Online Appendix B (Not to be Published)

Section B1 of this online Appendix presents the proofs of the propositions generated by our theoretical model in Section 3. Section B2 describes the institutional details of the trademark application process and the costs associated with the applications, registration, and maintenance of trademarks. Section B3 provides additional empirical evidence validating the instrumental variable used in our IV analyses. Section B4 discusses additional robustness tests by measuring trademarks at an extensive margin.

B1 Proofs of Propositions

Proof of Proposition 1. The proofs of part (i) and (ii) follow from the incentive compatibility (IC) conditions given in (8) and (9). If $C > \alpha\left(kX_H - X_L\right)$ and $C < \alpha\left(kX_H - X_L\right) + (1-\alpha)(k-1)X_H$, both sets of IC constraints will be satisfied. This implies that, given outsiders' posterior beliefs about firm type t ($P\left[t = \sum_{i=1}^{N} a_i^* | a^*\right] = 1$) and outsiders' valuation of the firm given in (5), the entrepreneur of a type t firm will indeed maximize his objective function given in (2) by following the equilibrium strategy given in part (i) of the proposition and set $a_i^* = q_i$ for $i = 1, \ldots, N$. Thus, it follows that

$$m^* = \sum_{i=1}^{N} a_i^* = \sum_{i=1}^{N} q_i = t, \tag{B.1}$$

which means that outsiders' posterior beliefs about firm type are consistent with the firm's equilibrium strategy a^*.

Since the type t of the firm is fully revealed to outside investors through the firm's equilibrium strategy in the above separating equilibrium, the outsiders' equilibrium valuation

of the firm, $V_0(a^*)$, is equal to the firm's intrinsic value, $V_0(t)$ as specified in equations (5) and (6). This proves parts (i) and (ii) of the proposition.

Note that in equilibrium $m^* = t$. Therefore, it follows that

$$\frac{\partial V_0(a^*)}{\partial m^*} = \frac{\partial V_0(a^*)}{\partial t} = kX_H - X_L - C > 0, \tag{B.2}$$

since $C < \alpha(kX_H - X_L) + (1-\alpha)(k-1)X_H$. This proves part (iii) of the proposition. Similarly, note that

$$\frac{\partial X(t, a^*(t))}{\partial m^*} = \frac{\partial X(t, a^*(t))}{\partial t} = kX_H - X_L > 0, \tag{B.3}$$

which proves part (iv) of the proposition.

■

Proof of Proposition 2. Taking the first derivative of the total cost of staging given in (11) with respect to M and setting it to zero, we obtain the following first order condition:

$$\begin{aligned} \kappa I \frac{(-1)}{M^2} + F &= 0, \\ M^2 &= \kappa \frac{I}{2F}, \end{aligned} \tag{B.4}$$

from which we obtain the continuous part of the solution given in (12):

$$M = \sqrt{\kappa \frac{I}{2F}}. \tag{B.5}$$

Since the optimal number of stages has to be an integer number, we round this real number

solution given in (B.5) to the nearest integer number and obtain:

$$M^* = \left\lfloor \sqrt{\kappa \frac{I}{2F}} + 0.5 \right\rfloor. \tag{B.6}$$

■

B2 Costs Associated with Trademarks and Institutional Details

B2.1 Institutional Details Related to Trademark Applications, Registration, and Maintenance

According to the USPTO website, a trademark life cycle begins with a firm selecting a mark and filing it with the USPTO to be registered as a trademark.[1] Upon filing the application, the USPTO checks for the minimum filing requirements and assigns a serial number to the application provided that the application meets the filing criteria. After the assignment, the USPTO appoints an examining attorney to review the application. The USPTO explicitly mentions on their website that applications are randomly assigned to examining attorneys and are examined in the order in which they are received by the USPTO.[2] The examining attorney performs a complete examination of the application to determine whether the mark is eligible for registration. If the examining attorney believes that the mark meets statutory registration criteria, he will approve the application for publication.[3] Otherwise, he will issue

[1]Note that the trademark application and evaluation process is completely distinct from the patent application and evaluation process and is handled by a separate division of the USPTO.

[2]Please refer to following document by Graham, Hancock, Marco, and Myers (2013) for more detail regarding the trademark application process and datasets: https://www.uspto.gov/learning-and-resources/electronic-data-products/trademark-case-files-dataset-0. To quote Graham, Hancock, Marco, and Myers (2013): "In general, applications are randomly assigned to examining attorneys and examined in the order in which they are received by the USPTO."

[3]Unlike patent examiners who specialize in certain areas ("art-units"), the USPTO mentions on their website that various law offices examining trademarks currently do not specialize in examining trademarks in any particular subject matter.

an office action explaining grounds for rejection or suggest minor corrections if required. The most common ground for refusing registration is the existence of a "likelihood of confusion" between the applicant's mark and the mark in an existing registration by another firm.[4] Other grounds for refusal include that the proposed mark is generic or merely descriptive, geographic, a surname, deceptive, among other things. If the examining attorney raises no objections to registration, or if the applicant overcomes all objections, the examining attorney will approve the mark for publication in the "Official Gazette," a weekly publication of the USPTO. The USPTO will send a notice of publication to the applicant stating the date of publication. After the mark is published in the "Official Gazette," any party who believes it may be damaged by the registration of the mark has 30 days from the publication date to file either an opposition to the registration or a request to extend the time to oppose. An opposition is similar to a proceeding in a federal court, but is held before the Trademark Trial and Appeal Board (TTAB), an administrative tribunal within the USPTO. If no opposition is filed or if the opposition is unsuccessful, the application enters the next stage of the registration process.[5] It can take three to four months from the time the notice of publication is sent till the applicant receives an official notice of the next status of the application.

After getting a trademark registration, the registration owner must file required maintenance documents on a regular basis to keep the registration alive. Failure to file the required maintenance documents during the specified time periods will result in the cancellation of the trademark registration or invalidation of the extension of protection in the U.S. To maintain

[4]The likelihood of confusion should only bar registration when the earlier mark is owned by an entity other than applicant.

[5]Please refer to the USPTO website for additional information on the application process: https://www.uspto.gov/trademarks-getting-started/trademark-process#step5.

its trademark registration, a firm must file its first maintenance document between the fifth and sixth year after the registration date and other maintenance documents thereafter. It is important to note that it is the responsibility of a firm to police and enforce its trademark rights. While the USPTO will prevent another pending application for a similar mark used on related goods or in connection with related services from proceeding to registration based on a finding of likelihood of confusion, the USPTO will not engage in any separate policing or enforcement activities of trademarks.

B2.2 Costs Associated with Trademark Applications, Registration, and Maintenance

As we argued in the introduction (footnote 4), there are direct and indirect costs associated with the trademark application process and maintenance. First, regarding the direct costs of filing trademark applications, the USPTO website provides details of the specific amount that firms must pay for each class of goods/services. For example, if the application of a mark will be used in different classes, then the application fee will be counted towards all classes, with $200-$400 for each class. Thus, the total application fee itself may be a few thousand dollars for each trademark application. Further, a trademark requires maintenance as well, which will cost a few thousand dollars every year. As explained on the USPTO website, although anyone can apply for a trademark, trademark application does include multiple steps that require significant work, such as selecting marks, identifying mark formats, identifying goods and services, searching, and checking the filing basis. Therefore, the USPTO suggests that applicants should consider hiring a trademark attorney to help with the preparation and the application process overall.

Second, there are substantial indirect costs associated with trademark applications and

maintenance. There is a substantial cost involved in the trademark opposition process (any person/entity with a real interest in the proceedings may oppose a trademark application when it is published for opposition during the application process and may attempt to stop it if from registration). Citing the 2013 Report of Economic Survey by the American Intellectual Property Law Association (AIPLA), Gaddis, Garboczi, Stewartson, and Reid (2015) mention that the median cost to a party during trademark opposition is $80,000.[6] Further, this white paper mentions that attorneys' fees are not recoverable in these cases even if the opposition is frivolous. They claim that frivolous trademark oppositions are a real problem facing small businesses and entrepreneurs, who cannot bear the financial costs of defending an opposition under the current USPTO rules. It is even possible that smaller firms may simply abandon their trademark applications under the threat of opposition. Additionally, it is the responsibility of the firm to enforce its trademark rights by monitoring unfair usage of its trademarks by rivals, which may involve substantial monitoring and potential litigation costs. According to the 2013 Report of the Economic Survey by AIPLA, the total costs of trademark infringement litigation on average are as follows: $375,000 through trial when less than $1 million is at issue; $794,000 when $1-10 million is at issue; $1.4 million when $10-25 million is at issue; and $2 million in costs when the amount at issue exceeds $25 million.[7]

Based on the aforementioned direct and indirect costs associated with the trademark application process and maintenance, it is reasonable to assume that firms will file for trademarks only if the expected benefits from trademarks exceed the expect costs associated with

[6]See more details on the trademark opposition cost at: https://tlpc.colorado.edu/wp-content/uploads/2015/05/TMOppositionReform_WhitePaper3.pdf.

[7]More details on trademark litigation are available at: http://www.ipwatchdog.com/2015/07/16/trademark-bullying-defending-your-brand-or-vexatious-business-tactics/id=59155/.

them, and that firms will likely avoid filing trademark applications unless they believe that the benefits of doing so exceed the total costs associated with trademark application, registration, and maintenance. Consistent with the substantial costs involved in the trademark application process, our empirical evidence shows that only about 16% of VC-backed firms have at least one trademark in the five years before receiving the first round of VC investment, although around 54% of these firms have at least one trademark by the time of exit. This revealed preference by firms provides additional support for the view that there are significant costs involved with obtaining and maintaining trademarks and that firms (especially private firms, which are likely to be cash constrained) will choose to obtain a trademark for one of their products trademarks only if the benefits of doing so outweigh the costs.

B3 Validity Test of Our Instrumental Variable

In this section, we present the result supporting the validity of our instrumental variable, which is the leniency of trademark application examiners. As described in detail in Section 4.2 in the main text of our paper, we use a measure of trademark examiners' leniency as an instrument for the number of trademarks granted to a firm. We compute yearly measures of examiners' leniency. For our instrument to be valid, it should not be affected by trademark applicant firms' characteristics and their investor characteristics. In Table B1, we test our instrument's validity by regressing average examiner leniency, our instrument, on a set of firm (trademark applicant) characteristics. We show that the examiner leniency is not affected by firm and investor characteristics such firm-age, patents, citations, and VC age. This result therefore provides additional supporting evidence for the validity of our instrument.

B4 The Effect of Trademarks on VC staging and Performance of Startups: Extensive Margin

We also show the effect of trademarks on the extensive margin. We show that our results in the main paper are robust if we measure trademarks using an indicator variable, which take the value one if a startup has at least one trademark or otherwise equal to zero. In Table B2, we show that our results on VC staging are robust if we measure trademarks at an extensive margin. In Table B3, we show that our results on sales are robust if we measure trademarks at an extensive margin. In Table B4, we show that our results on employment are robust if we measure trademarks at an extensive margin. In Table B5, we show that our results on successful exit are robust if we measure trademarks at an extensive margin.

References

Gaddis, B. A., Garboczi, P., Stewartson, C., Reid, B. E., 2015. Discouraging Frivolous Claims in Trademark Opposition Proceedings: A Policy Proposal to the United States Patent and Trademark Office. Working Paper, University of Colorado Law School.

Graham, S. J., Hancock, G., Marco, A. C., Myers, A. F., 2013. The USPTO Trademark Case Files Dataset: Descriptions, Lessons, and Insights. Journal of Economics and Management Strategy 22, 669–705.

Table B1: Validity Test of Instrument: Trademark Examiner Leniency and Firm Characteristics

This table reports the OLS regression results regressing the trademark examiner leniency on various firm characteristics. All variables are defined in detail in Appendix A in the main paper. Constant (suppressed) and fixed effects for two-digit SIC and state of a firm's headquarters are included in all regressions. All standard errors are clustered at the lead-VC level and are reported in parentheses below the coefficient estimates. ***, **, and * represent statistical significance at the 1, 5, and 10 percent levels, respectively.

Variables	(1) Examiner Leniency
Ln (1 + No. of Patents)	0.004
	(0.004)
Ln (1 + No. of Citations)	-0.412
	(0.376)
Ln (VC Fund Size)	-0.000
	(0.001)
Ln (1 + Firm Age)	0.001
	(0.002)
Observations	3,979
Adjusted R-squared	0.044
Industry FE	Yes
State FE	Yes

Table B2: The Relation between Trademarks and the Staging of Venture Capital Investment: Extensive Margin

This table reports the OLS regression results of the effect of trademarks on staging by VCs. We use an indicator variable to measure trademarks. *Trademark Dummy* is an indicator variable that takes the value equal to one if a startup has at least one trademark in the five-year period prior to the first round of VC investment in the startup. All other variables are defined in detail in Appendix A in the main paper. Constant (suppressed), two-digit SIC industry fixed effects, and state of a firm's headquarters fixed effects are included in all regressions. All standard errors are clustered at the lead VC level and are reported in parentheses below the coefficient estimates. ***, **, and * represent statistical significance at the 1, 5, and 10 percent levels, respectively.

Variables	(1) Fraction of Investment in Round 1	(2) No. of Rounds by VCs
Trademark Dummy	0.136***	-0.888***
	(0.010)	(0.062)
Ln (1 + No. of Patents)	0.026*	-0.271***
	(0.016)	(0.103)
Ln (1 + No. of Citations)	-2.148	22.109**
	(1.354)	(9.077)
Ln (1 + Firm Age)	-0.113***	1.115***
	(0.007)	(0.054)
Syndicate Size	-0.051***	0.141***
	(0.002)	(0.011)
Ln (1 + VC Age)	-0.076***	0.568***
	(0.008)	(0.052)
Ln (VC Fund Size)	0.014***	-0.064**
	(0.004)	(0.028)
Observations	12,898	12,898
Adjusted R-squared	0.239	0.239
Industry FE	Yes	Yes
State FE	Yes	Yes

Table B3: The Relation between Trademarks and Long-run Sales of Startups: Extensive Margin

This table reports the OLS regression results of the effect of trademarks on the long-run sales of startups. We use an indicator variable to measure trademarks. *Trademark Dummy* is an indicator variable that takes the value equal to one if a startup has at least one trademark in the five-year period prior to the first round of VC investment in the startup. All other variables are defined in detail in Appendix A in the main paper. Constant (suppressed), two-digit SIC industry fixed effects, and state of a firm's headquarters fixed effects are included in all regressions. All standard errors are clustered at the lead VC level and are reported in parentheses below the coefficient estimates. ***, **, and * represent statistical significance at the 1, 5, and 10 percent levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	Raw Sales			Adjusted Sales		
Variables	Year 3	Year 4	Year 5	Year 3	Year 4	Year 5
Trademark Dummy	10.592**	14.157**	12.563*	0.640***	0.674***	0.603***
	(4.798)	(6.969)	(6.478)	(0.149)	(0.155)	(0.153)
Ln (1 + No. of Patents)	-8.044***	-9.618***	-9.662***	-0.478***	-0.465***	-0.360**
	(1.938)	(2.257)	(2.602)	(0.145)	(0.146)	(0.159)
Ln (1 + No. of Citations)	496.353***	485.897***	544.674***	38.919***	40.667***	42.306**
	(177.050)	(161.973)	(206.668)	(15.026)	(15.373)	(18.284)
Ln (1 + Firm Age)	1.931	2.825	4.406*	0.272***	0.317***	0.332***
	(2.041)	(2.254)	(2.539)	(0.097)	(0.096)	(0.104)
Syndicate Size	-0.505	-0.028	-0.052	-0.060*	-0.049	-0.053*
	(0.941)	(0.874)	(0.928)	(0.032)	(0.031)	(0.029)
Ln (1 + VC Age)	2.142	2.615	3.621*	0.085	0.102	0.161**
	(1.465)	(1.791)	(1.880)	(0.064)	(0.068)	(0.076)
Ln (VC Fund Size)	1.816***	1.704***	1.799***	0.125***	0.108***	0.092***
	(0.486)	(0.448)	(0.475)	(0.036)	(0.033)	(0.036)
Observations	8,715	8,503	8,277	8,715	8,503	8,277
Adjusted R-squared	0.007	0.009	0.010	0.002	0.012	0.011
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes	Yes

Table B4: The Relation between Trademarks and Long-run Employment of Startups: Extensive Margin

This table reports the OLS regression results of the effect of trademarks on the long-run employment at startups. We use an indicator variable to measure trademarks. *Trademark Dummy* is an indicator variable that takes the value equal to one if a startup has at least one trademark in the five-year period prior to the first round of VC investment in the startup. All other variables are defined in detail in Appendix A in the main paper. Constant (suppressed), two-digit SIC industry fixed effects, and state of a firm's headquarters fixed effects are included in all regressions. All standard errors are clustered at the lead VC level and are reported in parentheses below the coefficient estimates. ***, **, and * represent statistical significance at the 1, 5, and 10 percent levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	Raw Employment			Adjusted Employment		
Variables	Year 3	Year 4	Year 5	Year 3	Year 4	Year 5
Trademark Dummy	0.037**	0.047***	0.051***	0.434***	0.501***	0.480***
	(0.014)	(0.015)	(0.016)	(0.115)	(0.121)	(0.121)
Ln (1 + No. of Patents)	-0.038***	-0.043***	-0.041***	-0.313***	-0.341***	-0.308**
	(0.010)	(0.010)	(0.012)	(0.108)	(0.100)	(0.148)
Ln (1 + No. of Citations)	2.418***	2.589***	3.145***	30.480***	32.765***	39.086**
	(0.933)	(0.952)	(1.171)	(11.090)	(11.785)	(16.395)
Ln (1 + Firm Age)	0.030***	0.035***	0.032***	0.281***	0.339***	0.287***
	(0.010)	(0.011)	(0.011)	(0.074)	(0.066)	(0.071)
Syndicate Size	-0.001	0.001	-0.001	-0.042	-0.033	-0.054**
	(0.004)	(0.004)	(0.005)	(0.026)	(0.024)	(0.026)
Ln (1 + VC Age)	0.005	0.005	0.009	0.052	0.061	0.104*
	(0.007)	(0.008)	(0.009)	(0.053)	(0.052)	(0.055)
Ln (VC Fund Size)	0.012***	0.010***	0.009***	0.115***	0.090***	0.065**
	(0.003)	(0.003)	(0.003)	(0.040)	(0.028)	(0.032)
Observations	8,716	8,504	8,278	8,716	8,504	8,278
Adjusted R-squared	0.032	0.044	0.045	-0.001	0.025	0.020
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes	Yes

Table B5: The Relation between Trademarks and the Propensity for Successful Exit: Extensive Margin

This table reports the linear probability model (LPM) regression results of successful exits of VC-backed firms on trademarks. We use an indicator variable to measure trademarks. *Trademark Dummy* is an indicator variable that takes the value equal to one if a startup has at least one trademark in the five-year period prior to the first round of VC investment in the startup. All other variables are defined in detail in Appendix A in the main paper. Constant (suppressed), two-digit SIC industry fixed effects and state of a firm's headquarters fixed effects are included in all regressions. All standard errors are clustered at the lead VC level and are reported in parentheses below the coefficient estimates. ***, **, and * represent statistical significance at the 1, 5, and 10 percent levels, respectively.

	(1)	(2)	(3)
Variables	IPO and M&A	IPO only	M&A only
Trademark Dummy	0.095***	0.040***	0.056***
	(0.011)	(0.009)	(0.012)
Ln (1 + No. of Patents)	0.028	-0.013	0.041**
	(0.020)	(0.014)	(0.021)
Ln (1 + No. of Citations)	6.588***	4.151***	2.437
	(1.578)	(1.352)	(1.746)
Ln (1 + Firm Age)	0.002	0.010**	-0.008
	(0.006)	(0.004)	(0.005)
Ln (Total Investment)	0.053***	0.027***	0.026***
	(0.004)	(0.003)	(0.003)
Ln (1 + VC Age)	0.032***	0.010**	0.022***
	(0.007)	(0.005)	(0.006)
Ln (VC Fund Size)	-0.015***	-0.007***	-0.008***
	(0.003)	(0.002)	(0.003)
No. of Rounds by VCs	0.002	0.004**	-0.001
	(0.002)	(0.002)	(0.002)
Average Syndicate Size per Round	0.009***	0.011***	-0.002
	(0.003)	(0.003)	(0.003)
Observations	12,898	12,898	12,898
Adjusted R-squared	0.141	0.068	0.082
Industry FE	Yes	Yes	Yes
State FE	Yes	Yes	Yes

Table B6: The Relation between the Number of Trademarks and the Propensity for Successful Exit (Logit Regressions)

This table reports the logit regression results of successful exits of VC-backed firms on trademarks. We show marginal effects in these regressions. All variables are defined in detail in Appendix A in the main paper. Constant (suppressed), two-digit SIC industry fixed effects and state of a firm's headquarters fixed effects are included in all regressions. All standard errors are clustered at the lead VC level and are reported in parentheses below the coefficient estimates. ***, **, and * represent statistical significance at the 1, 5, and 10 percent levels, respectively.

	(1)	(2)	(3)
		Logit	
Variables	IPO and M&A	IPO only	M&A only
Ln (1 + No. of Trademarks)	0.067***	0.024***	0.040***
	(0.009)	(0.006)	(0.009)
Ln (1 + No. of Patents)	0.024	-0.012	0.038*
	(0.019)	(0.011)	(0.020)
Ln (1 + No. of Citations)	6.596***	2.822***	2.326
	(1.585)	(0.862)	(1.590)
Ln (1 + Firm Age)	0.000	0.011**	-0.009*
	(0.006)	(0.005)	(0.006)
Ln (Total Investment)	0.057***	0.037***	0.028***
	(0.004)	(0.004)	(0.004)
Ln (1 + VC Age)	0.034***	0.012**	0.023***
	(0.007)	(0.005)	(0.007)
Ln (VC Fund Size)	-0.016***	-0.008***	-0.008***
	(0.003)	(0.002)	(0.003)
No. of Rounds by VCs	0.001	0.000	-0.002
	(0.002)	(0.001)	(0.002)
Average Syndicate Size per Round	0.007**	0.007***	-0.002
	(0.003)	(0.002)	(0.003)
Observations	12,883	12,771	12,868
Pseudo R2	0.1237	0.1242	0.08
Industry FE	Yes	Yes	Yes
State FE	Yes	Yes	Yes

Figure B1: Distribution of Trademark Examiner Approval Rates

This figure shows the sample distribution of annual trademark examiner approval rates, defined as in equation (13). The sample consists of all trademark applications available at USPTO website from 1985 to 2010. We only consider examiners who have reviewed a minimum of 10 applications in a year.