mayor's party alignment with the state governor and the president

	Growth rate per capita GDP		Economic sectors (growth rate of per capita added value)		
			Agriculture	Industry	Service
	(1)	(2)	(3)	(4)	(5)
All natural disasters	-0.0130***				
	(0.0038)				
Droughts		-0.0118***	-0.0296**	0.0046	-0.0033
		(0.0044)	(0.0117)	(0.0088)	(0.0032)
Floods		-0.0132**	-0.0240**	-0.0067	-0.0058**
		(0.0053)	(0.0117)	(0.0088)	(0.0028)
Lagged per capita GDP	-0.5310***	-0.5426***	-0.8512***	-0.3756***	-0.7899***
	(0.1228)	(0.1175)	(0.0858)	(0.0955)	(0.0886)
Specification tests (p-values)					
Hansen test of overidentification	0.5126	0.5292	0.3379	0.4600	0.4905
Arellano-Bond test for AR(1) in FD	0.0000	0.0000	0.0000	0.0001	0.0234
Arellano-Bond test for AR(2) in FD	0.6317	0.6762	0.6529	0.6986	0.1875
Number of Instruments	69	75	74	75	75
Observations	1,656	1,656	1,656	1,656	1,656

Notes: See the notes to table 3 for the list of control variables included in the regressions. Robust standard errors are in parentheses. All variables are in log terms. ***p-value < 0.01, ** p-value < 0.05, and * p-value < 0.1.

Table A4. The Garantia-Safra programme in Ceará between 2003 and 2011

Agriculture year	Premium/Min. wage (nominal value)	Participating municipalities	Municipalities with farmers benefiting from the programme	Registered small farmers	Small farmers benefiting from the programme
2002-2003	475/240	160	1	109,126	573
2003-2004	550/260	74	26	36,106	13,274
2004-2005	550/300	146	128	128,663	120,908
2005-2006	550/350	161	7	160,012	11,338
2006-2007	550/380	152	124	172,931	159,734
2007-2008	550/415	167	26	285,363	68,451
2008-2009	550/465	161	135	260,687	219,413
2009-2010	600/510	172	172	290,105	290,105
2010-2011	640/540	180	0	272,581	0

Source: Ministério do Desenvolvimento Agrário.