Blood in the water: An abductive approach to startup valuation on ABC's Shark Tank ☆

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ABSTRACT

Most negotiations over startup valuation take place behind closed doors. As a result, we lack knowledge about how valuation is negotiated between entrepreneurs and investors. We constructed a dataset by hand to exploit the unique nature of a popular business pitch television show, ABC's Shark Tank, to examine this issue. Our descriptive findings suggest that entrepreneurs who initially offer less of their company to investors are more likely to receive investment offers. We also discovered that startup valuation negotiations tend to take place over the relative equity percentage each party receives rather than investment amount. Finally, although investors are more likely to experience negotiation gains, entrepreneurs who successfully pit sharks against each other receive deal terms closer to their initial ask. These results add to the emerging literature on dynamic process of startup valuation.

1. Introduction

New ventures pursuing high growth opportunities often need to obtain equity financing from outside investors such as venture capitalists (VCs). Since these investment opportunities are characterized by considerable uncertainty and imperfect information, potential investors need to make a series of inferences regarding a venture's prospects when deciding whether to invest (Hall and Hofer, 1993). Further complicating the possibility of finding a mutually acceptable funding arrangement is that the entrepreneur holds considerably more information regarding the venture's prospects of success (Amit et al., 1990; Trester, 1998; Cumming et al., 2019).

To facilitate information transfer between the two parties, entrepreneurs often "pitch" their ventures to investors by sharing information about the business proposition and previous experiences of the entrepreneurs themselves, which are commonly regarded as the main criteria for investment decisions (MacMillan et al., 1985; Fried and Hisrich, 1994; Block et al., 2019). As such, startup valuation in the VC context is a dynamic process where valuations are subject to change during a negotiation phase until both investors and entrepreneurs decide upon a mutually agreeable final valuation (Yang et al., 2009; Heughebaert and Manigart, 2012). However, since most knowledge on startup valuation stems from commercial VC databases, experiments, industry surveys, and other empirical settings such as crowdfunding, which only state final startup valuations, the valuation process itself remains somewhat of a black box (Köhn, 2018).

In this paper, we shed light on the dynamics of startup equity negotiation by exploiting the unique features of business pitch

competitions, which provide early-stage finance and feedback for entrepreneurs (Clingingsmith and Shane, 2018). We use hand collected data from the most public, high-stakes pitch competition in the United States: ABC's Shark Tank. The show's premise has entrepreneur-contestants pitch to a panel of five judges/investors ("sharks") who potentially make offers to invest. The show is also unique in that investors negotiate with entrepreneurs over valuation (e.g., equity share and investment amount) in real-time. We construct a dataset of all entrepreneurs/firms that have aired on Shark Tank between 2009 and 2015.

Since a natural setting such as Shark Tank is unlikely to provide a critical test for theory, we employ an abductive approach to examine the equity negotiation process. Our research setting facilitates insights into the dynamics of pre-money valuation during the negotiation process between entrepreneurs and investors. To this end, we first examine the features of a pitch that lead to investment offers. We then explore how pre-money valuation is negotiated by examining the "quality" of the offer and whether concessions are made over price (i.e., equity share) or quantity (i.e., investment amount). Finally, we turn to bidding dynamics under investor competition. Because the literature says little about whether and how these factors influence the negotiation process, we engaged in playful exploration (Wennberg and Anderson, 2020) of the data to interrogate how pre-money firm valuation is negotiated during the pitch process.

2. Important factors in pitch competitions

2.1. Entrepreneurial team and venture characteristics

Although there is some debate among academics and practitioners as to the relative importance of different factors to screen and invest in startups, previous work indicates that VCs and angel investors broadly consider factors that capture: the attractiveness of the market, strategy, technology, product or service, customer adoption, competition, deal terms, and the quality and experience of the entrepreneur/management team (Tyebjee and Bruno, 1984; MacMillan et al., 1985; Kaplan and Strömberg, 2004; Block et al., 2019).

The most recent survey of the field by Gompers et al. (2020) suggests that VCs emphasize the entrepreneurial team and business-related factors as the most important criteria during investment screening (as reported by 47% and 37% of VCs respectively). Given the importance of entrepreneurial team and venture characteristics to potential investors, entrepreneurs often integrate information about their work histories and venture prospects into pitch materials (Hor et al., 2021). In this article, we seek to understand how these factors influence the likelihood of receiving an offer from investors and how they affect the subsequent negotiation over deal terms.

2.2. Deal terms and valuation dynamics

Deal terms and the pre-money valuation of a startup are also regarded as important features during investment screening and selection by investors (Kaplan and Strömberg, 2004; Gompers et al., 2020). The equity stake that investors get in return for their investment in the company is equal to the proportion of their investment divided by the company value (Collewaert and Manigart, 2016). As such, firm valuation and deal pricing are critical for entrepreneurs and investors since the deal terms affect both the amount of equity (and control) that entrepreneurs are able to retain in return for investment by a risk capital investor (Vance, 2005). For investors, lower valuations for a given investment amount imply a higher equity stake, which subsequently enhances their return potential and control over the venture (Mason and Harrison, 2002; Hsu, 2007). We focus on how deal terms are negotiated through concessions over investment amount and equity share.

2.3. Bidding dynamics with competition

To reduce uncertainty during investment screening, investors are likely to observe how other investors gauge a startup's quality or business prospects. This concept, characterized as "social proof," suggests that when several investors are interested in a startup, interorganizational relationships can lead to fiercer competition or cooperation (Haunschild, 1994; Haunschild and Miner, 1997). In equity negotiations between a single startup and multiple investors, investors have two potential strategies: compete over investments or form an alliance to increase their bargaining position over entrepreneurs (Hong, 2013). In this paper, we attempt to tease out how pre-money valuation changes during negotiation when investors cooperate (Joint offer) from situations where they enter into competition over an investment (Competing offer).

3. Methods

Our approach is a quantitative exploration (Wennberg and Anderson, 2020; Chandra et al., 2021) that is suitable to explore novel and important phenomena without needing to establish hypotheses due to a lack of suitable theory to explain the phenomena. In doing so, we engage in exploratory modelling of the relationship between the variables above to explain the likelihood of receiving an offer and how pre-money valuation is subsequently affected during the negotiation phase.

3.1. Data and sample

Since Shark Tank's internal data are not available to the public, we construct a unique and novel dataset by hand that includes all entrepreneur-contestants/firms that have aired on the show from Season 1 to Season 6 (N = 495). A research assistant independently and manually coded all variables by watching the show. The show edits the pitch process, which can sometimes go on for more than an hour, into palatable acts for television. However, sharks have revealed in interviews that "everything you see is true, none of it is retaped, and the elements that are crucial to the outcome are included" (Smith and Viceisza, 2018, p. 466). However, a number of details are uniformly included for every pitch that appears on the show. This, at least anecdotally, suggests that the most relevant

determinants from the standpoint of intention-to-fund are included in the aired segment. Table 1 presents details about the coding of variables and summary statistics.

According to Inc. Magazine, less than 1% of the 45,000 people who applied to be on Shark Tank in 2014 received the opportunity to pitch, making Shark Tank one of, if not the most, selective pitch competitions in the world.[2] Clearly, Shark Tank producers also care about the show's potential for "good" TV since ratings ultimately drive the longevity of the show. As a result, the show needs entrepreneurs who are guaranteed to fail, and since sharks are completely unfamiliar with the firms prior to entering the tank, producers include some "doozies" to elicit visceral reactions from the sharks.[3] To alleviate concerns that this form of selection crowds in entrepreneurs unlikely to get funded regardless of the pitch, we used the "ridiculous idea" dummy created by Smith and Viceisza (2018).[4] Nevertheless, given the unique features of the dataset, we caution broad extrapolation of our findings to other contexts.

3.2. Method

To better understand the determinants of the likelihood to receive an offer, we start by estimating a classification tree (Breiman et al., 2017). This recursive partitioning technique is useful in our case as it can handle many types of predictors, does not require form specification of the predictors' relationship to the response, and can effectively handle missing data and implicitly conduct feature selection. To avoid overfitting and to create an independent comparison point, the data is split between a training and test set (80% training, 20% testing). To prune the tree, we compared the tree with the complexity parameter associated with minimum error and with the smallest tree within one standard error of the tree with smallest absolute error. Both criteria led to the same tree and pruning the tree increases prediction accuracy from 66.7% to 69.7%. In a second step, we estimate a probit model of the "Offer" dummy variable (that takes a value of one if sharks made an offer to the entrepreneur) on the set of variables identified in the classification tree.

Next, we turn to the negotiation stage and study the bidding dynamics and impact on the final deal terms. We first explore whether negotiations over venture valuation are driven by equity share or investment amount by analyzing changes between the initial deal terms offered by the entrepreneur and the final deal terms after negotiation. Then, we investigate the impact of competition between investors, making a distinction between cases when an investor makes an offer alone (Single offer), together with another investor (Joint offer), or is competing with another investor (Competing offer).

We then regress this bidding dynamic variable on the relative change in venture valuation. To this end, we construct a ratio of the best offer to initial offer. This ratio reflects how close the final offer is from the entrepreneur's initial demand and considers both accepted and rejected offers. Since the venture value can be calculated by dividing the investment amount by the equity share offered to investors and investors and entrepreneurs can adjust both instruments, using a ratio allows us to consider both channels.[5]

To correct sample-induced endogeneity related to the fact that we only observe our dependent variable for entrepreneurs who received an offer, we ran a two-stage analysis using Heckman twostep procedure (Heckman, 1979). The first step in this process uses the probit model described above to estimate the probability that an entrepreneur receives an offer. The second step regresses the best-offer-to-initial-offer ratio on the categorical bidding dynamics variables, a set of control variables and a selection parameter (the inverse Mills ratio). Although we used multiple statistical techniques to identify these relationships, it is important to keep in mind that our methodology does not enable us to make causal claims. The results presented below are thus exploratory.

4. Results

4.1. Likelihood to receive an offer

Fig. 1 depicts the distribution of initial equity share, superimposed with density lines indicating cases where entrepreneurs received an offer (solid line) and cases where they did not (dotted line). Interestingly, a higher proportion of entrepreneurs who received an offer proposed a lower initial equity share to investors (with a peak around 10% of equity). By contrast, entrepreneurs who did not receive an offer tend to propose a higher initial equity share (with a peak at around 20% of equity). A Kolmogorov-Smirnov test corroborates that the distribution of initial equity share is different between entrepreneurs who receive an offer and those who do not ($D = 0.2359$, $p < 0.001$).

A classification tree (Fig. 2) confirms the finding that entrepreneurs who offer less initial equity are more likely to receive an offer since "initial equity share" is the first fork in the tree (with a split at $\pm$ 17% of equity). The sequence generally reflects the importance of each factor. Factors that appear higher in the tree (i.e., earlier splits) or multiple times are more important than factors that occur lower in the tree or not at all. The following additional features were selected from the classification tree as important to the likelihood of receiving an offer: duration, education, episode number, time devoted, patent status, season number, team size, initial investment,

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[2] Source: https://www.inc.com/graham-winfrey/ten-secrets-you-would-never-guess-about-shark-tank.html#:~:text=Of%20the%2045%2C000%20people%20who,see%20the%20light%20of%20day.

[3] Source: https://www.businessinsider.com/mark-cuban-what-shark-tank-is-like-behind-the-scenes-2014-3.

[4] This variable was coded independently by two researchers. Given that the ideas were unlikely to be funded, they first filtered through pitches that did not receive an offer. They subsequently worked through the remaining pitches and cross-checked the results for validity. The coding was further corroborated by each episode's show notes which summarize highlights and public opinion. Twenty pitches were dropped from the final sample.

[5] If the best offer from investors matches the initial offer, the ratio is equal to 1. Consider an initial offer asking for investment of 100 in exchange for 10% equity. After negotiation, consider that the investors' best offer is to provide 50 for a 10% stake (negotiation over investment amount) or 100 for a 20% stake (negotiation over equity share), both result in a ratio 0.5. A ratio less than 1 indicates the entrepreneur ended up with a less attractive deal.

Table 1
Sample description

Variable	Definition	Summary statistics			
		N	Mean	Median	SD
Investment asked by entrepreneur					
Initial equity %	Equity % initially offered by entrepreneur to sharks	495	0.18	0.15	0.1
Initial investment	Investment asked by entrepreneur to sharks (M USD)	495	0.26	0.15	0.46
Initial venture value	Venture value based on Initial investment and Initial equity % (M USD)	495	2.17	1	3.76
Entrepreneur characteristics					
Female	Dummy variable, equal to 1 when female entrepreneur, 0 otherwise	495	0.26	0	0.44
Mixed team	Dummy variable, equal to 1 when mixed team of entrepreneur, 0 otherwise	495	0.15	0	0.35
Team size	Number of people on core team	476	1.49	1	0.62
Full-time	Dummy variable, equal to 1 when entrepreneur works full time for the venture, 0 otherwise	460	0.27	0	0.44
Education	Categorical variable capturing the highest level of education within team: 0 = not disclosed; 1 = high school; 2 = undergraduate; 3 = graduate; 4 = PhD / Doctoral. Summary statistics shown for each category alone.	474	0.78	1	0.42
			0.01	0	0.11
			0.09	0	0.28
			0.11	0	0.32
			0.01	0	0.09
Past experience	Dummy variable, equal to 1 when past entrepreneurial experience, 0 when no experience or not discussed	475	0.09	0	0.28
Venture characteristics					
No patent effort	Dummy variable, equal to 1 when no patent effort, 0 otherwise	446	0.69	1	0.46
Patent filed	Dummy variable, equal to 1 when any type of patent filed, 0 otherwise	446	0.13	0	0.34
Patent obtained	Dummy variable, equal to 1 when patent obtained, 0 otherwise	446	0.18	0	0.39
Licensing	Dummy variable, equal to 1 if licensing was discussed	474	0.07	0	0.25
Duration	Number of months in business	296	28.69	14.5	36.3
Current sales	Current or recent sales (M USD)	303	0.52	0.14	1.06
Cumulative sales	Cumulative sales from start of business (M USD)	186	1.06	0.27	2.33
Projected sales	Projected sales for next year / period (M USD)	90	2.82	1	4.8
Bulk orders	Dummy variable, equal to 1 when product received any bulk order, 0 if no bulk orders or not discussed	118	0.31	0	0.47
Endorsement	Dummy variable, equal to 1 when celebrity / other external endorsement for venture, 0 otherwise	474	0.09	0	0.29
Bad idea	Dummy variable created by Smith and Viceisza (2018), equal to 1 when the pitch concept was clearly allowed to air for entertainment purposes.	495	0.04	0	0.19
Offer characteristics					
Offer	Dummy variable, equal to 1 when entrepreneur receive an offer from the sharks	495	0.62	1	0.49
Number of sharks bidding	Number of sharks bidding or involved in the deal	495	1.3	1	1.33
Bidding dynamics	Categorical variable capturing the bidding dynamics: 0=no offer received; 1= offer received from one shark; 2=offer received from a shark group (several sharks bidding together); 3=multiple offers received from different sharks (whether alone or in a group). Summary statistics shown for each category alone.	468	0.40	0	0.49
			0.23	0	0.42
			0.09	0	0.28
			0.28	0	0.45
Best offer to initial offer ratio	Ratio of best offer value to initial offer value. The best offer corresponds to the accepted deal or the offer on the table in case of no deal.	307	0.67	0.5	0.91
Best equity % offered	Shark's equity % accepted or offered in case of no deal.	307	0.34	0.3	0.2
Accepted equity %	Shark's equity % accepted by entrepreneur.	248	0.32	0.3	0.18
Best venture value offered	Shark's venture valuation accepted or offered in case of no deal (M USD)	307	1.34	0.5	2.88
Accepted venture value	Shark's venture valuation accepted (M USD)	247	1.25	0.5	2.42
Venture value change	Best venture value offered minus Initial venture value	307	-0.95	-0.38	2.63

Notes: Data have been retrieved all entrepreneur-contestants/firms that have aired on the Shark Tank show from Season 1 to Season 6.

entrepreneur's gender, and bad idea (ordered by variable importance).[6]

In addition to venture and entrepreneur characteristics, season number and episode number were also flagged by the classification tree. The latter two variables are specific to the TV show format of the business pitch competition and capture changes in investor composition as some investors only appear in a few seasons (season number) as well as reflect "TV editing decisions" since the order and grouping of pitches are edited to create an attractive show for the TV audience (i.e., to ensure that each episode has some pitches that are successful and some that fail). However, several variables were not identified as important, including: licensing, current sales, cumulative sales, projected sales, bulk orders, past experience, and endorsement. As a result, we do not consider these variables for the regression analysis. Given the tendency for classification trees to select variables that have many possible splits or missing values, we also built a conditional inference tree as a robustness check. Running a conditional inference tree leads to a much-trimmed tree, with only one split: initial equity share ± 15% (note that the prediction accuracy of this tree is lower than the previous tree: 57.6% vs. 69.7%). This test confirmed the importance of initial equity share in the likelihood of receiving an offer.

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[6] A significant share of pitches receiving an investment offer satisfy two conditions: initial equity is below 17% and they have been in business for less than 66 months (50% of pitches satisfy these criteria and 75% of those received an offer). Although interpretation is more complex with a high number of splits, several characteristics, such as patent status, time devoted, team size, are more relevant for ventures that have been in business for at least 4.5 months.
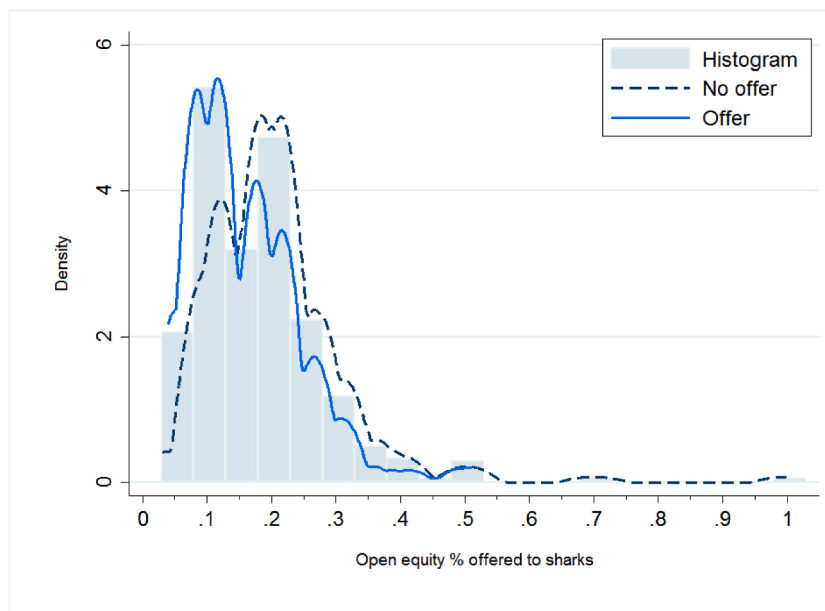
Fig. 1. Likelihood to receive an offer and initial equity percentage.

Based on the classification tree results, we estimated the probit model described in the previous section (see Table 2, columns 1–3). Average marginal effects are reported with season-episode clustered standard errors. Given that duration data are only sparsely available (the number of observations drops from 420 to 259), we ran the regression with and without this variable (columns 2–3 in Table 2). The results support our initial visual analysis as well as a number of well-established findings regarding equity financing, namely the signaling roles of equity retention, patents, and education and venture characteristics such as team size and post-revenue (Leland and Pyle, 1977; Audretsch et al., 2012; Gompers et al., 2020).[7] Interestingly, gender is not a significant predictor for the likelihood to receive an offer (β = 0.005, p = 0.93; offer rate for female-only teams 64% vs. 61% male-only teams, t = −0.54). Despite the specificities of the Shark Tank format, the share of fully female team in our sample (26%) is roughly in line with empirical results from funding rates using data aggregators such as Crunchbase (20% of global startups that raised their first funding round had a female founder in 2019).[8] In terms of investment volume, women founders received 19% of the funds over our sample period (total investment was $12.7 million for fully female teams, $44.4 million for male founders and $9.4 million for mixed teams).

4.2. Deal terms and valuation dynamics

To puzzle out valuation dynamics, we first explore the final deal terms. Table 3 provides summary statistics for the change in venture value, investment amount and equity share compared to the entrepreneur's initial ask. Most entrepreneurs entering the show will see their venture value decrease during the negotiation phase (by a mean of $950k; median of $375k). There tends to be little negotiation over investment amount. For 80% of pitches that enter negotiation, the investment amount asked by the entrepreneur is exactly matched by investors. By contrast, equity share is matched in only 3% of cases. Fig. 3 further illustrates the change in equity share against the change in investment amount, making a distinction between accepted and rejected deals. Out of a total of 307 cases that include a final deal on the table, very few result in pure negotiation gains for entrepreneurs (only 11 cases, 3.6%), and initial offers are matched in just 8 cases (2.6%). By contrast, investors frequently realize a negotiation gain (236 cases, 76.9%), mostly by matching the requested investment amount and obtaining a higher share of equity. In the remaining 52 cases, negotiation leads to a trade-off between equity share and investment amount.

To further explore the 'quality' of the deals, and in particular its relationship with the initial equity share, Fig. 4 depicts the distribution of the change in pre-money valuation, superimposed with density lines indicating where entrepreneurs' initial equity share is ± 15% (which corresponds to the median initial equity share). Comparing the density lines, we observe significantly more variance for deals where the entrepreneur initially offered an equity share below 15%, compared to those offering more than that threshold. This suggests that initial equity share partially drives the relative change in venture value.[9]

The selection models (Table 2, columns 4–5) further investigate these preliminary findings. Column (4) reports results for the full sample and column (5) reports results after excluding some outliers (top 1% ratios). Initial equity share is a significant predictor of the

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[7] As a robustness check, we also used the number of sharks bidding instead of the Offer dummy as the dependent variable, which yielded consistent results.

[8] Source: https://about.crunchbase.com/wp-content/uploads/2020/03/Funding-To-Female-Founders_Report.pdf.

[9] Caution should nevertheless be exerted when extrapolating this result as it can be driven by the relative larger impact of smaller initial equity shares (the lower the initial offer, the greater the distance to the final offer).
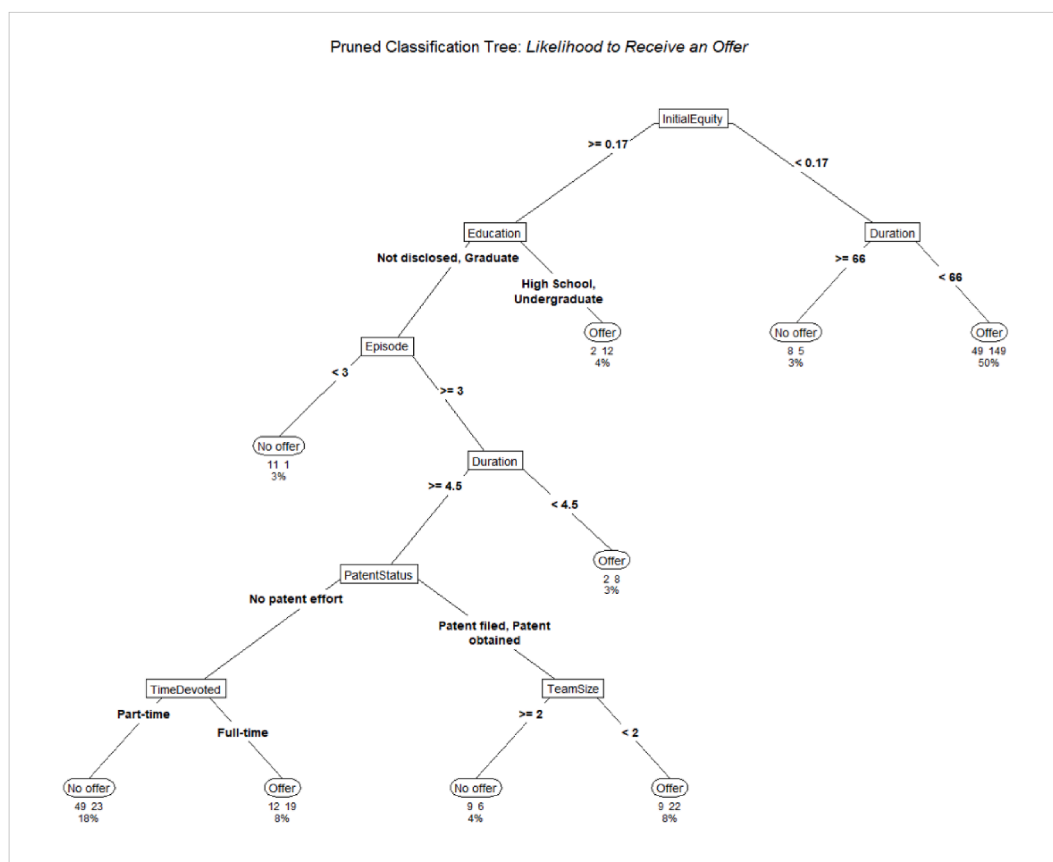
Notes: The end node of each branch provides information regarding the percentage of observation satisfying the criterion as well as the split between those who received an offer or not. For instance, for the right-right node: 50% of pitches in the sample have initial equity < 17% and have been in business for less than 66 months. Among those 198 pitches, 149 received an offer (~75%), 49 did not.

Fig. 2. Pruned Classification Tree – Likelihood to receive an offer.

best-offer-to-initial-offer ratio when outliers are removed ($\beta = 1.05$, $p = 0.053$).

4.3. Bidding dynamics with competition

Focusing on the influence of competition between investors, bidding dynamics played a significant role for our "quality of the final offer" proxy, as illustrated in Fig. 5 and Table 2 (columns 4–5). Our results suggest that when investors are competing, the distribution of the best-offer-to-initial-offer ratio is shifted to the right (on average, a "bidding war" boosts the ratio by 0.25; cf. Fig. 5), which leads to a better deal for the entrepreneur and is confirmed by a Kolmogorov-Smirnov test ($D = 0.225$, $p = 0.001$).[10]

As shown in Table 2, investor competition is a highly significant predictor of the quality of the offer ($\beta = 0.199$, $p = 0.001$). In other words, competition between investors increases the best-offer-to-initial-offer ratio by almost 0.20 compared to cases where only one investor makes an offer. By contrast, having multiple investors make a joint offer does not significantly increase the quality of the offer compared to cases where only one investor makes an offer ($\beta = 0.063$, $p = 0.457$).

5. Discussion and conclusion

Our exploratory analysis documents three core findings that we believe warrant further research. First, although entrepreneurs that provide signals of quality are more likely to receive an investment offer, signals don't necessarily carry through to the negotiation stage (except for initial equity share, which has a detrimental effect during negotiation). Second, negotiations between entrepreneurs and investors tend to be oriented around the price of equity (i.e., equity share) rather than investment amount – where investors are more

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[10] Using the numerical example of footnote n° 4 where investors are negotiating over equity share (initial offer is 100 for 10% and the deal on the table is 100 for 20%), competition between investors boosts the ratio from 0.5 to 0.75, which is equivalent to a reduced equity share by 6.66 percentage points, and thus a final deal of 100 for 13.33% instead of 20%.

Table 2

Results from regression analysis.

|	DV: Likelihood to receive an offer			DV: Best-offer-to-initial-offer ratio	
	(1)	(2)	(3)	(4)	(5)
	Probit (AME)	Probit (AME)	Probit (AME)	Selection	Selection (w/out outliers)
Initial equity share	−1.120***	−1.126***	−1.585***	0.720	1.050*
	(0.243)	(0.264)	(0.409)	(0.678)	(0.543)
Open investment (M)	−0.040	−0.212***	−0.114	−0.219	−0.128
	(0.058)	(0.074)	(0.123)	(0.213)	(0.188)
Bidding dynamics					
– Joint offer				0.063	0.107
				(0.081)	(0.074)
– Competing offers				0.199***	0.209***
				(0.058)	(0.055)
Controls					
Patent filed		0.233***	0.150	0.245	0.119
		(0.064)	(0.096)	(0.161)	(0.118)
Patent obtained		0.226***	0.225***	0.109	0.047
		(0.061)	(0.083)	(0.150)	(0.120)
Full-time		0.144**	0.087	0.038	−0.056
		(0.059)	(0.088)	(0.120)	(0.095)
Female entrepreneur		0.005	0.023	−0.027	−0.053
		(0.059)	(0.075)	(0.072)	(0.062)
Mixed team entrepreneur		−0.112	−0.101	−0.166	−0.091
		(0.074)	(0.098)	(0.108)	(0.082)
Team size		0.086**	0.109**	0.006	−0.023
		(0.039)	(0.054)	(0.081)	(0.058)
Education: High school		0.080	0.028	0.049	−0.015
		(0.198)	(0.185)	(0.208)	(0.162)
Education: Undergraduate		0.214***	0.165*	0.192	0.108
		(0.071)	(0.099)	(0.155)	(0.123)
Education: Graduate		0.150**	0.135	0.069	0.011
		(0.074)	(0.083)	(0.120)	(0.095)
Education: PhD/Doctoral		.	.	1.401*	0.360
		.	.	(0.792)	(0.286)
Duration			−0.001		
			(0.001)		
Constant				−0.251	0.021
				(0.329)	(0.227)
Selection correction					
Inverse Mills' ratio				0.461	0.170
				(0.394)	(0.285)
Season FE		✓	✓	✓	✓
Episode FE		✓	✓	✓	✓
Excluding "bad ideas"		✓	✓	✓	✓
Observations	495	420	253	405	403
Nb. Clusters	121	115	104	.	.
Pseudo R-squared	0.04	0.15	0.18	.	.
ROC	0.65	0.75	0.78	.	.

Notes: Numbers in parenthesis denote the season-episode cluster standard errors in col. (1–3), and bootstrapped standard errors (with 1000 reps) in (4–5). Stars indicating: *p < 0.1, **p < 0.05 and ***p < 0.01. This table reports estimation results for all entrepreneur-contestants/firms that have aired on the Shark Tank show from Season 1 to Season 6. A probit model was used to estimate the probability to receive an offer, and average marginal effect are shown. Columns (4–5) report the regression results after taking into account selection (Heckman twostep procedure, where the selection equation corresponds to that of column (2)). Column (5) excludes ratio above 2 (top 1% outliers). The category "not disclosed" is the reference category for Education (PhD dummy excluded in (2–3) due to absence of variability).

Table 3

Venture value, equity % and investment money change for all deals (accepted and refused by the entrepreneur).

|	All				Only accepted deals			
	N	Mean	Median	SD	N	Mean	Median	SD
Change in venture value (M USD)	307	−0.95	−0.38	2.63	250	−0.73	−0.30	1.67
Change in equity (%)	307	0.18	0.15	0.19	250	0.16	0.13	0.15
Change in investment (M USD)	307	0.13	0	1.68	250	0.03	0	0.12

Notes: For all changes: best value/equity/investment minus the initial value/equity/investment. The "All" columns include accepted deals as well as deals on the table but refused by the entrepreneur.
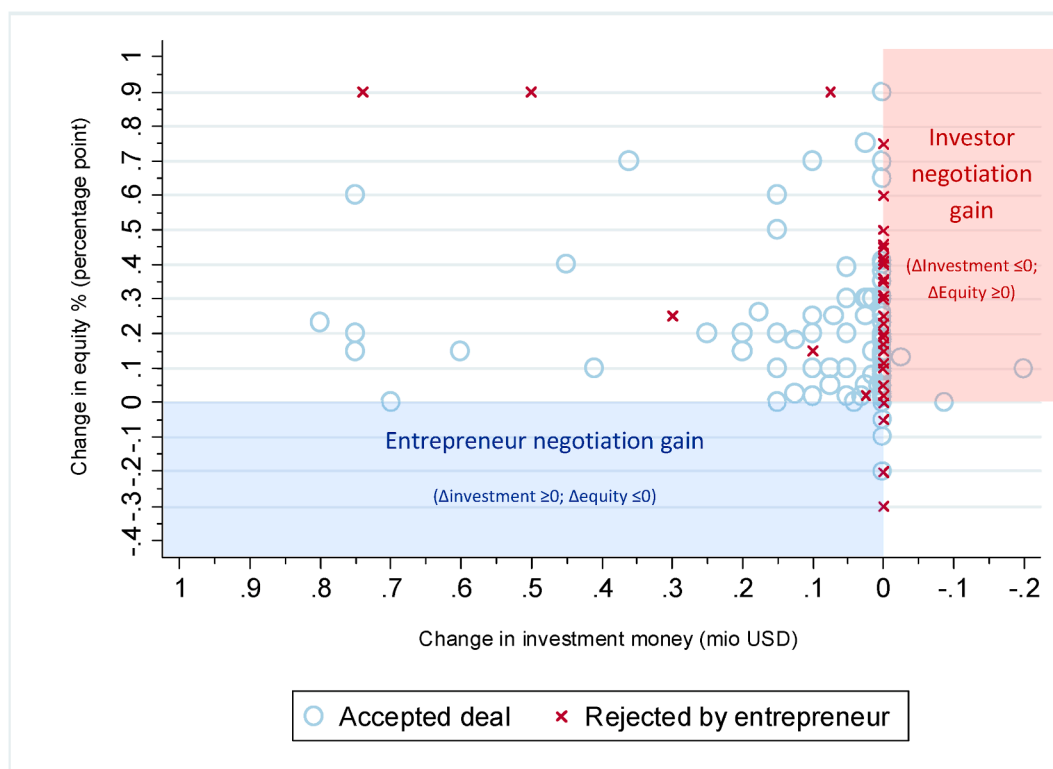
Notes: One outlier venture excluded for readability (it had a valuation above $10 million). Number of cases per quadrant: top-left 52 cases (45 accepted, 7 rejected); top-right 236 cases (189 accepted, 47 rejected); bottom-left 11 cases (8 accepted, 3 rejected); bottom-right 0 case; center 8 cases (8 accepted, 0 rejected).

Fig. 3. Change in investors share of equity and investment money compared to entrepreneur's initial offer (including accepted and refused deals).
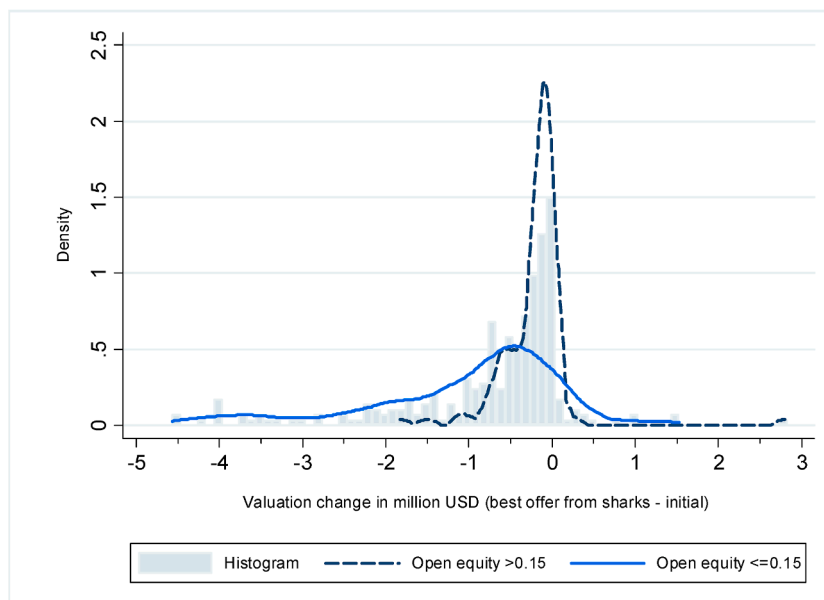
Notes: Venture values higher or lower than $5 million excluded for readability.

Fig. 4. Distribution of change in pre-money venture valuation with kernel densities for cases where the entrepreneur's initial equity share was below or above 15% (median).
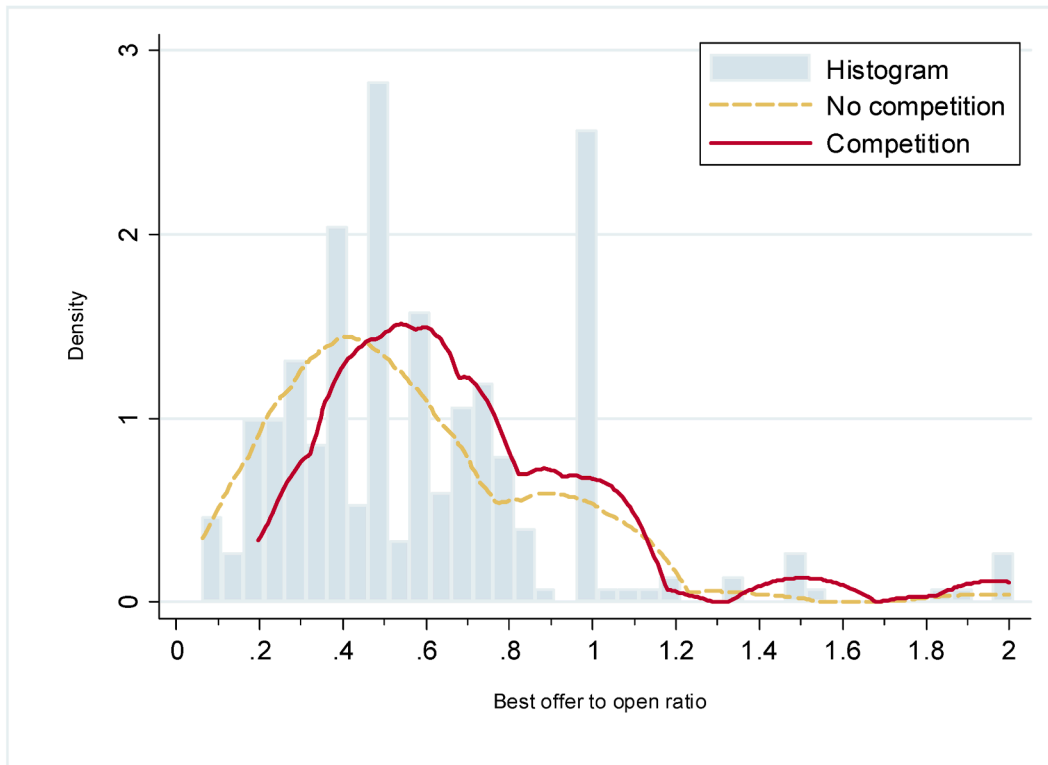
Notes: Ratios above 3 were excluded for readability. The average best-offer-to-initial-offer ratio under competition is 0.823 and 0.575 when there is no competition. A t-test reveals the difference between the two averages is significantly different from zero (difference=0.248, t-statistic=2.2, p=0.029).

Fig. 5. Best-offer-to-initial-offer ratio distribution, with kernel densities for cases where investors are competing or not for the deal.

likely to experience negotiation gains. Third, entrepreneurs who are able to elicit competition between investors receive significantly better-quality final deal terms.

A core feature of our exploration into how entrepreneurial characteristics and venture prospects affects the likelihood of receiving a funding offer and the subsequent valuation process suggests that entrepreneurs face a trade-off when using equity retention as a signal of quality. Consistent with earlier signaling theory research, our study indicates that signaling through equity retention can help entrepreneurs increase the likelihood of receiving funding offers (Ahlers et al., 2015; Vismara, 2016). Although our empirical approach attempts to tease out the effect of alternative variables, equity retention may simply reflect that entrepreneurs with an existing track record or sales traction can justify a higher initial price. Compared to the "take-it-or-leave-it" environment of crowdfunding, our empirical setting allows us to explore how investors and entrepreneurs negotiate. Our findings indicate that using equity retention as a signal of quality negatively affects the quality of offers to entrepreneurs. Somewhat surprisingly, other signals related to venture quality and team characteristics are insignificant in our negotiation models.

One potential explanation for the skewed negotiating dynamics could be that investors tend to be sophisticated and experienced and can use these skills to take advantage of relatively naive entrepreneurs. Entrepreneurs vary in terms of financial and technical expertise and experience and often may be pitching to investors for the first time. By contrast, investors have extensive experience negotiating equity valuations and typically apply a higher risk premium and argue for a larger share of equity than the founder deems reasonable (Douglas et al., 2014). Compounding this effect is the nature of the game show, since time pressure has also been shown to skew negotiating power towards investors (Ahlers et al., 2016). A counterpoint to this interpretation could be that entrepreneurs also use advanced negotiation tactics, for instance by setting a high initial price relative to their actual reservation price (Chertkoff and Conley, 1967; Galinsky and Mussweiler, 2001). We believe that disentangling the negotiation strategies of investors and entrepreneurs is a fruitful avenue for further research.

We interpret the tendency to negotiate over equity share rather than investment amount to be driven by the intended use of the funds. Entrepreneurs often raise equity with the intention to fund business activities for a sufficient timeframe (i.e., runway) (Shepherd and Gruber, 2021). As such, the initial investment amount asked for by the entrepreneur is likely to reflect costs associated with the acquisition of personnel, equipment or other capital expenditures. Since the costs of these investments are relatively fixed, investors and entrepreneurs only have one lever to negotiate over in practice, which is the share of the pie that each party receives. Moreover, the fact that investors frequently offered a higher investment amount than initially asked by the entrepreneur (see Fig. 3) could further

indicate that investors associate investments with specific projects and are often willing to push entrepreneur to "think bigger" (by offering extra money to scale, increase capacity or sales channel, etc.). Alternatively, investors may have an equity share target when making early-stage investment and may thus automatically seek to negotiate the equity share according to industry norms and heuristics (Zacharakis and Shepherd, 2007).

Finally, we turn to the competitive dynamics between investors during negotiations. On one hand, competition between investors allows entrepreneurs to gain more bargaining power (e.g., by raising their outside option, see Cahuc et al. (2006) for an illustration in the context of wage bargaining) and thus negotiate better deal terms. On the other hand, investors provide more than capital; they offer management skills and experience, as well as a network of existing connections (e.g., supply chain partners) (Hellmann and Puri, 2002). A deal with several VCs can then multiply these advantages, allowing the entrepreneur to reduce risk, lower the need for costly search and monitoring, and shorten time to market. Nevertheless, entrepreneurs may have an explicit interest to partner with a specific investor, and entrepreneurs have demonstrated willingness to forego better financial terms to be associated with reputable investors (Hsu, 2004). In other words, given that syndication (when investors cooperate) offers a better "general package" (Brander et al., 2002; Lerner, 1994; Wilson, 1968), investors feel the urge to raise their offer to the entrepreneur, which could explain why it doesn't lead to higher quality offers in our empirical analysis.

Despite some unique strengths to examine real-time equity negotiation, our study is subject to limitations. First, sample selection is an obvious concern. For one, entrepreneurs may simply go on the show to increase visibility for their product rather than to seek funding from the sharks. Smith and Viceisza (2018) find that a Shark Tank appearance is associated with a longer-run existence of firms and Inc. Magazine also suggests that entrepreneurs (regardless of receiving an investment offer) enjoy a post-show revenue spike. Additionally, since Shark Tank is a TV show where the investors have reached celebrity status, the investment pitch dynamics that we document likely differ from other contexts. Extending examination of negotiations to other pitch contexts could help to corroborate our findings, for example through analysis of TechCrunch's Startup Battlefield or Y Combinator's Demo Day. Second, our research methodology does not enable us to make causal claims. Although we attempt to mitigate these concerns in our empirical analysis, we present these results as exploratory. In the process of identifying these relationships, we used multiple statistical techniques, made multiple comparisons, and exercised our judgement in the analysis process to best reveal the phenomenon. As a result, a fruitful avenue for further research could use an experimental design to isolate and test the dynamic role of equity retention, negotiation gains under different competitive/cooperative conditions, etc.

Finally, our descriptive results indicate that an entrepreneur's characteristics can play a role in the likelihood to receive an offer. Being fully devoted to the venture, having a larger venture team and disclosing achievement of a university degree (undergraduate or graduate) can increase an entrepreneur's chances to receive an offer. Despite the specificities of the Shark Tank format, these results are in line with previous findings on the importance of venture team characteristics such as ability, educational background, industry and entrepreneurial experience (Bernstein et al., 2017; Gompers et al., 2020). Educational background can for instance signal an entrepreneur's skills and access to a wider personal network of social ties (e.g., a prestigious university spin off). Interestingly, gender is not a significant predictor for the likelihood to receive an offer or the quality of the offer received. However, in contrast to Crunchbase data, where female-only founded firms received just 3% of total funding in 2019, women founders received 19% of the funds invested by the sharks over our sample period. Since women investors are more likely to invest in female founding teams, a potential explanation for this difference could be higher proportion of female investors in the Shark Tank show (two out of six), compared to the typical pool of investors in the Crunchbase data.[11] Exploring these differences is a topic for future research.

To conclude, in a market where startup founders offer an idea and investors are the consumers, startup founders should carefully reflect on pricing. Taken at face value, our findings suggest that entrepreneurs can benefit by using equity retention as a signal to increase the likelihood of entering the negotiation phase of investment due diligence. However, entrepreneurs should be cognizant that sending signals of quality through equity retention can negatively impact the quality of investment offers. One strategy to level the playing field can be to pit investors against each other or be ready to trade equity share for access to investor's networks or domain knowledge.

Data availability

The dataset and replication codes can be accessed via GitHub:https://github.com/hallopatricio/Shark-Tank.

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[11] A study showed that, in 2019, roughly 13% and 15% of partners at American and Canadian venture firms were women, respectively. Source: https://news.crunchbase.com/news/venture-capital-female-gender-diversity/.

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