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Social network and radical innovation: evidence from the U.S. pharmaceutical and biotechnology industry

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Appendix A

Table A1. Alternative radicalness measure using longer time window

| | Radicalness | | | |
|-------------------------------------|----------------------|----------------------|----------------------|----------------------|
| | (1) | (2) | (3) | (4) |
| Tie strength (ln) | | -0.010*** (0.002) | -0.008*** (0.003) | -0.012*** (0.003) |
| Structural hole | | | -0.005 (0.004) | -0.007* (0.004) |
| Tie strength (ln) * Structural hole | | | | 0.005* (0.003) |
| Innovation productivity (ln) | 0.003*** (0.001) | 0.010*** (0.002) | 0.008*** (0.002) | 0.008*** (0.002) |
| Network size (ln) | -0.003** (0.001) | -0.006*** (0.002) | -0.006*** (0.002) | -0.006*** (0.002) |
| Collaboration inclination | -0.015*** (0.005) | -0.003 (0.005) | -0.006 (0.006) | -0.006 (0.006) |
| Year FE | Yes | Yes | Yes | Yes |
| Firm-location FE | Yes | Yes | Yes | Yes |
| N | 19343 | 19343 | 19343 | 19343 |
| R-square | 0.726 | 0.727 | 0.727 | 0.727 |

Note: Robust standard error in parentheses. ***p < 0.01; **p < 0.05; *p < 0.1.

Table A2. Fewer controls

| | Radicalness | | | |
|-------------------------------------|-------------|-----------|-----------|-----------|
| | (1) | (2) | (3) | (4) |
| Tie strength (ln) | -0.004* | -0.011*** | -0.016*** | -0.009*** |
| | (0.002) | (0.003) | (0.003) | (0.002) |
| Structural hole | -0.019*** | -0.009** | -0.006* | -0.012*** |
| | (0.004) | (0.004) | (0.004) | (0.003) |
| Tie strength (ln) * Structural hole | 0.006** | 0.009*** | 0.007** | 0.009*** |
| | (0.003) | (0.003) | (0.003) | (0.003) |
| Innovation productivity (ln) | | 0.002 | 0.011*** | |
| | | (0.002) | (0.002) | |
| Network size (ln) | -0.006*** | | -0.010*** | |
| | (0.001) | | (0.002) | |
| Collaboration inclination | -0.018*** | -0.017*** | | |
| | (0.004) | (0.005) | | |
| Year FE | Yes | Yes | Yes | Yes |
| Firm-location FE | Yes | Yes | Yes | Yes |
| N | 19343 | 19343 | 19343 | 19343 |
| R-square | 0.697 | 0.696 | 0.698 | 0.695 |

Note: Robust standard error in parentheses. ***p < 0.01; **p < 0.05; *p < 0.1.

| | Innovation success | | | | | | | | | | | |
|-------------|--------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| R-square | 0.753 | 0.752 | 0.753 | 0.757 | 0.757 | 0.758 | 0.758 | 0.757 | 0.758 | 0.752 | 0.751 | 0.752 |
| F Statistic | 61.96*** | 56.95*** | 60.24*** | 71.38*** | 66.52*** | 69.04*** | 71.73*** | 67.11*** | 69.42*** | 65.95*** | 60.41*** | 63.86*** |

Note: Robust standard error in parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

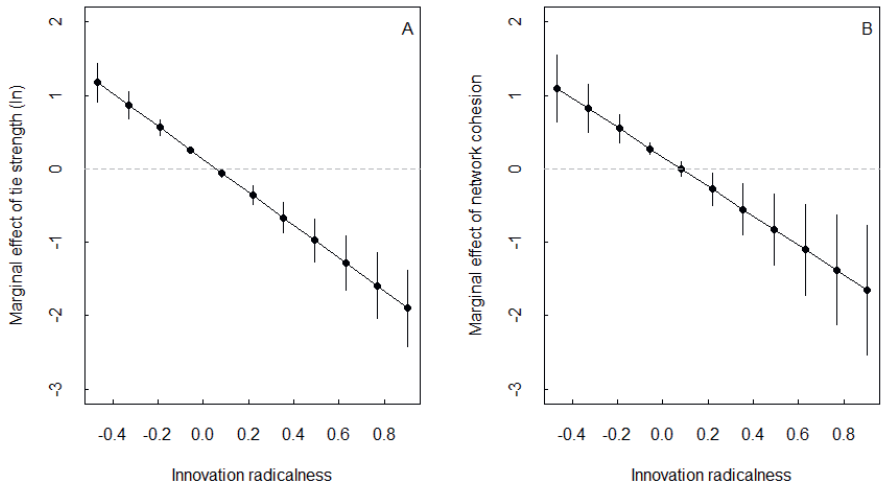


Figure B1. Robustness test: Dropping control variables. Points represent the regression coefficients, and vertical bars represent 90% confidence interval.

Appendix C

Table C1. Do not control the number of citations

| | ln(Private value) | | | |
|-----------------------------------|----------------------|---------------------|----------------------|----------------------|
| | OLS | | | |
| | (1) | (2) | (3) | (4) |
| Destructiveness | -0.080*** (0.004) | | -0.077*** (0.004) | -0.078*** (0.004) |
| Dissimilarity | | 0.199*** (0.006) | 0.198*** (0.006) | 0.198*** (0.006) |
| Dissimilarity * Destructiveness | | | | 0.019*** (0.003) |
| ln(References) | 0.159*** (0.006) | 0.198*** (0.006) | 0.167*** (0.006) | 0.167*** (0.006) |
| Patent class * Year fixed effects | Y | Y | Y | Y |
| N | 1066637 | 1066637 | 1066637 | 1066637 |
| R-square | 0.193 | 0.197 | 0.198 | 0.198 |

Note. Destructiveness and dissimilarity are standardized. Robust standard error clustered at patent class * year level in paratheses. *** p<.001, ** p<.01, * p<.05.

Table C2. Alternative destructiveness measure: Shorter and fixed time window

| | ln(Private value) | | | |
|--------------------------------------|----------------------|---------------------|----------------------|----------------------|
| | OLS | | | |
| | (1) | (2) | (3) | (4) |
| Destructiveness (5Y) | -0.139*** (0.004) | | -0.135*** (0.004) | -0.135*** (0.004) |
| Dissimilarity | | 0.203*** (0.006) | 0.200*** (0.006) | 0.200*** (0.006) |
| Dissimilarity * Destructiveness (5Y) | | | | 0.024*** (0.003) |
| ln(References) | 0.109*** (0.006) | 0.171*** (0.006) | 0.118*** (0.006) | 0.118*** (0.006) |
| ln(Citations 5Y) | 0.202*** (0.005) | 0.180*** (0.005) | 0.199*** (0.005) | 0.199*** (0.005) |
| Patent class * Year fixed effects | Y | Y | Y | Y |
| N | 950308 | 950308 | 950308 | 950308 |
| R-square | 0.203 | 0.205 | 0.208 | 0.208 |

Note. Destructiveness (5Y) and dissimilarity are standardized. Robust standard error clustered at patent class * year level in paratheses. *** p<.001, ** p<.01, * p<.05.

Table C3. Alternative destructiveness measure: Originality

| | ln(Private value) | | | |
|-----------------------------------|----------------------|---------------------|----------------------|----------------------|
| | OLS | | | |
| | (1) | (2) | (3) | (4) |
| Originality | -0.054*** (0.003) | | -0.051*** (0.003) | -0.054*** (0.003) |
| Dissimilarity | | 0.196*** (0.006) | 0.195*** (0.006) | 0.194*** (0.006) |
| Dissimilarity * Originality | | | | 0.014*** (0.003) |
| ln(References) | 0.148*** (0.006) | 0.153*** (0.006) | 0.156*** (0.006) | 0.156*** (0.006) |
| ln(Citations) | 0.210*** (0.004) | 0.209*** (0.004) | 0.208*** (0.004) | 0.208*** (0.004) |
| Patent class * Year fixed effects | Y | Y | Y | Y |
| N | 1066637 | 1066637 | 1066637 | 1066637 |
| R-square | 0.202 | 0.206 | 0.207 | 0.207 |

Note. Originality and dissimilarity and are standardized. Robust standard error clustered at patent class * year level in paratheses. *** p<.001, ** p<.01, * p<.05.

Table C4. Alternative dissimilarity measures: Ratio of new keywords

| | ln(Private value) | | | |
|--|----------------------|---------------------|----------------------|----------------------|
| | OLS | | | |
| | (1) | (2) | (3) | (4) |
| Destructiveness | -0.143*** (0.004) | | -0.143*** (0.004) | -0.146*** (0.004) |
| Ratio of new keywords | | 0.008** (0.002) | 0.009*** (0.002) | 0.007** (0.002) |
| Ratio of new keywords * Destructiveness | | | | 0.012*** (0.002) |
| ln(References) | 0.082*** (0.006) | 0.145*** (0.006) | 0.083*** (0.006) | 0.082*** (0.006) |
| ln(Citations) | 0.237*** (0.005) | 0.211*** (0.004) | 0.237*** (0.005) | 0.237*** (0.005) |
| Patent class * Year fixed effects | Y | Y | Y | Y |
| N | 1066637 | 1066637 | 1066637 | 1066637 |
| R-square | 0.204 | 0.201 | 0.204 | 0.204 |

Note. Destructiveness and ratio of new keywords are standardized. Robust standard error clustered at patent class * year level in parentheses. *** p<.001, ** p<.01, * p<.05.

Table C5. Alternative dissimilarity measures: Ratio of new keyword pairs

| | ln(Private value) | | | |
|---|----------------------|---------------------|----------------------|----------------------|
| | OLS | | | |
| | (1) | (2) | (3) | (4) |
| Destructiveness | -0.143*** (0.004) | | -0.144*** (0.004) | -0.151*** (0.004) |
| Ratio of new keyword pairs | | 0.031*** (0.003) | 0.034*** (0.003) | 0.030*** (0.003) |
| Ratio of new keyword pairs * Destructiveness | | | | 0.020*** (0.002) |
| ln(References) | 0.082*** (0.006) | 0.146*** (0.006) | 0.083*** (0.006) | 0.081*** (0.006) |
| ln(Citations) | 0.237*** (0.005) | 0.209*** (0.004) | 0.236*** (0.005) | 0.236*** (0.005) |
| Patent class * Year fixed effects | Y | Y | Y | Y |
| N | 1066637 | 1066637 | 1066637 | 1066637 |
| R-square | 0.204 | 0.201 | 0.204 | 0.204 |

Note. Destructiveness and ratio of new keyword pairs are standardized. Robust standard error clustered at patent class * year level in parentheses. *** p<.001, ** p<.01, * p<.05.

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