Supplementary information

THE IMPACT OF INSTITUTIONS ON INNOVATION NETWORKS: EMPIRICAL EVIDENCE FROM POLAND

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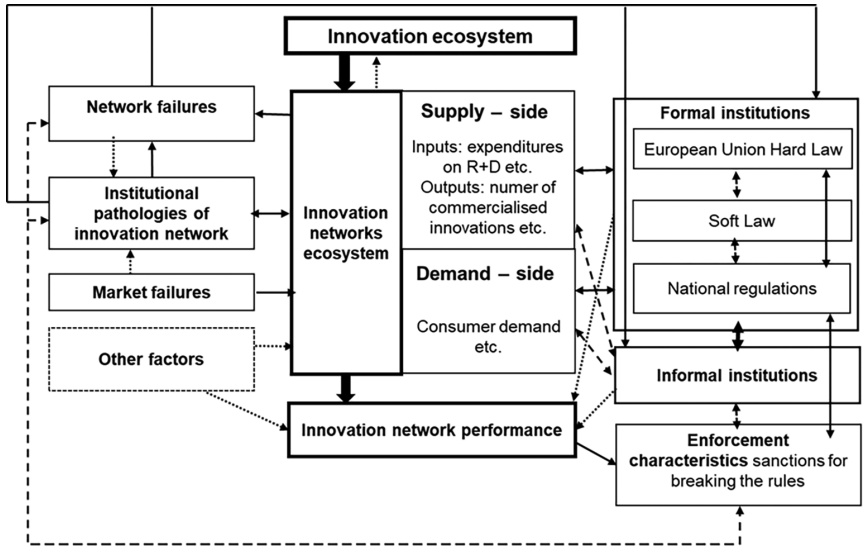
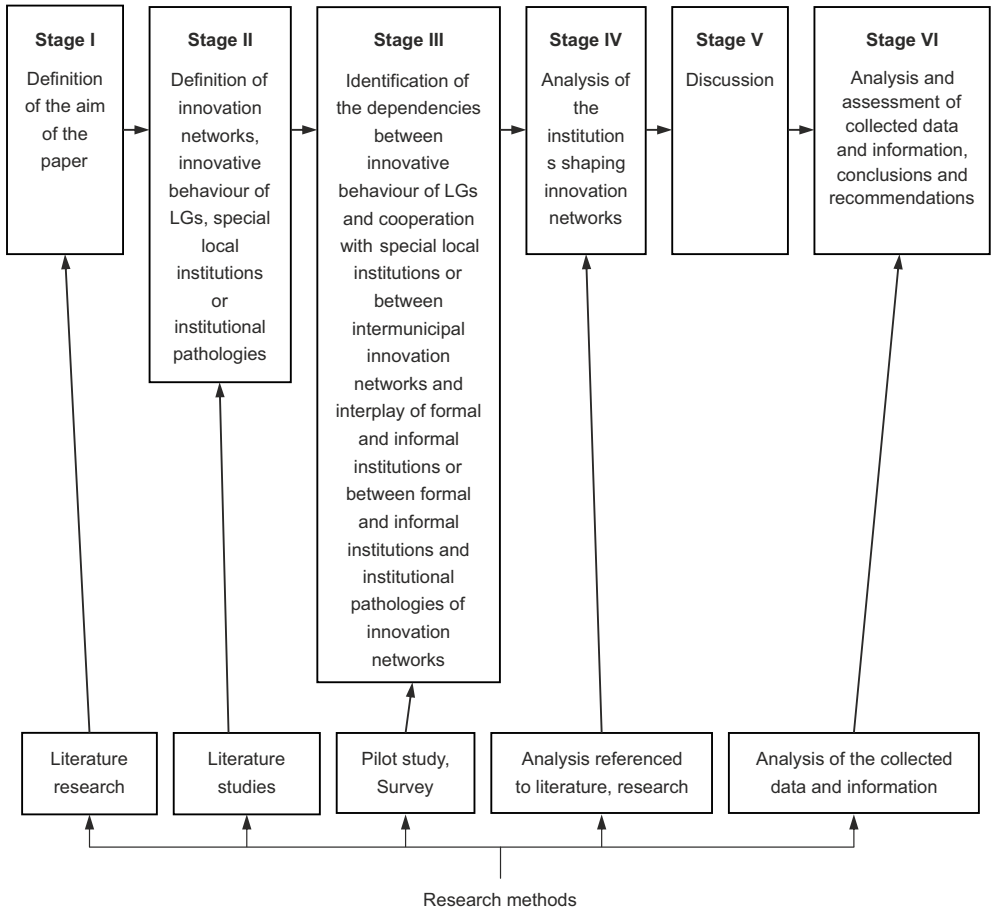
Supplement 1. Conceptual model of the relationship between formal and informal institutions, and innovation networks (source: authors' own compilation based on the literature of the subject). Line intensity and weight reflect the impact of relationship, and arrows indicate its directionality



Supplement 2. Stages of this study process based on Gorzelany-Dziadkowiec et al. (2019)



Supplement 3. Survey, which was sent to all Polish local governments (LG) after translation into English

1. Location (please enter the name of the LG).
2. Voivodeship (please enter the name of the voivodeship).
3. Type of LG (please select the appropriate answer).
4. Has your LG cooperated in the last three years with special local institutions (e.g. technology transfer centres, business environment institutions, science and technology parks, technology incubators, academic business incubators, regional and local loan funds, seed capital funds, advisory and training centres, business angel networks or chambers of commerce, etc.)?
5. Please indicate the names of special local institutions (e.g. technology transfer centres, business environment institutions, science and technology parks, technology incubators, academic business incubators, regional and local loan funds, seed capital funds, advisory and training centres, business angel networks or chambers of commerce,

etc.), with which the LG has cooperated most intensively in the last three years. Please indicate up to three of the most important such institutions.

6. Please indicate if the LG is or was a member of an innovation network, understood as the relationships between at least three independent organisations – connected with each other by a set of long-term cooperation ties – who seek innovation, in the last three years.
7. Please indicate which innovation networks the LG belongs to.
8. Please indicate the benefits of the LG's participation in the innovation network.
9. Please indicate the role of LGs in the innovation network.
10. Please indicate what types of innovations the network of which the LG is / was a member is working on.
11. Please indicate how many entities belong to the innovation network of which the LG is a member.
12. Please indicate which entities, apart from the LG, are also members of the innovation network.
13. Please indicate the organisational and legal form of the innovation network leader entity of which the LG is/was a member.
14. Please indicate whether the network of which the LG is/was a member has (had):
    - A Code of Ethics;
    - Formalised rules of cooperation between network members;
    - Sanctions for breaking the rules;
    - Common values and norms;
    - A monitoring system for obeying the rules;
    - A network governance code;
    - Common culture;
    - Not applicable.
15. Please indicate the key values for the innovation network of which the LG is (was) a member.
16. Please indicate which coordination mechanisms apply to the innovation network of which the LG is (was) a member.
17. Please specify to what extent the following statements are true (based on a seven-point Likert scale):
    - Our network is based on compliance with established rules;
    - Our network is based on innovative flow, competitive advantage and satisfactory financial results;
    - Our network is based on the common interest over the individual interest;
    - Our network is based on the stability of network members, structures and relations;
    - Our network is based on the continuous transfer of knowledge between members;
    - Our network is free of opportunism, distrust or rent-seeking behaviour;
    - Our network is supported by the institutional environment;
    - Our network is based on efficient delegation of tasks by the leader and partner management.

18. Please rate the activity of the innovation network of which the LG is/was a member in each area.
19. Please list the scientific and research institutions, which your network has cooperated with in the last three years.

Supplement 4. List of dependent and independent variables used in the empirical analysis

Table 4.1. List of dependent variables used in the empirical analysis (source: authors' own compilation)

No.	Variable	Explanation of the variable
1	*meminne*	Innovative behaviour of local governments manifested by participation in innovation networks of all kinds. The variable takes a value of 0 if LGs do not participate in innovation networks and 1 otherwise i.e. LGs participate in innovation networks.
2	*interpl*	Interplay between formal and informal institutions manifested by innovation network characteristics based on formal rules, sanctions for breaking the rules, a monitoring system for obeying the rules, codes of ethics, common values and norms, and a common culture and governance codes. The variable (*interpl*) takes a value of 0 if innovation networks are based only on informal institutions or only on formal institutions and 1. Otherwise i.e. innovation networks are based on interplay between formal and informal institutions.
3	*complia*	Institutional pathologies of innovation networks manifested by network characteristics such as lack of compliance with established rules. The variable takes a value of 0 if members' lack of compliance with established rules and 1 do not affect innovation networks otherwise, i.e. innovation networks are affected by a lack of compliance with established rules.
4	*indimem*	Institutional pathologies of innovation networks manifested by network characteristics such as individual members' interests taking precedence over their common interests. The variable takes a value of 0 if individual members' interests taking precedence over their common interests and 1 do not affect innovation networks; otherwise, individual members' interests taking precedence over their common interests affect i.e. innovation networks.
5	*stabili*	Institutional pathologies of innovation networks manifested by network characteristics such as a lack of stability of members, structure or relations. The variable takes a value of 0 if a lack of stability of members, structure or relations and 1 do not affect innovation networks; otherwise, i.e. innovation networks are affected by a lack of stability of members, structure or relations.
6	*oppodis*	Institutional pathologies of innovation networks manifested by network characteristics such as opportunism, distrust, or rent-seeking behaviour between members. The variable takes a value of 0 if members' opportunism, distrust, or rent-seeking behaviour and 1 do not affect innovation networks; otherwise, i.e. innovation networks are affected by members' opportunism, distrust, or rent-seeking behaviour.

Table 4.2. List of independent variables used in the empirical analysis (source: authors' compilation)

No.	Variable	Explanation of the variable
1	*coopsli*	Cooperation with special local institutions such as technology transfer centres, business environment institutions, science and technology parks, technology incubators, academic business incubators, regional and local loan funds, seed capital funds, advisory and training centres, business angel networks or chambers of commerce.
2	*typesin*	Types of innovation networks such as inter-municipal (intercity) innovation networks, municipal (city) forums, clusters, strategic alliances, public-private innovation networks, innovation networks, innovative partnerships, purchasing groups.
3	*formaru*	Formal rules of cooperation between network members.
4	*sanncio*	Sanctions for breaking the rules.
5	*comvano*	Common values and norms such as creativity, cooperation, reciprocity, trust or positive attitude to risk.
6	*monisys*	Monitoring system for obeying the rules.
7	*governor*	Innovation network governance codes.
8	*codethi*	Codes of ethics defining good practice for network members.
9	*comcult*	Common culture such as common innovative, creativity and/or entrepreneurial culture.

Supplement 5. Regression analysis

Table A5.1. Regression analysis for H1 (source: authors' own compilation)

Model Summary										
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	0.470[a]	0.221	0.216	0.39236	0.221	51.529	1	182	0.000	2.050

Note: [a]Predictors: (Constant), coopsli; [b]Dependent Variable: meminne.

ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	7.933	1	7.933	51.529	0.000[b]
	Residual	28.018	182	0.154		
	Total	35.951	183			

Note: [a]Dependent Variable: meminne; [b]Predictors: (Constant), coopsli.

Coefficients														
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	0.159	0.033		4.868	0.000	0.094	0.223					
	coopsli	0.508	0.071	0.470	7.178	0.000	0.368	0.648	0.470	0.470	0.470	1.000	1.000

Note: [a]Dependent Variable: meminne.

Table A5.2. Regression analysis for H2 (source: authors' own compilation)

Model Summary										
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	0.083[a]	0.007	–0.014	0.37610	0.007	0.322	1	47	0.573	2.084

Note: [a]Predictors: (Constant), typesin; [b]Dependent Variable: interpl.

ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	0.046	1	0.046	0.322	0.573[b]
	Residual	6.648	47	0.141		
	Total	6.694	48			

Note: [a]Dependent Variable: interpl.; [b]Predictors: (Constant), typesin.

Coefficients														
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	0.138	0.070		1.975	0.054	–0.003	0.278					
	typesin	0.062	0.109	0.083	0.568	0.573	–0.158	0.282	0.083	0.083	0.083	1.000	1.000

Note: [a]Dependent Variable: interpl.

Table A5.3. Regression analysis for H3 (source: authors' own compilation)

Model Summary										
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	0.519[a]	0.270	0.254	2.12427	0.270	17.356	1	47	0.000	2.148

Note: [a]Predictors: (Constant), formaru; [b]Dependent Variable: indimem.

ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	78.319	1	78.319	17.356	0.000[b]
	Residual	212.089	47	4.513		
	Total	290.408	48			

Note: [a]Dependent Variable: indimem; [b]Predictors: (Constant), formaru.

Coefficients														
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	0.159	0.033		4.868	0.000	0.094	0.223					
	formaru	0.508	0.071	0.470	7.178	0.000	0.368	0.648	0.470	0.470	0.470	1.000	1.000

Note: [a]Dependent Variable: indimem.

Model Summary										
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	0.564[a]	0.318	0.202	2.19725	0.318	2.736	7	41	0.020	2.206

Note: [a]Predictors: (Constant), formaru, sanncio, company, monisys, goverco, codethi, comcult; [b]Dependent Variable: indimem.

ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	92.463	7	13.209	2.736	0.020[b]
	Residual	197.945	41	4.828		
	Total	290.408	48			

Note: [a]Dependent Variable: indimem; [b]Predictors: (Constant), formaru, sanncio, company, monisys, goverco, codethi, comcult.

Coefficients													
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	2.104	0.421		4.999	0.000	1.254	2.954					
	formaru	2.510	0.708	0.502	3.547	0.001	1.081	3.939	0.519	0.485	0.457	0.829	1.207
	sanncio	−0.764	1.777	−0.086	−0.430	0.670	−4.353	2.825	0.177	−0.067	−0.055	0.416	2.403
	comvano	0.148	0.989	0.025	0.150	0.882	−1.850	2.146	0.274	0.023	0.019	0.578	1.729
	monisys	0.709	2.035	0.058	0.348	0.730	−3.402	4.819	0.186	0.054	0.045	0.607	1.646
	governor	−0.765	2.447	−0.044	−0.313	0.756	−5.706	4.176	0.100	−0.049	−0.040	0.823	1.215
	comcult	1.003	1.083	0.159	0.926	0.360	−1.185	3.190	0.265	0.143	0.119	0.560	1.785
	codethi	1.475	2.465	0.120	0.598	0.553	−3.503	6.453	0.144	0.093	0.077	0.414	2.414

Note: [a]Dependent Variable: indimem.

Model Summary										
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	0.517[a]	0.268	0.252	2.44946	0.268	17.165	1	47	0.000	2.204

Note: [a]Predictors: (Constant), formaru; [b]Dependent Variable: complia.

ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	102.987	1	102.987	17.165	0.000[b]
	Residual	281.993	47	6.000		
	Total	384.980	48			

Note: [a]Dependent Variable: complia; [b]Predictors: (Constant), formaru.

Coefficients														
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	2.867	0.447		6.410	0.000	1.967	3.766					
	formaru	2.975	0.718	0.517	4.143	0.000	1.531	4.420	0.517	0.517	0.517	1.000	1.000

Note: [a]Dependent Variable: complia.

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	0.598[a]	0.358	0.266	2.42574	0.358	3.904	6	42	0.003	2.141

Note: [a]Predictors: (Constant), formaru, sanncio, company, monisys, goverco, codethi, comcult; [b]Dependent Variable: complia.

ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	145.637	7	20.805	3.564	0.004[b]
	Residual	239.343	41	5.838		
	Total	384.980	48			

Note: [a]Dependent Variable: complia; [b]Predictors: (Constant), formaru, sanncio, company, monisys, goverco, codethi, comcult.

Coefficients														
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	2.500	0.463		5.402	0.000	1.565	3.435					
	formaru	2.709	0.778	0.471	3.482	0.001	1.138	4.281	0.517	0.478	0.429	0.829	1.207
	sanncio	–1.265	1.954	–0.124	–0.648	0.521	–5.212	2.681	0.237	–0.101	–0.080	0.416	2.403
	comvano	0.692	1.088	0.103	0.636	0.528	–1.505	2.889	0.363	0.099	0.078	0.578	1.729
	monisys	0.138	2.238	0.010	0.062	0.951	–4.382	4.658	0.219	0.010	0.008	0.607	1.646
	governor	–1.629	2.690	-0.082	–0.606	0.548	–7.063	3.804	0.102	–0.094	–0.075	0.823	1.215
	comcult	1.728	1.191	0.239	1.451	0.154	–0.677	4.133	0.354	0.221	0.179	0.560	1.785
	codethi	3.132	2.710	0.221	1.155	0.255	–2.342	8.605	0.219	0.178	0.142	0.414	2.414

Note: [a]Dependent Variable: complia.

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	0.617[a]	0.381	0.368	2.06999	0.381	28.939	1	47	0.000	2.145

Note: [a]Predictors: (Constant), formaru; [b]Dependent Variable: stabili.

ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	124.000	1	124.000	28.939	0.000[b]
	Residual	201.388	47	4.285		
	Total	325.388	48			

Note: [a]Dependent Variable: stabili; [b]Predictors: (Constant), formaru.

Coefficients														
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	2.367	0.378		6.262	0.000	1.606	3.127					
	formaru	3.265	0.607	0.617	5.380	0.000	2.044	4.486	0.617	0.617	0.617	1.000	1.000

Note: [a]Dependent Variable: stabili.

Model Summary										
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	0.690[a]	0.476	0.387	2.03875	0.476	5.326	7	41	0.000	2.302

Note: [a]Predictors: (Constant), formaru, sanncio, company, monisys, goverco, codethi, comcult; [b]Dependent Variable: stabili.

ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	154.971	7	22.139	5.326	0.000[b]
	Residual	170.417	41	4.157		
	Total	325.388	48			

Note: [a]Dependent Variable: stabili; [b]Predictors: (Constant), formaru, sanncio, company, monisys, goverco, codethi, comcult.

Coefficients													
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	2.074	0.391		5.311	0.000	1.285	2.863					
	formaru	2.981	0.657	0.564	4.540	0.000	1.655	4.307	0.617	0.578	0.513	0.829	1.207
	sanncio	0.324	1.649	0.034	0.196	0.845	–3.007	3.654	0.245	0.031	0.022	0.416	2.403
	comvano	0.146	0.918	0.024	0.159	0.875	–1.708	1.999	0.380	0.025	0.018	0.578	1.729
	monisys	0.291	1.889	0.022	0.154	0.878	–3.523	4.105	0.190	0.024	0.017	0.607	1.646
	governor	–1.152	2.270	–0.063	–0.507	0.615	–5.736	3.433	0.133	–0.079	–0.057	0.823	1.215
	codethi	–0.082	2.287	–0.006	–0.036	0.972	–4.701	4.537	0.109	–0.006	–0.004	0.414	2.414
	comcult	1.951	1.005	0.293	1.941	0.059	–0.079	3.980	0.395	0.290	0.219	0.560	1.785

Note: [a]Dependent Variable: stabili.

Model Summary										
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	0.551[a]	0.303	0.288	2.12979	0.303	20.460	1	47	0.000	1.797

Note: [a]Predictors: (Constant), formaru; [b]Dependent Variable: oppodis.

ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	92.807	1	92.807	20.460	0.000[b]
	Residual	213.193	47	4.536		
	Total	306.000	48			

Note: [a]Dependent Variable: oppodis; [b]Predictors: (Constant), formaru.

Coefficients														
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	2.333	0.389		6.001	0.000	1.551	3.116					
	formaru	2.825	0.624	0.551	4.523	0.000	1.568	4.081	0.551	0.551	0.551	1.000	1.000

Note: [a]Dependent Variable: oppodis.

Model Summary										
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	0.621[a]	0.385	0.280	2.14209	0.385	3.670	7	41	0.004	1.846

Note: [a]Predictors: (Constant), formaru, sanncio, company, monisys, goverco, codethi, comcult; [b]Dependent Variable: oppodis.

ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	117.869	7	16.838	3.670	0.004[b]
	Residual	188.131	41	4.589		
	Total	306.000	48			

Note: [a]Dependent Variable: oppodis; [b]Predictors: (Constant), formaru, sanncio, company, monisys, goverco, codethi, comcult.

Coefficients													
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	2.116	0.410		5.156	0.000	1.287	2.944					
	formaru	2.632	0.690	0.513	3.815	0.000	1.238	4.025	0.551	0.512	0.467	0.829	1.207
	sanncio	0.655	1.733	0.072	0.378	0.708	–2.845	4.154	0.187	0.059	0.046	0.416	2.403
	comvano	–0.322	0.964	–0.054	–0.334	0.740	–2.270	1.625	0.299	–0.052	–0.041	0.578	1.729
	monisys	0.645	1.984	0.051	0.325	0.747	-3.362	4.653	0.171	0.051	0.040	0.607	1.646
	governor	–0.266	2.385	–0.015	–0.111	0.912	–5.083	4.551	0.149	–0.017	–0.014	0.823	1.215
	codethi	–1.168	2.403	–0.092	–0.486	0.629	–6.021	3.685	0.047	–0.076	–0.060	0.414	2.414
	comcult	1.841	1.056	0.285	1.744	0.089	–0.291	3.974	0.362	0.263	0.214	0.560	1.785

Note: [a]Dependent Variable: oppodis.

References

Gorzelany-Dziadkowiec, M., Gorzelany, J., Stauskis, G., Hernik, J., Van Assche, K., & Noszczyk, T. (2019). The innovation process in local development – the material, institutional, and intellectual infrastructure shaping and shaped by innovation. *Technological and Economic Development of Economy*, *25*(6), 1232–1258. https://doi.org/10.3846/tede.2019.11094