

Supplement to "Transboundary Pollution in China: A Study of Polluting Firms' Location Choices in Hebei Province"

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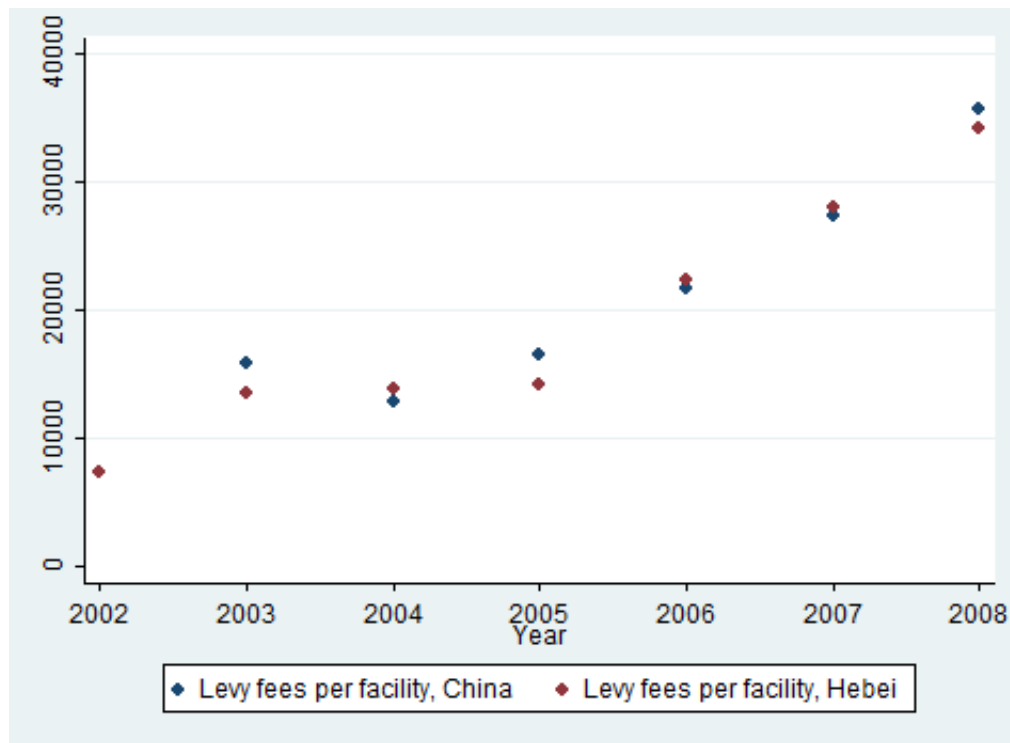
Appendix S.1. Environmental regulation in Hebei province compared with its neighbors

Indicator 1 [†]		Indicator 2 [‡]	
Inner Mongolia	196.51	Inner Mongolia	0.43
Hebei	262.06	Hebei	0.73
Liaoning	280.31	Tianjin	0.89
Henan	312.66	Shanxi	0.90
Beijing	315.42	Henan	0.92
Shanxi	417.77	Liaoning	1.11
Shandong	484.24	Shandong	1.47
Tianjin	610.59	Beijing	1.89

[†] Refers to the share of industrial pollution treatment investment in innovation investment.

[‡] Refers to levy fees divided by the number of charged organizations.

Appendix S.2. Tightening of the environmental policy in Hebei and China



Data source: Authors' calculations using data from the Ministry of Environmental Protection and Hebei Environmental Protection Bureau.

Appendix S.3. Alternative indicator for *Border*

	Contemporaneous variables (1)	Lagged explanatory variables (2)
Border	10.40*** (0.000)	11.28*** (0.000)
Agglo. industry	0.122 (0.895)	1.290 (0.144)
Land area	0.180 (0.329)	0.790*** (0.000)
Wage	-2.467*** (0.000)	-2.070*** (0.001)
Education	-0.331 (0.955)	2.629 (0.641)
Local market	0.947*** (0.000)	0.651*** (0.007)
External market	0.072 (0.304)	0.064 (0.388)
SEZ	-0.731 (0.156)	-0.509 (0.432)
District	0.656** (0.019)	0.708** (0.039)
GDP per cap.	1.515*** (0.000)	1.149*** (0.000)
Sq. GDP per cap.	-0.626*** (0.004)	-0.434* (0.088)
River	0.115*** (0.001)	0.114*** (0.001)
Port	-0.044 (0.920)	-0.788 (0.171)
Topography	0.408*** (0.008)	0.0458 (0.802)
Constant	5.532 (0.214)	1.767 (0.751)
Year dummies	Yes	Yes
N	1029	882

Note: Baseline model estimated using an alternative measure of *Border*: dummy equal to one if the county seat is located within 50 miles of the border to another province, 0 otherwise (Gray and Shadbegian, 2004).

P-values in parenthesis : * p<0.1, ** p<0.05, *** p<0.01.

Appendix S.4. Estimation results obtained by dropping the polluting firms which set up in the interior districts of Tangshan city

	Contemporaneous variables			Lagged explanatory variables		
	(1)	(2)	(3)	(4)	(5)	(6)
	Border 1	Border 2	Distance	Border 1	Border 2	Distance
Border	0.406** (0.019)	0.132** (0.018)	-0.181** (0.028)	0.601*** (0.001)	0.191*** (0.001)	-0.182* (0.059)
Agglo. industry	1.084 (0.112)	1.037 (0.131)	0.945 (0.159)	1.558** (0.022)	1.510** (0.028)	1.403** (0.037)
Land area	0.320** (0.012)	0.307** (0.026)	0.384*** (0.001)	0.061 (0.526)	0.063 (0.533)	0.123 (0.179)
Wage	-2.166*** (0.000)	-2.239*** (0.000)	-2.237*** (0.000)	-1.500*** (0.005)	-1.641*** (0.002)	-1.619*** (0.004)
Education	0.097 (0.984)	-0.230 (0.961)	-1.090 (0.817)	0.342 (0.953)	-0.366 (0.950)	-1.746 (0.760)
Local market	0.614*** (0.000)	0.594*** (0.000)	0.689*** (0.000)	0.828*** (0.000)	0.796*** (0.000)	0.937*** (0.000)
External market	0.081 (0.236)	0.090 (0.196)	0.091 (0.196)	0.103 (0.155)	0.116 (0.123)	0.104 (0.193)
SEZ	-0.697 (0.164)	-0.727 (0.150)	-0.843 (0.157)	-0.765 (0.264)	-0.795 (0.248)	-0.827 (0.315)
District	0.756** (0.011)	0.771*** (0.009)	0.739** (0.011)	0.234 (0.531)	0.268 (0.472)	0.168 (0.639)
GDP per cap.	1.425*** (0.000)	1.442*** (0.000)	1.487*** (0.000)	0.745*** (0.001)	0.786*** (0.001)	0.838*** (0.000)
Sq. GDP per cap.	-0.769*** (0.002)	-0.771*** (0.002)	-0.819*** (0.002)	-0.509 (0.124)	-0.526 (0.113)	-0.528 (0.136)
River	0.087*** (0.000)	0.085*** (0.000)	0.087*** (0.000)	0.018 (0.566)	0.019 (0.538)	0.019 (0.543)
Port	-0.355 (0.409)	-0.410 (0.343)	-0.301 (0.498)	-0.679 (0.342)	-0.762 (0.276)	-0.546 (0.475)
Topography	0.349** (0.045)	0.364** (0.040)	0.403** (0.017)	0.037 (0.844)	0.047 (0.802)	0.131 (0.472)
Constant	14.15*** (0.001)	14.89*** (0.001)	16.49*** (0.000)	8.647* (0.068)	10.04** (0.034)	11.45** (0.028)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
N	1029	1029	1029	882	882	882

Note: P-values in parenthesis : * p<0.1, ** p<0.05, *** p<0.01.

Appendix S.5. First-stage probit results

	Contemporaneous variables			Lagged explanatory variables		
	(1) Border 1	(2) Border 2	(3) Distance	(4) Border 1	(5) Border 2	(6) Distance
Agglo. Industry	1.554 (0.540)	1.355 (0.614)	2.046 (0.419)	1.630 (0.660)	1.417 (0.683)	1.894 (0.553)
Education	27.90* (0.085)	28.81 (0.113)	26.42** (0.037)	26.59** (0.021)	26.15** (0.032)	23.40* (0.076)
Local market	-1.626 (0.111)	-1.663 (0.140)	-1.563** (0.026)	-1.597 (0.127)	-1.585 (0.119)	-1.523* (0.087)
River	1.336* (0.077)	1.308* (0.087)	1.462** (0.035)	1.531* (0.055)	1.505** (0.047)	1.631** (0.020)
Topography	0.910 (0.287)	0.984 (0.313)	0.944 (0.174)	0.532 (0.253)	0.594 (0.222)	0.607 (0.225)
Trend	0.577*** (0.008)	0.581*** (0.008)	0.566*** (0.009)	0.460** (0.024)	0.457** (0.029)	0.415* (0.051)
Constant	-16.05* (0.063)	-15.84* (0.071)	-17.82** (0.030)	-16.17** (0.023)	-16.01** (0.020)	-17.51*** (0.008)
N	1029	1029	1029	882	882	882

Note: P-values in parenthesis : * p<0.1, ** p<0.05, *** p<0.01.

Appendix S.6. Transboundary pollution or access to international markets? (Corresponds to Panel A of Table 4)

	Contemporaneous variables			Lagged explanatory variables		
	(1) Border 1	(2) Border 2	(3) Distance	(4) Border 1	(5) Border 2	(6) Distance
Terrestrial border	0.464** (0.024)	1.591*** (0.004)	-0.157* (0.065)	0.673*** (0.003)	2.053*** (0.001)	-0.194** (0.036)
Maritime border	0.338 (0.237)	0.087 (0.970)	-0.237*** (0.007)	0.257 (0.417)	-1.541 (0.695)	-0.214** (0.029)
Agglo. industry	1.048 (0.177)	0.470 (0.616)	0.900 (0.189)	1.699* (0.071)	1.454* (0.083)	1.544* (0.099)
Land area	0.291** (0.041)	0.120 (0.458)	0.358*** (0.004)	0.572*** (0.005)	0.665*** (0.001)	0.767*** (0.000)
Wage	-2.422*** (0.000)	-2.588*** (0.000)	-2.441*** (0.000)	-2.252*** (0.001)	-2.407*** (0.000)	-2.224*** (0.000)
Education	-1.395 (0.784)	-0.151 (0.983)	-0.936 (0.843)	4.212 (0.512)	1.793 (0.773)	6.049 (0.324)
Local market	0.594*** (0.001)	0.934*** (0.000)	0.718*** (0.000)	0.420* (0.063)	0.692*** (0.004)	0.537** (0.026)
External market	0.0772 (0.289)	0.0906 (0.195)	0.0700 (0.324)	0.0827 (0.272)	0.0981 (0.220)	0.0768 (0.327)
SEZ	-0.781 (0.151)	-1.003* (0.068)	-1.063 (0.134)	-0.740 (0.270)	-0.854 (0.184)	-0.832 (0.288)
District	0.745** (0.019)	0.735*** (0.008)	0.849*** (0.002)	0.762** (0.039)	0.874*** (0.008)	0.898** (0.013)
GDP per cap.	1.500*** (0.000)	1.463*** (0.000)	1.430*** (0.000)	1.090*** (0.000)	1.077*** (0.000)	0.976*** (0.000)
Sq. GDP per cap.	-0.581*** (0.010)	-0.581** (0.010)	-0.655*** (0.008)	-0.409 (0.105)	-0.381 (0.166)	-0.409 (0.118)
River	0.0913*** (0.000)	0.108*** (0.001)	0.0957*** (0.000)	0.110*** (0.001)	0.102*** (0.004)	0.112*** (0.001)
Port	-0.617 (0.190)	-0.00807 (0.990)	-0.736 (0.158)	-1.142* (0.084)	-0.386 (0.549)	-1.256* (0.078)
Topography	0.344* (0.082)	0.444*** (0.005)	0.431** (0.012)	0.0417 (0.838)	0.116 (0.549)	0.116 (0.572)
Constant	16.60*** (0.000)	16.76*** (0.000)	20.73*** (0.000)	15.24*** (0.008)	15.70*** (0.009)	18.96*** (0.002)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
N	1029	1029	1029	882	882	882
Vuong statistic	2.70	2.60	2.64	2.35	2.44	2.22

Note: P-values in parenthesis : * p<0.1, ** p<0.05, *** p<0.01.

Appendix S.7. Transboundary pollution or Beijing-Tianjin effect? (Corresponds to Panel B-1 of Table 4)

	Contemporaneous variables			Lagged explanatory variables		
	(1)	(2)	(3)	(4)	(5)	(6)
	Border 1	Border 2	Distance	Border 1	Border 2	Distance
Border	0.375** (0.027)	0.126** (0.021)	-0.142* (0.085)	0.501*** (0.009)	0.175*** (0.004)	-0.158* (0.097)
Market BT	0.815*** (0.003)	0.797*** (0.003)	0.857*** (0.001)	0.869*** (0.006)	0.799** (0.012)	0.957*** (0.003)
Agglo. industry	1.127 (0.105)	1.073 (0.126)	0.969 (0.143)	1.907** (0.031)	1.823** (0.042)	1.684* (0.057)
Land area	0.296** (0.032)	0.278* (0.067)	0.360*** (0.003)	0.624*** (0.004)	0.626** (0.012)	0.772*** (0.000)
Wage	-2.421*** (0.000)	-2.492*** (0.000)	-2.484*** (0.000)	-2.162*** (0.000)	-2.265*** (0.000)	-2.256*** (0.000)
Education	1.572 (0.733)	1.288 (0.781)	0.500 (0.914)	8.637 (0.168)	8.259 (0.200)	8.033 (0.192)
Local market	0.692*** (0.000)	0.673*** (0.000)	0.762*** (0.000)	0.462* (0.057)	0.430* (0.078)	0.548** (0.028)
External market	0.057 (0.430)	0.065 (0.377)	0.065 (0.369)	0.062 (0.395)	0.076 (0.321)	0.069 (0.380)
SEZ	-0.814* (0.085)	-0.843* (0.078)	-0.900* (0.093)	-0.785 (0.197)	-0.811 (0.188)	-0.789 (0.233)
District	0.949*** (0.000)	0.964*** (0.000)	0.944*** (0.000)	0.994*** (0.004)	1.023*** (0.003)	1.021*** (0.003)
GDP per cap.	1.335*** (0.000)	1.350*** (0.000)	1.392*** (0.000)	0.841*** (0.001)	0.867*** (0.001)	0.891*** (0.001)
Sq. GDP per cap.	-0.633*** (0.007)	-0.632*** (0.007)	-0.666*** (0.006)	-0.411 (0.107)	-0.412 (0.137)	-0.401 (0.123)
River	0.094*** (0.000)	0.092*** (0.000)	0.095*** (0.000)	0.113*** (0.001)	0.110*** (0.002)	0.112*** (0.002)
Port	-0.450 (0.291)	-0.505 (0.239)	-0.383 (0.374)	-1.074* (0.095)	-1.184* (0.067)	-1.001 (0.118)
Topography	0.449** (0.029)	0.466** (0.025)	0.487** (0.014)	0.116 (0.599)	0.121 (0.603)	0.146 (0.530)
Constant	11.89*** (0.008)	12.71*** (0.005)	13.59*** (0.004)	9.543* (0.084)	10.94* (0.052)	11.39* (0.053)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
N	1029	1029	1029	882	882	882
Vuong statistic	2.32	2.34	2.39	1.93	1.86	1.99

Note: P-values in parenthesis : * p<0.1, ** p<0.05, *** p<0.01.

Appendix S.8. Transboundary pollution or Beijing-Tianjin effect? (Corresponds to Panel B-2 of Table 4)

	Contemporaneous variables			Lagged explanatory variables		
	(1)	(2)	(3)	(4)	(5)	(6)
	Border 1	Border 2	Distance	Border 1	Border 2	Distance
BT border	0.561*** (0.001)	2.404*** (0.000)	-0.230*** (0.001)	0.734*** (0.000)	2.773*** (0.000)	-0.235*** (0.005)
Other borders	0.312* (0.078)	0.273*** (0.008)	-0.184** (0.028)	0.427** (0.028)	0.310** (0.015)	-0.175* (0.097)
Agglo. industry	1.125 (0.110)	0.564 (0.443)	0.910 (0.177)	1.716** (0.046)	1.010 (0.248)	1.537* (0.092)
Land area	0.288** (0.026)	0.255* (0.087)	0.331*** (0.007)	0.547** (0.012)	0.564** (0.012)	0.704*** (0.000)
Wage	-2.349*** (0.000)	-2.640*** (0.000)	-2.446*** (0.000)	-2.078*** (0.001)	-2.415*** (0.000)	-2.222*** (0.000)
Education	-1.814 (0.698)	-0.158 (0.974)	0.033 (0.994)	4.543 (0.460)	5.965 (0.338)	6.705 (0.265)
Local market	0.590*** (0.002)	0.706*** (0.000)	0.806*** (0.000)	0.375 (0.124)	0.562** (0.035)	0.642*** (0.008)
External market	0.068 (0.341)	0.057 (0.417)	0.067 (0.346)	0.074 (0.313)	0.063 (0.403)	0.069 (0.364)
SEZ	-0.701 (0.146)	-1.006** (0.037)	-0.850 (0.122)	-0.672 (0.268)	-1.014 (0.102)	-0.709 (0.289)
District	0.739** (0.013)	1.047*** (0.000)	0.748*** (0.006)	0.759** (0.036)	1.139*** (0.001)	0.784** (0.022)
GDP per cap.	1.435*** (0.000)	1.326*** (0.000)	1.448*** (0.000)	0.938*** (0.000)	0.796*** (0.002)	0.969*** (0.000)
Sq. GDP per cap.	-0.592** (0.012)	-0.586** (0.016)	-0.644*** (0.009)	-0.405 (0.110)	-0.375 (0.207)	-0.396 (0.141)
River	0.087*** (0.001)	0.078*** (0.002)	0.092*** (0.000)	0.102*** (0.003)	0.090** (0.012)	0.106*** (0.003)
Port	-0.526 (0.252)	-0.924* (0.068)	-0.485 (0.296)	-1.198* (0.081)	-1.548** (0.036)	-1.026 (0.136)
Topography	0.402** (0.033)	0.547*** (0.005)	0.455** (0.012)	0.136 (0.520)	0.282 (0.200)	0.153 (0.498)
Constant	15.97*** (0.000)	18.06*** (0.000)	20.53*** (0.000)	13.83** (0.014)	16.11*** (0.006)	18.53*** (0.002)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
N	1029	1029	1029	882	882	882
Vuong statistic	2.84	2.63	2.73	2.28	2.01	2.16

Note: P-values in parenthesis : * p<0.1, ** p<0.05, *** p<0.01.

Appendix S.9. Transboundary pollution or Beijing-Tianjin effect? (Corresponds to Panel B-3 of Table 4)

	Contemporaneous variables		Lagged explanatory variables	
	(1) Border 1	(2) Border 2	(3) Border 1	(4) Border 2
BT border	0.314 (0.269)	2.560*** (0.003)	0.649** (0.040)	3.170*** (0.000)
Other borders	0.343** (0.049)	0.280*** (0.008)	0.437** (0.024)	0.327*** (0.009)
Distance to BT	-0.116 (0.286)	0.025 (0.809)	-0.039 (0.758)	0.066 (0.582)
Agglo. industry	1.024 (0.140)	0.551 (0.457)	1.690* (0.053)	0.950 (0.276)
Land area	0.280** (0.029)	0.257* (0.089)	0.549** (0.012)	0.570*** (0.010)
Wage	-2.380*** (0.000)	-2.643*** (0.000)	-2.100*** (0.001)	-2.414*** (0.000)
Education	-0.029 (0.995)	-0.426 (0.932)	5.191 (0.418)	5.272 (0.401)
Local market	0.638*** (0.001)	0.705*** (0.000)	0.389 (0.117)	0.558** (0.035)
External market	0.0629 (0.376)	0.0596 (0.409)	0.0721 (0.320)	0.0684 (0.366)
SEZ	-0.728 (0.125)	-1.015** (0.037)	-0.682 (0.260)	-1.033* (0.097)
District	0.787*** (0.005)	1.051*** (0.000)	0.781** (0.032)	1.153*** (0.001)
GDP per cap.	1.409*** (0.000)	1.329*** (0.000)	0.931*** (0.000)	0.817*** (0.001)
Sq. GDP per cap.	-0.596** (0.012)	-0.583** (0.017)	-0.404 (0.113)	-0.379 (0.195)
River	0.087*** (0.001)	0.078*** (0.002)	0.102*** (0.003)	0.090** (0.012)
Port	-0.531 (0.248)	-0.936* (0.064)	-1.197* (0.082)	-1.583** (0.030)
Topography	0.434** (0.022)	0.542*** (0.008)	0.147 (0.491)	0.269 (0.223)
Constant	17.26*** (0.000)	17.83*** (0.000)	14.37** (0.014)	15.42** (0.010)
Year dummies	Yes	Yes	Yes	Yes
N	1029	1029	882	882
Vuong statistic	2.81	2.63	2.27	2.03

Note: P-values in parenthesis : * p<0.1, ** p<0.05, *** p<0.01.

Appendix S.10. Has transboundary pollution increased over time? (Corresponds to Table 5)

	Contemporaneous variables			Lagged explanatory variables		
	(1) Border 1	(2) Border 2	(3) Distance	(4) Border 1	(5) Border 2	(6) Distance
Border*2002	0.095 (0.751)	-0.003 (0.976)	-0.107 (0.440)	0.545* (0.073)	0.164* (0.076)	0.031 (0.862)
Border*2003	0.363 (0.199)	0.110 (0.188)	0.088 (0.657)	0.617 (0.130)	0.208 (0.118)	-0.380*** (0.006)
Border*2004	0.714** (0.040)	0.255** (0.031)	-0.380*** (0.002)	0.229 (0.541)	0.102 (0.373)	-0.062 (0.766)
Border*2005	0.413 (0.261)	0.141 (0.200)	-0.119 (0.567)	0.774 (0.132)	0.301** (0.042)	-0.380* (0.085)
Border*2006	0.836* (0.096)	0.319** (0.028)	-0.377* (0.065)	0.925 (0.120)	0.264* (0.099)	-0.525*** (0.009)
Border*2007	1.013* (0.087)	0.283* (0.073)	-0.493** (0.014)	2.649** (0.013)	0.707*** (0.001)	-0.464*** (0.008)
Border*2008	2.756** (0.010)	0.719*** (0.000)	-0.440*** (0.006)			
Agglo. industry	1.103 (0.106)	0.974 (0.144)	1.088 (0.102)	1.713* (0.074)	1.540 (0.105)	1.516* (0.073)
Land area	0.331** (0.010)	0.355*** (0.008)	0.397*** (0.001)	0.635*** (0.003)	0.662*** (0.004)	0.806*** (0.000)
Wage	-2.482*** (0.000)	-2.539*** (0.000)	-2.493*** (0.000)	-2.188*** (0.000)	-2.258*** (0.000)	-2.232*** (0.000)
Education	-0.680 (0.889)	-0.510 (0.917)	-2.782 (0.561)	6.088 (0.330)	6.078 (0.336)	4.020 (0.483)
Local market	0.737*** (0.000)	0.718*** (0.000)	0.830*** (0.000)	0.536** (0.028)	0.501** (0.035)	0.662*** (0.008)
External market	0.0817 (0.222)	0.0926 (0.171)	0.0919 (0.188)	0.0790 (0.267)	0.0958 (0.198)	0.0871 (0.242)
SEZ	-0.758 (0.123)	-0.784 (0.116)	-0.950 (0.166)	-0.725 (0.243)	-0.765 (0.221)	-0.805 (0.321)
District	0.818*** (0.005)	0.881*** (0.002)	0.687** (0.016)	0.854** (0.016)	0.940*** (0.007)	0.766** (0.023)
GDP per cap.	1.452*** (0.000)	1.478*** (0.000)	1.536*** (0.000)	1.008*** (0.000)	1.032*** (0.000)	1.132*** (0.000)
Sq. GDP per cap.	-0.652*** (0.004)	-0.689*** (0.002)	-0.620** (0.010)	-0.465* (0.074)	-0.507* (0.072)	-0.419* (0.099)
River	0.0944*** (0.000)	0.0902*** (0.000)	0.0935*** (0.000)	0.110*** (0.001)	0.105*** (0.002)	0.107*** (0.002)
Port	-0.443 (0.308)	-0.505 (0.242)	-0.336 (0.465)	-1.039 (0.107)	-1.154* (0.070)	-0.944 (0.153)
Topography	0.351** (0.042)	0.368** (0.029)	0.356** (0.033)	0.0471 (0.813)	0.0759 (0.705)	0.0612 (0.740)
Constant	16.59*** (0.000)	17.21*** (0.000)	17.52*** (0.000)	14.04** (0.011)	14.79*** (0.008)	13.88** (0.018)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
N	1029	1029	1029	882	882	882
Vuong statistic	2.80	2.94	2.74	2.43	2.44	2.45

Note: P-values in parenthesis : * p<0.1, ** p<0.05, *** p<0.01.