

Environmental management, environmental innovation, and productivity
growth: a global firm-level investigation

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ONLINE APPENDIX

Additional Tests and Results

Table A1. Statistics of countries and firms

Country	# Firms	% Firms
Jordan	338	1.36%
Israel	334	1.35%
Morocco	638	2.57%
Albania	371	1.49%
Belarus	564	2.27%
Georgia	511	2.06%
Tajikistan	260	1.05%
Turkey	1,646	6.63%
Ukraine	1,182	4.76%
Uzbekistan	1,096	4.42%
Russia	1,201	4.84%
Poland	726	2.92%
Romania	810	3.26%
Serbia	306	1.23%
Kazakhstan	1,160	4.67%
Moldova	358	1.44%
Bosnia and Herzegovina	315	1.27%
Azerbaijan	143	0.58%
North Macedonia	306	1.23%
Armenia	434	1.75%
Kyrgyzstan	316	1.27%
Mongolia	358	1.44%
Estonia	356	1.43%
Kosovo	170	0.68%
Czechia	498	2.01%
Hungary	787	3.17%
Latvia	322	1.30%
Lithuania	350	1.41%

Slovakia	429	1.73%
Slovenia	396	1.60%
Bulgaria	671	2.70%
Croatia	404	1.63%
Montenegro	128	0.52%
Egypt	3,072	12.38%
Greece	600	2.42%
Portugal	985	3.97%
Lebanon	515	2.07%
Tunisia	521	2.10%
Cyprus	306	1.23%
Italy	708	2.85%
Malta	230	0.93%
Total # observations	24,821	100%

Source: Business Environment and Enterprise Performance Survey, EBRD, 2017-2019.

Table A2. Comparison statistics – firms by environmental management and innovation

	Internal management		External management		Environmental innovation inputs		Environmental innovation outputs	
	Yes	No	Yes	No	Yes	No	Yes	No
Productivity	5.181	4.940	5.213	5.012	5.123	5.019	5.162	5.014
Foreign ownership (%)	8.49%	3.47%	9.37%	4.82%	7.51%	4.40%	8.47%	4.53%
Export (%)	20.61%	11.60%	22.42%	13.86%	19.33%	11.90%	21.29%	12.59%
Government ownership (%)	1.20%	0.18%	1.37%	0.46%	0.93%	0.57%	1.03%	0.61%
Employees	119.29	60.73	139.24	69.58	112.937	56.889	129.841	59.476
Employees with university education (%)	11.80%	11.79%	11.88%	11.73%	11.68%	12.13%	12.17%	11.33%
# Observations	8,893	4,841	5,731	8,003	10,233	3,501	7,646	6,088

Note: Averages of firms with and without each environmental activity are reported in this table.

Source: Business Environment and Enterprise Performance Survey, EBRD, 2017-2019.

Table A3. Firms' innovation activities by environmental management

	Internal management		External management	
	Yes	No	Yes	No
Environmental innovation inputs	7,615	2,618	4,923	5,310
	(85.63%)	(54.08%)	(85.90%)	(66.35%)
Environmental innovation outputs	6,112	1,534	4,058	3,588
	(68.73%)	(31.69%)	(70.81%)	(44.83%)
Environmental innovation effectiveness	6,112	1,531	4,058	3,585
	(68.73%)	(31.63%)	(70.81%)	(44.80%)
General innovation inputs	2,862	509	2,088	1,283
	(32.18%)	(10.51%)	(36.43%)	(16.03%)
General innovation outputs	3,454	762	2,362	1,854
	(38.84%)	(15.74%)	(41.21%)	(23.17%)
General innovation effectiveness	1,843	261	1,380	724
	(20.72%)	(5.39%)	(24.08%)	(9.05%)
# Observations	8,893	4,841	5,731	8,003
	(100%)	(100%)	(100%)	(100%)

Notes: Numbers of firms with and without environmental management are reported. Percentages of firms are in parentheses.

Source: Business Environment and Enterprise Performance Survey, EBRD, 2017-2019.

Table A4. All firms and firms by environmental innovation

	All firms	Environmental innovation inputs		Environmental innovation outputs	
		Yes	No	Yes	No
Internal management	8,893	7,615	1,278	6,112	2,781
	(64.75%)	(74.42%)	(36.50%)	(79.94%)	(45.68%)
External management	5,731	4,923	808	4,058	1,673
	(41.73%)	(48.11%)	(23.08%)	(53.07%)	(27.48%)
Environmental innovation inputs	10,233	10,233	0	7,644	2,589
	(74.51%)	(100%)	(0%)	(99.97%)	(42.53%)
Environmental innovation outputs	7,646	7,644	2	7,646	0
	(55.67%)	(74.70%)	(0.06%)	(100%)	(0%)
Environmental innovation effectiveness	7,643	7,643	0	7,643	0
	(55.65%)	(74.69%)	(0%)	(99.96%)	(0%)
General innovation inputs	3,371	3,080	291	2,613	758
	(24.54%)	(30.10%)	(8.31%)	(34.17%)	(12.45%)
General innovation outputs	4,216	3,788	428	3,132	1,084
	(30.70%)	(37.02%)	(12.23%)	(40.96%)	(17.81%)
General innovation effectiveness	2,104	1,982	122	1,713	391
	(15.32%)	(19.37%)	(3.48%)	(22.40%)	(6.42%)
# Observations	13,734	10,233	3,501	7,646	6,088
	(100%)	(100%)	(100%)	(100%)	(100%)

Notes: Numbers of firms with and without environmental innovation are reported. Percentages of firms are in parentheses.

Source: Business Environment and Enterprise Performance Survey, EBRD, 2017-2019.

Table A5. Firms by environmental innovation and environmental management

		All firms	Firms with environmental innovation inputs	Firms with environmental innovation outputs	
Internal Management	Self-monitoring	8,105	6,971	5,641	
		(59.01%)	(68.12%)	(73.78%)	
	Environment strategy	2,454	2,286	2,066	
		(17.87%)	(22.34%)	(27.02%)	
	Environment manager	1,586	1,493	1,374	
		(11.55%)	(14.59%)	(17.97%)	
	Environment target	4,167	3,972	3,486	
		(30.34%)	(38.82%)	(45.59%)	
	Renewable resource	720	699	656	
		(5.24%)	(6.83%)	(8.58%)	
	External Management	External auditing	2,451	2,258	1,973
			(17.85%)	(22.07%)	(25.80%)
Environment scheme		54	53	53	
		(0.39%)	(0.52%)	(0.69%)	
Environment taxation		2,925	2,339	1,832	
		(21.30%)	(22.86%)	(23.96%)	
Environment standard		1,715	1,562	1,358	
		(12.49%)	(15.26%)	(17.76%)	
Customer requirement		1,926	1,773	1,596	
		(14.02%)	(17.33%)	(20.87%)	
# Observations		13,734	10,233	7,646	
		(100%)	(100%)	(100%)	

Notes: Numbers of firms with and without environmental innovation are reported. Percentages of firms are in parentheses.

Table A6. Determinants of internal environmental management

	(i)	(ii)	(iii)	(iv)	(v)
	Self-monitoring	Environment strategy	Environment manager	Environment target	Renewable resource
Foreign ownership (%)	0.326 (0.043)	0.281 (0.042)	0.380 (0.045)	0.087 (0.040)	0.107 (0.062)
Export (%)	0.298 (0.033)	0.479 (0.036)	0.549 (0.040)	0.407 (0.033)	0.511 (0.048)
Government ownership (%)	0.826 (0.188)	0.777 (0.136)	0.909 (0.132)	0.960 (0.125)	0.689 (0.181)
Government contract	0.287 (0.025)	0.235 (0.027)	0.311 (0.030)	0.204 (0.024)	0.283 (0.037)
Employees	-0.732 (1.055)	-0.062 (1.062)	0.355 (0.961)	0.095 (1.003)	-0.028 (1.724)
Employees with university education (%)	0.248 (0.046)	0.158 (0.052)	0.114 (0.061)	-0.047 (0.048)	0.136 (0.078)
Informal competition	0.157 (0.019)	0.162 (0.022)	0.054 (0.026)	0.190 (0.020)	0.154 (0.033)
# Observations	24,821				

Notes: Standard errors are reported in parentheses. “Employees” are measured in thousands of people.

Table A7. Determinants of external environmental management

	(i)	(ii)	(iii)	(iv)	(v)
	External auditing	Environment scheme	Environment taxation	Environment standard	Customer requirement
Foreign ownership (%)	0.225 (0.043)	0.170 (0.020)	0.155 (0.044)	0.246 (0.047)	0.185 (0.044)
Export (%)	0.492 (0.037)	0.296 (0.016)	0.138 (0.037)	0.263 (0.041)	0.585 (0.037)
Government ownership (%)	0.590 (0.123)	0.353 (0.062)	0.401 (0.139)	0.458 (0.135)	0.314 (0.136)
Government contract	0.312 (0.027)	0.188 (0.012)	0.155 (0.027)	0.113 (0.030)	0.393 (0.027)
Employees	0.236 (1.046)	0.106 (0.402)	-0.801 (1.648)	0.254 (1.367)	0.031 (1.274)
Employees with university education (%)	0.039 (0.053)	0.283 (0.226)	0.136 (0.054)	0.355 (0.057)	0.022 (0.056)
Informal competition	0.094 (0.023)	0.722 (0.095)	0.119 (0.021)	0.064 (0.025)	0.220 (0.024)
# Observations	24,821				

Notes: Standard errors are reported in parentheses. “Employees” are measured in thousands of people.

Table A8. Determinants of environmental innovation

	(i)	(ii)
	Innovation inputs	Innovation outputs
Foreign ownership (%)	0.157	0.156
	(0.046)	(0.041)
Export (%)	0.289	0.325
	(0.036)	(0.033)
Government ownership (%)	0.077	0.414
	(0.140)	(0.125)
Government contract	0.345	0.353
	(0.027)	(0.024)
Employees	-1.359	-0.963
	(1.082)	(0.982)
Employees with university education (%)	-0.146	-0.027
	(0.047)	(0.044)
Informal competition	0.233	0.183
	(0.020)	(0.019)
# Observations	24,821	

Notes: Standard errors are reported in parentheses. “Employees” are measured in thousands of people.

Table A9. Correlation matrix

	Productivity	Foreign ownership (%)	Export (%)	Government ownership (%)	Employees
Foreign ownership (%)	0.123	-	-	-	-
Export %	0.096	0.301	-	-	-
Government ownership (%)	0.030	-0.018	0.015	-	-
Employees	0.143	0.061	0.084	0.057	-
Employees with university education (%)	0.129	0.022	-0.008	0.005	0.053

Table A10. VIF tests

	(i)	(ii)	(iii)
Internal management	7.169	6.988	6.988
External management	15.15	15.43	15.43
Environmental innovation inputs	5.972	-	-
Environmental innovation outputs	-	5.073	-
Foreign ownership (%)	3.614	3.758	3.768
Export (%)	4.330	4.121	4.123
Government ownership (%)	1.981	2.372	2.372
Government contract	1.511	1.458	1.444
Employees	1.029	1.029	1.029
Employees with university education (%)	1.893	1.867	1.867
Informal competition	5.604	5.213	5.261

Table A11. VIF Tests – with vs. without environmental innovation

	With innovation inputs	Without innovation inputs	With innovation outputs	Without innovation outputs
	(i)	(ii)	(iii)	(iv)
Internal management	4.774	1.072	4.231	1.098
External management	1.407	2.074	1.337	1.955
Foreign ownership (%)	3.510	4.237	3.520	4.399
Export %	4.344	1.347	4.021	1.147
Government ownership (%)	1.928	2.760	1.911	2.474
Government contract	4.868	1.280	4.623	1.122
Employees	1.030	1.189	1.030	1.158
Employees with university education (%)	1.812	2.333	1.794	2.135
Informal competition	4.052	4.090	3.700	4.089

Table A12. VIF Tests – with vs. without environmental management

	With internal management		Without internal management		With external management		Without external management	
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
Environmental innovation inputs	1.156	-	1.223	-	1.221	-	1.183	-
Environmental innovation outputs	-	1.189	-	1.196	-	1.253	-	1.203
Foreign ownership (%)	1.169	1.169	1.093	1.093	1.191	1.192	1.119	1.119
Export (%)	1.481	1.482	1.340	1.340	1.545	1.546	1.347	1.347
Government ownership (%)	1.234	1.234	1.025	1.024	1.289	1.289	1.135	1.135
Government contract	1.093	1.096	1.100	1.104	1.122	1.126	1.075	1.078
Employees	1.028	1.028	1.200	1.201	1.028	1.028	1.160	1.162
Employees with university education (%)	1.531	1.531	1.800	1.798	1.592	1.592	1.624	1.623
Informal competition	1.141	1.139	1.150	1.144	1.147	1.147	1.141	1.134