Internet Appendix for

"Does Banking Competition Affect Innovation?"

This internet appendix provides robustness tests and supplemental analyses to the main results presented in "Does Banking Competition Affect Innovation?". Section 1 presents the robustness checks for the baseline results reported in Section 4 of the paper. Section 2 provides various supplemental analyses.

1. Additional robustness checks

We conduct a rich set of robustness tests for our baseline results reported in Section 4 of the paper. First, we check if our baseline findings are robust to alternative approaches to clustering standard errors (we cluster standard errors by year in our baseline results) and report the results in Table A1. Specifically, we re-estimate Eqs. (1a) and (1b) by clustering standard errors by both state and year because *RSindex* is the same for all observations within a given state-year. We observe that the standard errors for the coefficient estimates on *RSindex* are indeed larger in magnitude than those in our baseline regressions, which reduces the significance level of the coefficient estimates. However, this approach does not change the statistical inference we obtain from this analysis.

[Insert Table A1 here.]

Second, in addition to the baseline OLS specification, we use alternative econometric models to check the robustness of our baseline findings. One concern is that our innovation variables are highly right skewed (the skewness of our patent count variable is 6.2). To address this concern, we employ a quantile regression model and report the regression results in Table A2. We first run the quantile regression model at the 90^{th} percentile and report the results in Panel A. The results are robust: We continue to observe positive and significant coefficient estimates of *RSindex* in columns (1) – (2) when we consider public and private patents together, or when we consider patents by public corporations, only, but insignificant coefficient estimate of *RSindex* in columns (3) in which we examine patents generated by private firms. We observe similar patterns in columns (3) – (6) with patent citations as the measure of innovation. Next, we conduct the quantile regressions at the 70^{th} percentile and report the results in Panel B. We observe generally similar results. In untabulated analyses, we obtain similar findings if we run

the quantile regressions at the 75th or the 85th percentile.

Another concern is that the dependent variables, patent counts and citations, are non-negative and discrete. To address this concern, we conduct a negative binomial model and report the results in Panel C. We find qualitatively similar results: The coefficient estimates of *RSindex* (again, except for in columns (3) and (6) in which we examine innovation generated by private firms) are all positive and significant at the 1% level.

[Insert Table A2 here.]

Third, to further address the concern regarding the right skewed distribution of the patent count and citations variables, we repeat the baseline regressions with various subsamples. We start by focusing on state-year observations with patent counts (and, separately, patent citations) falling in the top two terciles of the patent distribution (i.e., we exclude observations from the bottom tercile), and report the results in Table A3 Panel A. The coefficient estimates of *RSindex* across various specifications are positive and significant at either the 5% or 1% level (except for columns (3) and (6)), which is consistent with the baseline results reported in Table 2 of the paper. Next, we restrict our sample to state-year observations with patent counts (citations) falling in the top tercile of the patent distribution (i.e., we exclude observations from the bottom two terciles). We report the results in Table A3 Panel B. We find qualitatively similar results.

[Insert Table A3 here.]

Finally, in the paper, we follow Bertrand and Mullainathan (2003) to examine the dynamics of innovation surrounding deregulatory events and show there is no pre-existing trend in innovation before interstate branching deregulation. However, another reasonable reverse causality concern regarding our baseline tests is that corporations wishing to engage in innovative activities may relocate to certain states following or in anticipation of changes in banking competition. Further, changes in banking competition may affect the likelihood that new corporations establish headquarters within a state. We address these concerns with several sample selection procedures. First, we restrict our sample to patents (and, separately, citations on those patents) that are generated by corporations that do not relocate their headquarters any time during the sample period. Second, we restrict our sample of patents (and, separately, citations on those patents) that are generated by corporations that are headquartered within a state at least three years before any changes in bank branching laws.

The Compustat location data only provide the current state and county information of corporations' headquarters locations. Further, Compustat backfills the current information, overwriting all preceding observations whenever corporations relocate headquarters. To correct for these characteristics of the Compustat data, we collect data on corporations' historical headquarters locations from the Compact Disclosure database. Unlike Compustat, Compact Disclosure publishes data on the firm headquarter street address, city, state, and area zip code according to historical SEC filings, which helps us identify any headquarter location changes for each firm. We identify moving corporations as those with changing headquarter states from one year to the next within the Compact Disclosure database. Note, however, that we cannot track private firms' headquarter location changes because of data limitations. Therefore, we only control for the location decisions of public corporations.

Table A4 reports the regression results from estimating Eqs. (1a) and (1b) after excluding patents or citations generated by moving corporations based on the two alternative selection procedures described above. Consistent with our baseline regressions reported in Table 2 columns (1) and (4) in the paper, the coefficient estimates of *RSindex* are positive and significant at the 5% level in all regressions, suggesting that banking competition due to branching deregulation negatively affects total innovation output. The evidence from this set of robustness tests suggests that our baseline results are not endogenously driven by corporations' headquarter location decisions.

[Insert Table A4 here.]

2. Supplemental analyses

2.1. Additional test addressing omitted variables

Although we undertake placebo tests to address the concern that an omitted variable coinciding with deregulatory events could drive our results, we undertake an additional test to address this concern. Specifically, we restrict our attention to corporations with no debt throughout their lives. We infer that these corporations do not have debt because they have no demand for external finance. (We focus on corporations because they almost certainly have access to bank or arms-length debt, whereas private firms without debt simply might not have access to debt. Additionally, we restrict our attention to public corporations because we cannot

observe the balance sheets of private firms.) Therefore, if deregulatory events in these corporations' home states expand access to external finance, we hypothesize that these firms will be indifferent to the greater availability of external finance. Crucially, however, the innovation output of these corporations should still change as a result of fluctuations in a coincident, omitted variable. We re-estimate Eqs. (1a) and (1b) after restricting the sample to this set of corporations and report the results in Table A5. If an omitted variable drives the paper's main results, then the results should still be present in this sample. However, we find the coefficient estimates of *RSindex* are indistinguishable from zero whether we use patents or patent citations as a proxy for innovation. These non-results provide supporting evidence that the paper's main results are not drive by an omitted variable.

[Insert Table A5 here.]

2.2. Additional proxies for external finance dependence

In the paper, we use the measure of external finance dependence developed by Duchin, Ozbas, and Sensoy (2010) to examine whether the effect of banking competition on innovation is altered by a company's dependence on external finance. We also use company size, age, bank dependence following Acharya, Imbs, and Sturgess (2011) and the SA index following Hadlock and Pierce (2010) as alternative proxies for external finance dependence. In this subsection, we construct the Kaplan-Zingales (KZ) index as an alternative measure for external finance dependence. Specifically, we split out sample based on the KZ index. We impute these alternative partition variables from public corporations in industry *j* in year *t* to private firms in the same industry and year using the same procedure described in the paper. We also define $Dependence_t$ for the KZ index the same way as before so that $Dependence_t$ equals one for the firm-years (corporation-years) that are considered less external-finance-dependent and zero for firm-years (corporation-years) that are considered more external finance dependent. We report the results in Table A6. The coefficient estimate of *RSindex* is negative and significant at the 5% and 10% level in columns (1) and (2), respectively, suggesting that external finance dependent firms generate a larger number of patents and patents with higher impact post deregulation, consistent with the evidence documented in the paper.

[Insert Table A6 here.]

2.3. The effect of bank entry and failures

Deregulatory events change the structure of the banking industry by facilitating bank entry and failures. Subramanian and Yadav (2012) show that deregulation of bank entry enhances bank stability by lowering instances of bank failures. We test whether bank entry and bank failure rates affect our results. We obtain bank entry and failure data from the FDIC's website (http://www2.fdic.gov/hsob/index.asp). We re-estimate Eqs. (1a) and (1b) after controlling for bank entry, the number of new banks that open due to new openings, relocations, or mergers in a state-year, and bank failure, the number of banks that fail due to failed mergers or bankruptcies in a state-year. We report the results in Table A7.

[Insert Table A7 here.]

The coefficient estimate of *RSindex* remains positive and significant when we consider public and private patents together, or when we consider patents by public corporations, only. The coefficient on *RSindex* remains positive but statistically insignificant when we consider patents by private firms, only. The results weaken somewhat when we re-estimate Eq. (1b) with patent citations as the dependent variable. As in Table 2 Panel A of the paper, we continue to see a positive and significant coefficient for *RSindex*. However, when we consider patents produced by public corporations, only, the coefficient remains positive but is no longer statistically significant. As in our baseline findings, the coefficient on *RSindex* is positive and statistically insignificant when we consider citations on patents produced by private firms, only. Overall, our results remain robust to controlling for bank entry and bank failure.

2.4. Lending to external finance dependent companies

Although we show banking competition relaxes financing constraints for private firms and increases their innovation output in the paper, we are agnostic about the effect of banking competition on banks' lending to external-finance-dependent companies. We provide some suggestive evidence here. We construct two dependent variables for this set of tests. *IndLoan* is an indicator variable taking a value of one if the company received a loan in a given year, and zero otherwise. *LnLoan* is the natural logarithm of one plus the dollar amount of money borrowed by the company in a year. We collect bank loan information from DealScan. Our independent variables of interest measure banking competition, external finance dependence, and the interaction of the two. We construct a Herfindahl index to capture state-year banking

competition. We use the branch-level distribution of bank deposits within a state-year to compute the Herfindahl index for state *j* at year *t*. The bank deposit data is from the FDIC website (http://www2.fdic.gov/sod/dynaDownload.asp?barItem=6). We interact this measure with the various proxies of external finance dependence that we use in the paper: the Duchin, Ozbas, and Sensoy (2010) measure in Panel A, as well as company size in Panel B, age in Panel C, bank dependence in Panel D, and KZ index in Panel E, following Acharya, Imbs, and Sturgess (2011). We split the sample into lending outcomes from private firms and public corporations and report the results in Table A8.

[Insert Table A8 here.]

We find generally consistent evidence across panels with different proxies for external finance dependence. The preponderance of evidence from these tests suggests that banking competition leads to more loans and larger loans for external-finance-dependent firms. These results are stronger for private firms than public corporations.

References

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Table A1
Baseline regressions with alternative approaches to clustering standard errors

This table reports OLS regression estimates of Eqs. (1a) and (1b) with standard errors clustered both by state and year. The dependent variable in columns (1) – (3) is the natural logarithm of one plus the sum of the patents generated in the next three years in a state. The dependent variable in column (4) – (6) is the natural logarithm of one plus the number of citations for patents generated in the next three years in a state. Definitions of control variables are in the Appendix. Significance at the 1%, 5%, and 10% level is indicated by ***, **, and *, respectively.

	LnPat			LnCite		
	Total	Public	Private	Total	Public	Private
	(1)	(2)	(3)	(4)	(5)	(6)
RSindex	0.077**	0.102*	0.030	0.058*	0.066	0.041
	(0.032)	(0.058)	(0.025)	(0.034)	(0.069)	(0.034)
Mining	0.013	0.031	0.001	0.013	0.098*	0.000
	(0.031)	(0.047)	(0.028)	(0.033)	(0.053)	(0.029)
Construction	-0.012	0.055	-0.028	-0.004	0.115	-0.023
	(0.036)	(0.067)	(0.023)	(0.043)	(0.080)	(0.033)
Manufacturing	0.016	0.023	-0.001	0.014	0.077	-0.000
	(0.025)	(0.043)	(0.023)	(0.028)	(0.054)	(0.023)
Transportation	-0.063	-0.139	-0.034	-0.082	-0.190	-0.042
	(0.064)	(0.146)	(0.036)	(0.069)	(0.213)	(0.040)
Trade	0.122**	0.116	0.090**	0.125*	0.172	0.077
	(0.058)	(0.107)	(0.040)	(0.070)	(0.136)	(0.053)
Finance	-0.005	-0.027	0.048*	-0.017	-0.010	0.037
	(0.027)	(0.044)	(0.027)	(0.027)	(0.057)	(0.025)
Service	-0.090**	-0.103	-0.083**	-0.104**	-0.060	-0.106**
	(0.038)	(0.066)	(0.039)	(0.045)	(0.083)	(0.042)
Government	-0.045	-0.069	-0.058**	-0.045	-0.039	-0.058
	(0.034)	(0.069)	(0.026)	(0.048)	(0.095)	(0.040)
Concentration	0.002	0.075	-0.028	0.009	0.060	-0.043
	(0.041)	(0.066)	(0.034)	(0.046)	(0.086)	(0.037)
Gross Product	-0.000	-0.000	0.000	0.000	-0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Intra	-0.226*	-0.402	-0.058	-0.253	-0.468	-0.098
	(0.128)	(0.249)	(0.063)	(0.168)	(0.324)	(0.102)
Inter	-0.095**	-0.084	-0.045	-0.166***	-0.216*	-0.091
	(0.044)	(0.087)	(0.067)	(0.047)	(0.126)	(0.091)

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Constant	7.029***	4.941	8.112***	9.784***	4.632	11.756***
	(2.430)	(5.177)	(1.377)	(2.958)	(6.900)	(1.875)
State FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,426	1,426	1,426	1,426	1,426	1,426
Adjusted R^2	0.966	0.927	0.971	0.954	0.901	0.954

Table A2

Baseline regressions with alternative econometric models

This table reports the results estimating Eqs. (1a) and (1b) with econometric specifications other than OLS regressions. For Panels A and B, the dependent variable in columns (1) – (3) is the natural logarithm of one plus the sum of the patents generated in the next three years in a state. The dependent variable in column (4) – (6) is the natural logarithm of one plus the number of citations for patents generated in the next three years in a state. In Panel C, the dependent variable in columns (1) – (3) is the sum of the patents generated in the next three years in a state and in columns (4) – (6) is the sum of the number of citations for patents generated in the next three years in a state. Definitions of control variables are in the Appendix. Significance at the 1%, 5%, and 10% level is indicated by ***, **, and *, respectively.

Panel A: Quantile regressions at the 90th percentile

	LnPat			LnCite		
	Total	Public	Private	Total	Public	Private
	(1)	(2)	(3)	(4)	(5)	(6)
RSindex	0.039***	0.118***	0.003	0.012***	0.079***	-0.003
	(0.001)	(0.002)	(0.005)	(0.004)	(0.006)	(0.002)
Mining	-0.005***	-0.039***	-0.003	0.010***	0.004	-0.022***
	(0.001)	(0.001)	(0.003)	(0.002)	(0.004)	(0.001)
Construction	-0.028***	0.006***	-0.033***	-0.028***	0.081***	-0.053***
	(0.001)	(0.002)	(0.004)	(0.003)	(0.004)	(0.002)
Manufacturing	0.001*	-0.003**	-0.013***	0.009***	0.019***	-0.020***
	(0.001)	(0.001)	(0.003)	(0.002)	(0.004)	(0.001)
Transportation	-0.043***	-0.033***	-0.015**	-0.023***	-0.062***	-0.014***
	(0.001)	(0.003)	(0.006)	(0.005)	(0.013)	(0.003)
Trade	0.086***	0.011***	0.073***	0.106***	0.064***	0.007**
	(0.001)	(0.003)	(0.006)	(0.005)	(0.008)	(0.003)
Finance	-0.013***	-0.033***	0.023***	-0.009***	-0.010***	0.012***
	(0.001)	(0.001)	(0.003)	(0.002)	(0.004)	(0.001)
Service	-0.076***	-0.046***	-0.066***	-0.062***	0.017***	-0.055***
	(0.001)	(0.002)	(0.006)	(0.004)	(0.006)	(0.003)
Government	-0.041***	-0.099***	-0.031***	-0.055***	-0.075***	-0.057***
	(0.001)	(0.002)	(0.003)	(0.003)	(0.005)	(0.002)
Concentration	0.020***	0.051***	0.009***	0.011***	0.043***	0.026***
	(0.001)	(0.002)	(0.003)	(0.003)	(0.005)	(0.002)
Gross Product	-0.000***	-0.000***	0.000	-0.000***	0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Intra	-0.035***	-0.059***	-0.032**	-0.066***	-0.102***	0.036***
	(0.002)	(0.005)	(0.012)	(0.009)	(0.013)	(0.006)
Inter	-0.018***	-0.041***	-0.059***	-0.088***	-0.034**	-0.047***
	(0.003)	(0.006)	(0.014)	(0.010)	(0.016)	(0.007)

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Constant	9.671***	8.719***	8.959***	8.818***	3.885***	8.523***
	(0.053)	(0.111)	(0.252)	(0.184)	(0.302)	(0.119)
State FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,426	1,426	1,426	1,426	1,426	1,426

Panel B: Quantile regressions at the 70th percentile

	LnPat			LnCite		
	Total	Public	Private	Total	Public	Private
	(1)	(2)	(3)	(4)	(5)	(6)
RSindex	0.048***	0.109***	0.003	0.058*	0.066	0.041
	(0.002)	(0.000)	(0.003)	(0.034)	(0.069)	(0.034)
Mining	0.000	0.015***	-0.016***	0.013	0.098*	0.000
	(0.002)	(0.000)	(0.002)	(0.033)	(0.053)	(0.029)
Construction	-0.040***	-0.012***	-0.058***	-0.004	0.115	-0.023
	(0.002)	(0.000)	(0.003)	(0.043)	(0.080)	(0.033)
Manufacturing	0.009***	0.032***	-0.024***	0.014	0.077	-0.000
	(0.002)	(0.000)	(0.002)	(0.028)	(0.054)	(0.023)
Transportation	-0.037***	-0.115***	0.002	-0.082	-0.190	-0.042
	(0.004)	(0.001)	(0.004)	(0.069)	(0.213)	(0.040)
Trade	0.082***	0.048***	0.088***	0.125*	0.172	0.077
	(0.003)	(0.000)	(0.004)	(0.070)	(0.136)	(0.053)
Finance	-0.001	-0.008***	0.004*	-0.017	-0.010	0.037
	(0.002)	(0.000)	(0.002)	(0.027)	(0.057)	(0.025)
Service	-0.072***	-0.051***	-0.086***	-0.104**	-0.060	-0.106**
	(0.002)	(0.000)	(0.004)	(0.045)	(0.083)	(0.042)
Government	-0.053***	-0.090***	-0.056***	-0.045	-0.039	-0.058
	(0.002)	(0.000)	(0.003)	(0.048)	(0.095)	(0.040)
Concentration	-0.002	0.014***	0.022***	0.009	0.060	-0.043
	(0.002)	(0.000)	(0.003)	(0.046)	(0.086)	(0.037)
Gross Product	-0.000***	-0.000***	0.000***	0.000	-0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Intra	-0.117***	-0.116***	-0.040***	-0.253	-0.468	-0.098
	(0.006)	(0.001)	(0.009)	(0.168)	(0.324)	(0.102)
Inter	-0.049***	-0.022***	-0.039***	-0.166***	-0.216*	-0.091
	(0.008)	(0.001)	(0.011)	(0.047)	(0.126)	(0.091)
Constant	10.307***	9.026***	10.150***	9.784***	4.632	11.756***
	(0.130)	(0.019)	(0.179)	(2.958)	(6.900)	(1.875)
State FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,426	1,426	1,426	1,426	1,426	1,426
Adjusted R^2	0.966	0.927	0.971	0.954	0.901	0.954

Panel C: Negative binomial model

	LnPat			LnCite		
	Total	Public	Private	Total	Public	Private
	(1)	(2)	(3)	(4)	(5)	(6)
RSindex	0.077***	0.115***	0.024	0.050***	0.084***	0.022
	(0.014)	(0.020)	(0.017)	(0.014)	(0.027)	(0.019)
Mining	0.010	0.023**	0.007	0.010	0.040**	0.002
	(0.007)	(0.010)	(0.006)	(0.011)	(0.020)	(0.010)
Construction	-0.029***	0.012	-0.042***	-0.018***	0.087**	-0.035***
	(0.008)	(0.026)	(0.008)	(0.007)	(0.035)	(0.013)
Manufacturing	0.008	0.012	0.000	0.010	0.034**	-0.003
	(0.009)	(0.014)	(0.006)	(0.010)	(0.015)	(0.009)
Transportation	-0.091***	-0.277***	-0.047**	-0.082***	-0.099	-0.053***
	(0.026)	(0.044)	(0.021)	(0.023)	(0.074)	(0.012)
Trade	0.127***	0.146***	0.100***	0.130***	0.136***	0.091***
	(0.012)	(0.027)	(0.013)	(0.017)	(0.042)	(0.017)
Finance	-0.009	-0.033***	0.047***	-0.013	-0.019	0.036***
	(0.007)	(0.012)	(0.007)	(0.009)	(0.017)	(0.008)
Service	-0.094***	-0.095***	-0.086***	-0.090***	-0.032	-0.102***
	(0.010)	(0.022)	(0.009)	(0.014)	(0.021)	(0.011)
Government	-0.050***	-0.094***	-0.055***	-0.060***	-0.106***	-0.061***
	(0.008)	(0.016)	(0.010)	(0.014)	(0.023)	(0.014)
Concentration	0.009	0.060***	-0.020*	0.002	0.063***	-0.031**
	(0.013)	(0.013)	(0.011)	(0.015)	(0.024)	(0.014)
Gross Product	-0.000*	-0.000**	0.000	-0.000	0.000	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Intra	-0.208***	-0.295***	-0.068***	-0.195***	-0.271***	-0.088***
	(0.028)	(0.040)	(0.017)	(0.024)	(0.053)	(0.028)
Inter	-0.086***	-0.097**	-0.025	-0.142***	-0.219***	-0.059*
	(0.030)	(0.048)	(0.030)	(0.035)	(0.067)	(0.035)
Constant	5.784***	3.193***	5.985***	3.817***	-1.668	4.649***
	(0.356)	(0.928)	(0.346)	(0.678)	(1.230)	(0.618)
State FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,426	1,426	1,426	1,426	1,426	1,426

Table A3

Baseline regressions with subsamples partitioned by patent count

This table reports OLS regression estimates of Eqs. (1a) and (1b) with alternative subsamples of the patent data. In Panel A we truncate the sample to state-years in the upper 66% of the patent count distribution and the upper 66% of the citations distribution. In Panel B we truncate the sample to state-years in the upper 33% of the patent count distribution and the upper 33% of the citations distribution. The dependent variable in columns (1) – (3) is the natural logarithm of one plus the sum of the patents generated in the next three years in a state. The dependent variable in column (4) – (6) is the natural logarithm of one plus the number of citations for patents generated in the next three years in a state. Definitions of control variables are in the Appendix. Robust standard errors clustered by year are reported in parenthesis. Significance at the 1%, 5%, and 10% level is indicated by ***, **, and *, respectively.

Panel A: Upper 66% of the sample

	LnPat			LnCite		
	Total	Public	Private	Total	Public	Private
	(1)	(2)	(3)	(4)	(5)	(6)
RSindex	0.112***	0.152***	0.043	0.090***	0.109**	0.050
	(0.037)	(0.055)	(0.028)	(0.035)	(0.050)	(0.034)
Mining	0.052	0.038	0.066**	0.045	0.072	0.051
	(0.034)	(0.051)	(0.031)	(0.032)	(0.044)	(0.033)
Construction	-0.057	-0.060	-0.044	-0.071	-0.042	-0.068
	(0.064)	(0.103)	(0.036)	(0.065)	(0.097)	(0.049)
Manufacturing	0.028	-0.007	0.053**	0.017	0.010	0.028
	(0.036)	(0.056)	(0.026)	(0.035)	(0.054)	(0.030)
Transportation	0.067	0.097	-0.014	0.134	0.272*	0.016
	(0.119)	(0.159)	(0.066)	(0.110)	(0.149)	(0.097)
Trade	0.078	0.048	0.119**	0.072	0.017	0.118**
	(0.059)	(0.084)	(0.050)	(0.057)	(0.082)	(0.056)
Finance	0.020	-0.027	0.097***	0.002	-0.024	0.063*
	(0.040)	(0.061)	(0.029)	(0.039)	(0.057)	(0.033)
Service	-0.027	-0.105	0.031	-0.023	-0.056	0.008
	(0.067)	(0.102)	(0.052)	(0.066)	(0.097)	(0.060)
Government	-0.084	-0.089	-0.090***	-0.084*	-0.062	-0.086**
	(0.052)	(0.085)	(0.027)	(0.050)	(0.096)	(0.034)
Concentration	-0.046	-0.022	-0.072*	-0.032	-0.019	-0.048
	(0.045)	(0.068)	(0.044)	(0.045)	(0.060)	(0.047)
Gross Product	0.000	0.000	0.000	0.000	0.000*	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Intra	-0.103	-0.125	-0.054	-0.082	-0.004	-0.104
	(0.085)	(0.131)	(0.067)	(0.085)	(0.127)	(0.084)

Continued below

Continued from above

Inter	0.042	0.032	0.046	-0.001	-0.117	0.041
	(0.052)	(0.119)	(0.035)	(0.043)	(0.093)	(0.047)
Constant	3.870	2.423	2.618	5.410**	2.912	4.566**
	(2.677)	(4.203)	(1.631)	(2.491)	(3.886)	(1.989)
State FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	956	956	956	956	956	956
Adjusted R^2	0.952	0.926	0.958	0.972	0.944	0.965

Panel B: Upper 33% of the sample

	LnPat			LnCite		
	Total	Public	Private	Total	Public	Private
	(1)	(2)	(3)	(4)	(5)	(6)
RSindex	0.087***	0.086**	0.052	0.060**	0.052*	0.047
	(0.029)	(0.035)	(0.033)	(0.026)	(0.031)	(0.036)
Mining	0.049	0.057	0.012	0.044	0.065*	0.015
	(0.033)	(0.041)	(0.028)	(0.031)	(0.033)	(0.034)
Construction	-0.022	-0.022	-0.050	-0.022	0.016	-0.092
	(0.065)	(0.090)	(0.053)	(0.062)	(0.070)	(0.060)
Manufacturing	0.024	-0.001	0.045	0.024	0.026	0.025
	(0.034)	(0.041)	(0.033)	(0.031)	(0.035)	(0.038)
Transportation	0.262***	0.371***	0.059	0.390***	0.532***	0.165
	(0.089)	(0.121)	(0.128)	(0.110)	(0.132)	(0.146)
Trade	0.060	0.001	0.135*	0.072	0.026	0.122*
	(0.053)	(0.063)	(0.069)	(0.057)	(0.059)	(0.071)
Finance	0.037	0.011	0.068*	0.026	0.013	0.047
	(0.035)	(0.043)	(0.038)	(0.033)	(0.036)	(0.049)
Service	0.054	0.031	0.072	0.101	0.113*	0.087
	(0.059)	(0.072)	(0.053)	(0.063)	(0.069)	(0.069)
Government	0.032	0.121	-0.088***	0.016	0.108	-0.068*
	(0.044)	(0.075)	(0.034)	(0.039)	(0.073)	(0.041)
Concentration	-0.010	0.005	-0.016	0.015	0.009	0.006
	(0.027)	(0.048)	(0.046)	(0.034)	(0.056)	(0.059)
Gross Product	0.000***	0.000***	0.000	0.000***	0.000***	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Intra	-0.134	-0.178*	-0.030	-0.093	-0.109	-0.061
	(0.085)	(0.093)	(0.093)	(0.074)	(0.082)	(0.089)
Inter	0.122***	0.120**	0.136*	0.074	0.029	0.146*
	(0.044)	(0.060)	(0.077)	(0.050)	(0.052)	(0.081)
Constant	4.656	4.468	3.696	1.621	-0.195	2.057
	(3.228)	(3.822)	(2.667)	(2.868)	(2.812)	(3.223)
State FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	485	485	485	485	485	485
Adjusted R^2	0.956	0.946	0.948	0.985	0.980	0.973

Table A4

Additional tests addressing reverse causality

This table reports OLS regression estimates from Eq. (1a) and (1b) for subsamples of the data. The dependent variable in columns (1) – (2) is the natural logarithm of one plus the sum of the patents generated in the next three years in a state. The dependent variable in column (3) – (4) is the natural logarithm of one plus the number of citations for patents generated in the next three years in a state. Columns (1) and (3) report coefficient estimates for the baseline sample after retaining corporation-year observations associated with corporations that do not move headquarters during the sample period. Columns (2) and (4) report coefficients estimates for the baseline sample after excluding corporation-year observations associated with corporations that did not exist prior to 1992. Robust standard errors clustered by year are reported in parenthesis. Significance at the 1%, 5%, and 10% level is indicated by ***, **, and *, respectively.

	LnPat		LnCite	
	(1)	(2)	(3)	(4)
RSindex	0.055***	0.070***	0.026	0.058**
	(0.015)	(0.012)	(0.034)	(0.028)
Mining	0.046***	0.026**	0.048*	0.021
	(0.011)	(0.011)	(0.028)	(0.027)
Construction	0.076***	0.081***	0.115***	0.116***
	(0.012)	(0.014)	(0.033)	(0.035)
Manufacturing	0.035***	0.010	0.069**	0.035
	(0.013)	(0.017)	(0.027)	(0.026)
Transportation	-0.005	0.021	-0.092	-0.055
	(0.034)	(0.030)	(0.069)	(0.068)
Trade	0.075*	0.050	0.147*	0.117
	(0.041)	(0.038)	(0.075)	(0.075)
Finance	-0.004	-0.021	-0.042*	-0.068***
	(0.010)	(0.014)	(0.023)	(0.023)
Service	-0.001	-0.043	-0.011	-0.058
	(0.022)	(0.027)	(0.038)	(0.040)
Government	-0.010	-0.020	-0.040	-0.050
	(0.015)	(0.013)	(0.035)	(0.032)
Concentration	0.072***	0.094***	0.150***	0.175***
	(0.015)	(0.016)	(0.025)	(0.026)
Gross Product	-0.000***	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Intra	-0.223***	-0.149***	-0.536***	-0.432***
	(0.032)	(0.028)	(0.074)	(0.062)
Inter	0.048	-0.019	0.113	0.043
	(0.056)	(0.060)	(0.109)	(0.111)

Continued below

Continued from above				
Constant	-3.801***	-3.306***	-4.175**	-3.638**
	(0.597)	(0.572)	(1.551)	(1.473)
State FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	1,426	1,426	1,426	1,426
Adjusted R^2	0.796	0.797	0.806	0.806

Table A5

Control sample of corporations with no debt

This table reports the OLS regression estimating Eqs. (1a) and (1b) on public firms with zero leverage throughout their lives. The dependent variable in columns (1) is the natural logarithm of one plus the sum of the patents generated in the next three years in a state. The dependent variable in column (2) is the natural logarithm of one plus the number of citations for patents generated in the next three years in a state. Definitions of control variables are in the Appendix. Robust standard errors clustered by year are reported in parenthesis. Significance at the 1%, 5%, and 10% level is indicated by ***, **, and *, respectively.

	LnPat	LnCite
	(1)	(2)
RSindex	0.053	0.067
	(0.036)	(0.121)
Intra	0.211	0.705*
	(0.161)	(0.405)
Inter	0.154	0.392
	(0.097)	(0.256)
Constant	1.318***	3.694***
	(0.189)	(0.487)
Controls	Yes	Yes
State FE	Yes	Yes
Year FE	Yes	Yes
Industry FE	Yes	Yes
Observations	641	641
Adjusted R2	0.471	0.490

Table A6

Additional sort: KZ index

This table reports OLS regression estimates of Eq. (3) with the external finance dependence proxy replaced by the KZ index. We consider companies with KZ index above the median EFD (*Dependence* = 0) in year *t* to be financially dependent. The dependent variable in columns (1) is the natural logarithm of one plus the sum of the patents generated in the next three years in a state. The dependent variable in column (2) is the natural logarithm of one plus the number of citations for patents generated in the next three years in a state. Definitions of control variables are in the Appendix. Robust standard errors clustered by year are reported in parenthesis. Significance at the 1%, 5%, and 10% level is indicated by ***, **, and * respectively.

	LnPat	LnCite
	(1)	(2)
RSindex	-0.006**	-0.011*
	(0.003)	(0.006)
Dependence	-0.024**	-0.076***
	(0.012)	(0.025)
RSindex × Dependence	0.014***	0.025***
	(0.003)	(0.007)
Constant	0.322**	0.471
	(0.153)	(0.436)
Controls	Yes	Yes
State FE	Yes	Yes
Year FE	Yes	Yes
Industry FE	Yes	Yes
Observations	223,655	223,655
Adjusted R^2	0.386	0.195

Table A7

Bank entry and failure

This table reports OLS regression estimates of Eqs. (1a) and (1b) with bank entry and failure as additional controls. The dependent variable in columns (1) – (3) is the natural logarithm of one plus the sum of the patents generated in the next three years in a state. The dependent variable in columns (4) – (6) is the natural logarithm of one plus the total number of citations for patents generated in the next three years in a state. Definitions of control variables are in the Appendix of the paper. Robust standard errors clustered by year are reported in parenthesis. Significance at the 1%, 5%, and 10% level is indicated by ***, **, and *, respectively.

	LnPat			LnCite		
	Total	Public	Private	Total	Public	Private
	(1)	(2)	(3)	(4)	(5)	(6)
RSindex	0.053***	0.067***	0.023	0.039**	0.020	0.044
	(0.012)	(0.020)	(0.014)	(0.015)	(0.029)	(0.032)
BankEntry	0.000	0.000	-0.001*	-0.001	-0.002	-0.002
	(0.001)	(0.001)	(0.000)	(0.001)	(0.002)	(0.001)
BankFailure	0.003***	0.004***	0.002**	0.003**	0.005	0.003*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)	(0.002)
Mining	0.017**	0.040***	0.010*	0.034***	0.147***	0.025
	(0.006)	(0.012)	(0.005)	(0.010)	(0.028)	(0.032)
Construction	0.024	0.067	-0.008	0.044**	0.205***	-0.019
	(0.018)	(0.042)	(0.012)	(0.018)	(0.033)	(0.063)
Manufacturing	0.009	0.006	0.001	0.022	0.128***	0.006
	(0.011)	(0.026)	(0.008)	(0.013)	(0.024)	(0.028)
Transportation	-0.123**	-0.234***	-0.059	-0.095	-0.328***	-0.023
	(0.046)	(0.070)	(0.036)	(0.062)	(0.113)	(0.085)
Trade	0.105***	0.107***	0.059***	0.091**	0.151***	0.052
	(0.023)	(0.036)	(0.017)	(0.037)	(0.051)	(0.052)
Finance	-0.012	-0.054**	0.041***	-0.005	0.013	0.043
	(0.011)	(0.022)	(0.010)	(0.012)	(0.035)	(0.030)
Service	-0.073***	-0.089*	-0.070***	-0.060***	0.042	-0.091*
	(0.022)	(0.044)	(0.018)	(0.020)	(0.036)	(0.051)
Government	-0.037***	-0.098***	-0.026	-0.003	-0.007	0.013
	(0.011)	(0.022)	(0.018)	(0.017)	(0.042)	(0.048)
Concentration	0.008	0.071***	-0.023**	0.006	0.011	-0.025
	(0.010)	(0.018)	(0.008)	(0.015)	(0.051)	(0.038)
Gross Product	-0.000	-0.000	-0.000	0.000	-0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Continued below

Continued from above

Intra	-0.223***	-0.328***	-0.097***	-0.246***	-0.504***	-0.146
	(0.037)	(0.088)	(0.031)	(0.041)	(0.097)	(0.101)
Inter	-0.080*	-0.077	-0.059	-0.140***	-0.266***	-0.120
	(0.041)	(0.062)	(0.041)	(0.048)	(0.086)	(0.108)
Constant	5.935***	4.395***	5.607***	2.029*	-3.827**	2.158
	(0.701)	(1.180)	(0.657)	(1.121)	(1.766)	(2.145)
State FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,020	1,020	1,020	1,020	1,020	1,020
Adjusted R^2	0.974	0.952	0.977	0.967	0.938	0.962

Table A8

Bank competition

This table reports OLS regression estimates of Eq. (3) with the dependent variable replaced by bank lending variables and *RSindex* replaced by a Herfindahl index to measure bank competition. Panel A defines companies with EFD values above the median EFD (Dependence = 0) in year *t* to be financially dependent. Panel B defines companies with assets values below the median assets value in year *t* as financially dependent *(Dependence* = 0). Panel C defines companies with age below the median age value in year *t* as financially dependent (*Dependence* = 0). Panel D defines companies with accumulative bank loans (both in state and out state) above the median accumulative bank loans in year *t* as financially dependent (*Dependence* = 0). Panel E defines companies with KZ index above the median KZ index in year *t* as financially dependent (*Dependence* = 0). Definitions of control variables are in the Appendix. Robust standard errors clustered by year are reported in parenthesis. Significance at the 1%, 5%, and 10% level is indicated by ***, **, and * respectively.

Panel A: External financial dependence

	Private Firms		Public Corporations	
	IndLoan	LnLoan	IndLoan	LnLoan
	(1)	(2)	(3)	(4)
Herfindahl	-0.007**	-0.031**	-0.062	-0.451
	(0.003)	(0.013)	(0.058)	(0.343)
Dependence	0.000	0.001	0.017***	0.089***
	(0.000)	(0.001)	(0.004)	(0.027)
Herfindahl× Dependence	0.000	0.000	-0.038	-0.226
	(0.004)	(0.018)	(0.054)	(0.230)
Constant	-0.004*	-0.014	0.379	2.305*
	(0.002)	(0.009)	(0.227)	(1.293)
Controls	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Ind FE	Yes	Yes	Yes	Yes
Observations	294,919	294,924	61,459	61,459
Adjusted R^2	0.003	0.003	0.042	0.058

Panel B: Assets

	Private Firms		Public Corporations	
	IndLoan	LnLoan	IndLoan	LnLoan
	(1)	(2)	(3)	(4)
Herfindahl	-0.006**	-0.025**	-0.033	-0.173
	(0.003)	(0.013)	(0.053)	(0.218)
Dependence	-0.001***	-0.003***	0.098***	0.697***
	(0.000)	(0.001)	(0.003)	(0.014)
Herfindahl× Dependence	-0.002	-0.014	-0.057	-0.659
	(0.004)	(0.017)	(0.088)	(0.438)
Constant	-0.003	-0.012	0.289	1.675
	(0.002)	(0.010)	(0.222)	(1.237)
Controls	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Ind FE	Yes	Yes	Yes	Yes
Observations	294,919	294,924	58,760	58,760
Adjusted R^2	0.003	0.003	0.059	0.090

Panel C: Age

	Private Firms		Public Corporations	
	IndLoan	LnLoan	IndLoan	LnLoan
	(1)	(2)	(3)	(4)
Herfindahl	-0.006	-0.028	-0.025	-0.190
	(0.005)	(0.023)	(0.069)	(0.322)
Dependence	0.000	0.000	0.070***	0.439***
	(0.000)	(0.001)	(0.006)	(0.038)
Herfindahl× Dependence	-0.001	-0.004	-0.149	-0.988*
	(0.005)	(0.024)	(0.122)	(0.587)
Constant	-0.004	-0.014	0.390***	2.380***
	(0.002)	(0.011)	(0.048)	(0.214)
Controls	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Ind FE	Yes	Yes	Yes	Yes
Observations	294,919	294,924	58,760	58,760
Adjusted R^2	0.003	0.003	0.059	0.090

Panel D: Bank dependence

	Private Firms		Public Corporations	
	IndLoan	LnLoan	IndLoan	LnLoan
	(1)	(2)	(3)	(4)
Herfindahl	-0.007**	-0.029**	-1.111***	-4.020***
	(0.002)	(0.011)	(0.289)	(1.145)
Dependence	-0.000	-0.001	-0.204***	-0.992***
	(0.000)	(0.001)	(0.030)	(0.099)
Herfindahl× Dependence	-0.006	-0.031	1.200***	4.190***
	(0.007)	(0.037)	(0.311)	(1.135)
Constant	-0.004*	-0.013*	0.203**	1.034***
	(0.002)	(0.007)	(0.073)	(0.284)
Controls	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Ind FE	Yes	Yes	Yes	Yes
Observations	294,919	294,924	33,452	33,452
Adjusted R^2	0.003	0.003	0.104	0.119

Panel E: KZ index

	Private Firms		Public Corporations	
	IndLoan	LnLoan	IndLoan	LnLoan
	(1)	(2)	(3)	(4)
Herfindahl	-0.006	-0.022	-0.144	-1.015**
	(0.004)	(0.016)	(0.091)	(0.424)
Dependence	-0.000**	-0.002**	-0.004	0.052***
	(0.000)	(0.001)	(0.004)	(0.018)
Herfindahl× Dependence	-0.002	-0.015	0.076	0.593
	(0.004)	(0.018)	(0.097)	(0.460)
Constant	-0.003	-0.011	0.180	0.765
	(0.002)	(0.009)	(0.112)	(0.467)
Controls	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Ind FE	Yes	Yes	Yes	Yes
Observations	294,919	294,924	42,705	42,705
Adjusted R^2	0.003	0.003	0.039	0.054