Pricing the Value of Cash Flow Rights in Crowdinvesting: An Analysis of Innovestment Backers

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First draft: 30 June 2015

This version: 8 February 2016

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* We are highly indebted to the managers and owners of Innovestment who provided the investor data to us as well as Matthias Schmitt who calculated the data on geographic distances. We would also like to thank Gregor Dorfleitner, Lars Klöhn, Alexander Rajko, Elisabeth Schulte, and the participants in the 3. Crowdinvesting Symposium (University of Munich), who provided valuable comments and suggestions on an earlier draft of the paper. The usual disclaimer applies.

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Abstract

In this paper, we analyze the pricing of cash flow rights in startup companies based on a unique dataset of crowdinvesting backers. Our sample consists of 44 campaigns and includes 1,450 bids made by 499 backers during the period from November 6, 2011 to March 25, 2014 on the German crowdinvesting portal Innovestment. In contrast to all other European crowdinvesting portals, Innovestment is running a multiunit sealed bid second price auction where backers can specify the price they are willing to pay for an investment ticket with the portal and startup specifying a lower threshold. We exploit this unique auction mechanism to analyze backers' willingness to pay for cash flow rights in a startup company. We find that campaign characteristics, investor sophistication, progress in funding, herding, and stock market volatility influence backers' willingness to pay in an economically meaningful fashion, whereas we do not find any evidence for a local bias or sniping at the end of an auction. Our findings indicate that portal design and self-regulation might well trump government rules in the pursuit to protect investors.

Keywords: Auction, Crowdinvesting, Innovestment, Regulation, Willingness to Pay.
JEL: D44, G11, K20, M13.

1. Introduction

Around the globe lawmakers are taking actions to bring crowdinvesting activities under a specific legal umbrella.[1] Crowdinvesting[2] (also referred to as investment-based crowdfunding[3], securities crowdfunding[4], or equity crowdfunding[5]) constitutes a financial innovation in securities issuance that gives small entrepreneurs access to the general public. Regulatory efforts often pursue the objective to facilitate entrepreneurial activities while also putting a minimum level of investor protection in place. To balance this trade-off, regulators must consider the actual behavior of investors in these markets. In this paper, we investigate how backers price the value of cash flow rights in a startup company when engaging in a crowdinvesting campaign based on a unique dataset of Innovestment backers.

Earlier studies on Internet-based entrepreneurial finance have mainly focused on donation-based crowdfunding (Bøg, Harmgart, Huck, and Jeffers, 2012; Burtch, Ghose, and Wattal, 2013; Meer, 2014; Koning and Model, 2013; Saxton and Wang, 2013; Smith, Windmeijer, and Wright, 2012), reward-based crowdfunding (Agrawal, Catalini and Goldfarb, 2013; Belleflamme, Lambert, and Schwienbacher, 2014; Colombo, Franzoni, and Rossi-Lamastra, 2015; Kuppuswamy and Bayus, 2014; Marom and Sade, 2013; Mollick, 2013; Mollick, 2014; Younkin and Kashkooli, 2013; Zvilichkovsky, Inbar, and Barzilay, 2013), and crowdlending (Burtch, Ghose, and Wattal, 2014; Herzenstein, Dholakia, and Andrews, 2011a; Herzenstein, Sonenshein, and Dholakia, 2011b; Hildebrand, Puri, and Rocholl, 2014; Lin and Viswanathan, 2013; Lin, Prabhala, and Viswanathan, 2012, Ly and Mason, 2012a; Ly and Mason, 2012b; Pope and Sydnor, 2011; Ravina, 2012; Zhang and Liu, 2012).

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[1] See Hornuf and Schwienbacher (2014a) for an overview.

[2] In this paper, we rely on the term 'crowdinvesting' (Klöhn and Hornuf, 2012; Hornuf and Schwienbacher, 2014b) and refer to the Internet-based investment in a startup company by a large number of natural persons—sometimes accompanied by co-investments of legal persons (e.g., angel investors or venture capitalists)—with the intention to obtain the residual claim on the future cash flows of a firm.

[3] See the FCA Consultation Paper CP13/13 'The FCA's regulatory approach to crowdfunding (and similar activities)' as well as the European Securities and Markets Authority 'Opinion Investment-based crowdfunding'.

[4] See Knight, Leo, and Ohmer (2012) and the US Securities and Exchange Commission, 17 CFR Parts 200, 227, 232 et al. Crowdfunding; Proposed Rule.

[5] See for instance the JOBS Act including the term 'crowdfunding' referring to transactions involving the offer or sale of a security as well as Ahlers, Cumming, Günther, and Schweizer (2013) defining the term 'equity crowdfunding' as an investment model where investors receive 'some form of equity or equity-like arrangements'.

In one of the first studies on crowdinvesting, Agrawal, Catalini, and Goldfarb (2013) analyze the revenue sharing model of Sellaband. Under the Sellaband model, backers receive a portion of the future returns that an artist generates by producing music. Ahlers, Cumming, Günther, and Schweizer (2015) investigate investors on the Australian equity portal ASSOB. They find evidence that startups listed on the portal use signals with regard to the financial roadmaps, risk factors, as well as the internal governance of the firm that encourage crowdinvestors to participate. Hornuf and Schwienbacher (2015) as well as Vismara (2015) investigate the funding dynamics in crowdinvesting. They find that investors base their decisions on the information that is offered by the entrepreneur in form of updates and by peer investments and comments of other crowdinvestors. Moreover, there is also evidence for a collective attention effect and herding behavior.

In what follows, we analyze the prizing of cash flow rights in a startup company by crowdinvesting backers. In contrast to all other European crowdinvesting portals, Innovestment has deviated from brokering fixed price investment tickets on a first-come, first-serve basis. Instead, the portal implemented a multiunit second price auction where backers can themselves specify the price they are willing to offer for each ticket with a lower threshold being specified by Innovestment and the startup to be listed. As a consequence, backers can outbid each other when acquiring cash flow rights in a startup company.

Our key contribution to the literature is to exploit this unique auction mechanism and to come forward with an analysis of backers' willingness to pay. We test whether (i) campaign characteristics, (ii) investor sophistication, (iii) the progress in the funding campaign, (iv) herding behavior, (v) stock market volatility, (vi) the distance between the backer and the startup, and (vii) sniping at the end of an auction play a role when backers decide how much money they are willing to offer for a ticket. Our sample consists of 44 campaigns that Innovestment accepted to be listed on their website. Our results are based on 1,450 bids made by 499 backers during the period from November 6, 2011 to March 25, 2014.

Our key findings are that campaign characteristics, investor sophistication, progress in the funding campaign, herding, and stock market volatility influence backers' willingness to pay in an economically meaningful fashion. We do not find any evidence for a local bias or sniping behavior at the end of the auction to influence the pricing of

cash flow rights in a startup company. The results suggest a limited scope for regulatory interventions, while self-imposed portal design and the organization of crowdinvesting campaigns might have a strong impact on backers' willingness to pay for cash flow rights and company shares more generally.

The remainder of this paper is organized as follows. Section 2 provides some background on crowdinvesting in general and a detailed explanation of the auction mechanism of the crowdinvesting portal Innovestment. Section 3 introduces the dataset and derives the paper's hypotheses. Section 4 presents the empirical results. Section 5 concludes and provides policy implications.

2. Theoretical and Institutional Background

2.1 Defining Crowdinvesting

Crowdfunding combines the idea of micro-finance with crowdsourcing (Mollick, 2013). In the United States (US), crowdfunding campaigns are nowadays either run under the donation or reward model. Under the former, backers donate money to support a philanthropic project without expecting any compensation. Under the latter, backers are promised tangible or intangible perks such as a supporter coffee mug or being mentioned on the campaign website. For some of the most popular projects, rewards resemble a pre-purchase of the product or service to be developed by the founder. In case of the Pebble smartwatch, for example, 68,929 backers spend in total more than 10 million USD to obtain a watch that connects to the smartphone. The first 200 backers pre-purchased a black watch for 99 USD. Another 40,799 backers then pre-paid 115 USD for the very same watch. The remaining backers pre-paid a slightly higher amount to obtain a fancier version of the watch.

The crowdfunding business model is fundamentally different from crowdlending, where backers invest in personal or business loans to receive a predetermined periodic interest payment from debtors. Crowdinvesting is a combination of crowdfunding and crowdlending. Backers spend money in crowdinvesting campaigns to support a founder, which seeks to develop a sustainable product or service, and expect a monetary return after the investment contract expires or the startup company is bought by a venture capitalist. In the majority of the crowdinvesting campaigns backers do, however, not pre-purchase the product or service to be developed. In the US, crowdinvesting is currently restricted to accredited investors and does not take place in any significant

manner. Although in 2012 the US was the first jurisdiction to pass a law specifically regulating crowdinvesting activities, the Securities and Exchange Commission (SEC) is supposed to implement specific rules on Title III of the Jumpstart Our Business Startups (JOBS) Act before crowdinvesting by soliciting the general public can take place.

Under German securities law, crowdinvesting by non-accredited investors has always been possible. Since 2011 more than 30 crowdinvesting portals began operating. The crowd participates in the future cash flows of a firm by investing in mezzanine financial instruments. Most founders do not offer common shares in a private limited liability company (LLC), as a notary would have to be involved to allow for such shares being transferred (Braun, Eidenmüller, Engert, and Hornuf, 2013). Moreover, the minimum capital requirement for setting up a public LLC (which does not require the involvement of a notary to transfer shares) often overburdens the founders of a startup company. Common shares of a public LLC are therefore rarely used in crowdinvesting campaigns. As a result, German startups most often use profit participating notes, cooperative certificates, silent partnerships, and convertible bonds when running a crowdinvesting campaign, which then replicate the future cash flows of the firm.

2.2 Innovestment

One of the oldest German crowdinvesting portals is Innovestment. The startup Particular completed its first successful campaign via the portal on December 25, 2011, the same year market leader and first mover Seedmatch appeared on the crowdinvesting market. In many respects Innovestment is similar to Seedmatch and numerous other crowdinvesting portals in Europe (Hornuf and Schwienbacher, 2014b). Before a campaign goes online, Innovestment and the founders have to agree on a valuation of the startup. Prior to that the founders of the startup decide how much capital they want to raise. Based on the financial needs of the firm and the value of the firm that was negotiated, Innovestment adapts a standardized financial contract—a silent partnership agreement—replicating an equity share in the startup. Becoming a silent partner allows investors to participate in the future cash flows of the startup during the lifespan of the contract and again when the silent partnership agreement expires.

Many startups running campaigns on Innovestment intended to raise EUR 100,000 and offered EUR 1,000 investment tickets to backers. If the initial valuation of the startup

was, for example, negotiated to be EUR 1,000,000, backers buying a single investment ticket obtained a right on 0.091 percent of the cash flow rights provided that the price of the investment ticket did not rise during the auction. It is important to note that backers who are ultimately becoming a silent partner of the startup do not receive any of the rights attached to a common equity share such as voting rights. However, they also do not participate in the losses of the startup they are investing in. Furthermore, the silent partnership agreements used by Innovestment are senior to ordinary shares and shareholder loans but rank after all ordinary liabilities. They usually expire after three to seven years and cannot be traded on a secondary market after the initial allotment took place.

While Innovestment is in many respects similar to all other European crowdinvesting portals, it also differs from them in one important respect and is therefore worth analyzing in further detail. European crowdinvesting portals uniformly allocate equity shares or one of the above-mentioned financial instruments by means of a fixed price first-come, first-serve allocation mechanism. That is, the portal stipulates a fixed price per investment ticket that usually applies for all of its investors and campaigns. The number of tickets being offered during a campaign is then determined by the overall funding limit as defined by the founders and the fixed price per ticket. The lower the price per ticket, the more tickets can be sold given the particular funding limit. As a result, the portal stops selling silent partnership agreements to the crowd once the funding limit and thus the predetermined number of tickets is reached.

Innovestment has deviated from stipulating a fixed price per investment ticket and implemented an adaptation of a multiunit sealed bid second price auction. In theory, under a second price auction it is a dominant strategy for backers to reveal their true willingness to pay for the cash flow rights in a startup company (Kagel and Levin, 2001). The Innovestment auction is particular as it involves three stages. Before describing these three stages in more detail, it is important to note that it is only at the end of a predetermined funding period (usually 30 days) that units are allotted to the investors and a legal transfer of money as well as silent partnership agreements takes place. Before that, backers only commit to buy cash flow rights according to their bids and funds are frozen on a trust account. Moreover, the portal only reveals the following information to backers: the current price per ticket, the overall funding amount reached

and, hence, whether the funding goal was reached or not. Nevertheless, individual bids by other investors are sealed.

During the first phase of the auction, backers can make pledges by specifying the number of tickets they want to buy and the price they are willing to pay for each ticket. Innovestment and the startup determine a lower threshold for the price of a single investment ticket, which is often determined to be EUR 1,000. Everyone who pledges money will be allotted the desired number of tickets during the first phase of the auction and the lowest bid applies to everyone. In principle, there is no reason for investors to outbid the lower threshold at this phase, as there is yet no scarcity in tickets and indicating their true willingness to pay would only drive up the price per ticket. However, backers may anticipating that the auction will run in the second phase and indicate their true willingness to pay for cash flow rights from the outset to avoid the potential transactions cost of being outbid and bidding again later.[6] Importantly, the Innovestment auction also operates under an all-or-nothing funding model. Under this model Innovestment and the startup determine a minimum funding goal, which has to be reached within a predetermined funding period. If the minimum funding goal is not reached within this timeframe, the capital pledged by the backers is returned to them.

The second phase of the auction begins, when a predetermined number of investment tickets is sold to the crowd. The number of tickets and hence the beginning of the second stage of the auction is not known to the Innovestment backers until it is finally reached. The number of investment tickets sold by the end of the first auction phase also determines the number that is available throughout the second phase and is then kept constant. From now on, investors can only outbid each other by posting higher prices. Backers anticipating that the second stage of the auction will be reached should now rationally reveal their true willingness to pay, given that this phase of the Innovestment auction is equivalent to a Vickrey auction. Importantly, the second phase of the auction is not restricted to investors from the first phase. Every investor who is registered at the portal can still join the bidding process. The second phase continues until the funding limit is reached. After the funding limit is reached, the auction enters the third stage. During this phase all registered users can still outbid investors. At this point, however, it is no longer possible to increase the overall sum of funds received by the startup. Higher

[6] Indeed, the CEO of Innovestment made this argument when she was asked why investors overbid the lower price threshold during the first phase of the auction.

bids consequently result in the overall number of investment tickets being reduced. Because the overall sum of funds stays constant, while the number of tickets is narrowed, the cash flow right the startup has to sell for a given amount of capital is reduced.[7]

What should be clear to the crowd is that the different phases of the auction mechanism have no hard ending rule, that is, silent partnership agreements cannot sell out as their availability only depends on the backers' willingness to pay. Everyone can invest at each phase of the auction until the predetermined funding period ends. Thus, unlike under the fixed price first-come, first-serve allocation mechanism, where it might be risky for the crowd to postpone an investment decision, investors have an incentive to reveal their true willingness to pay and may theoretically invest at any time of the funding period under the multiunit sealed bid second price auction mechanism.

3. Empirical Methodology and Data

Our dataset consists of 42 startups, which used the crowdinvesting portal Innovestment for their funding campaigns during the period from November 6, 2011 to March 25, 2014. In total, we have 1,627 bids for the 44 funding campaigns[8] during that period with a total volume of EUR 4,525,062 pledged. Total bids by individuals over the 2.5 year period vary from EUR 500 to EUR 149,839. Due to data availability issues for some of the explanatory variables (average income according to postal code; see also below) our sample contains 1,450 bids made by 499 backers.

3.1 Dependent Variable: Premium over Ticket Price

As dependent variable, we measure backers' willingness to pay for cash flow rights by calculating the relative "premium" over the initial ticket price in percent:

$$(1)\ premium = 100\frac{offered\ price - ticket\ price}{ticket\ price}$$

Table 1 shows descriptive statistics for the observed premia. Figure 1 shows the distribution of the premia, split for several subgroups. The first subgroup consists of all

[7] The second phase of the auction was abolished from November 1, 2012 onwards. Consequently, the first phase continued until the funding limit was reached. Thereafter, the third phase started immediately.

[8] Two startups in our sample ran multiple funding campaigns.

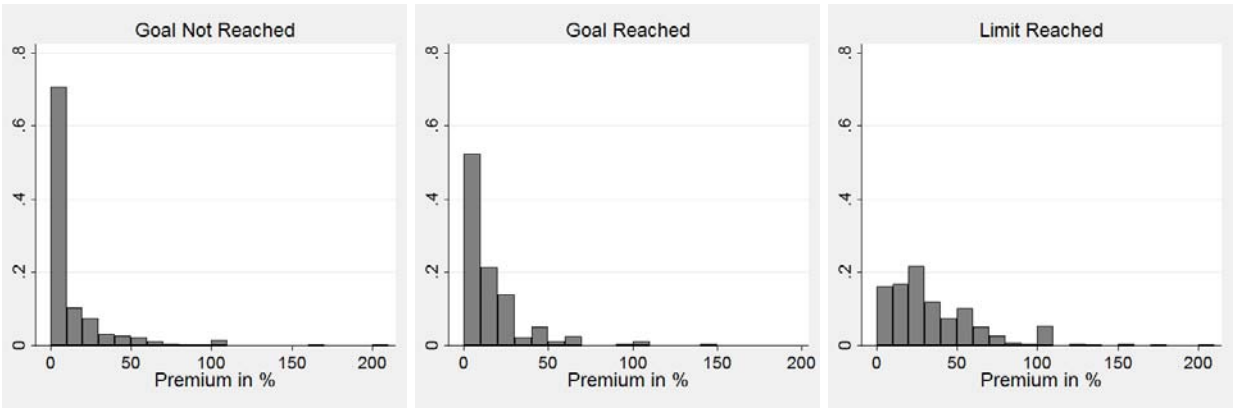
bids before the funding goal was reached, the second subgroup consists of all bids after the funding goal was reached but before the funding limit was reached, and the third subgroup consists of all bids after the funding limit was reached.

Table 1: Descriptive Statistics: Premium over Ticket Price

	Mean	Std. Dev.	Median	Min.	Max.	Obs.	0
All	18.32	25.87	8.00	0	203	1450	457
Goal Not Reached	10.67	20.81	1.00	0	203	757	370
Goal Reached	13.70	19.68	9.13	0	150	281	86
Limit Reached	35.53	29.67	29.80	0	203	412	1

Note: Column '0' indicates the frequency of bids without any premium.

Figure 1: Distribution of Premia over Ticket Price



Note: y-axis shows the relative frequency of premia within the three phases of the auction.

457 investment bids (31.5 percent of all bids in the sample) are made without any premium. Most of these are made before the funding goal was reached (370; 48.9 percent of all bids in phase 1).[9] However, the fact that over 50 percent of all bids in that subsample are made with a positive premium supports the anecdotal evidence that backers from the outset state their true willingness to pay.

The average premium over the ticket price is 18.3 percent. The mean premium is increasing over the three subsamples (10.7 percent before the funding goal was reached, 13.7 percent after the funding goal was reached, and 35.3 percent after the funding limit was reached) and these differences are statistically significant.[10] In addition, the

[9] The start of the second or third stage of the auction does not necessarily coincide with the funding goal or funding limit being reached.

[10] The results of t-tests for differences in means across subgroups are as follows: Goal Not Reached vs. Goal Reached: t = –2.17*; Goal Not Reached vs. Limit Reached: t = –15.11**; Goal Reached vs. Limit Reached: –11.65**. **/* indicates significance at the 1%/5% level.

standard deviation differs considerably across subgroups. It is 1.5 times as large in the third subgroup compared to the first and second subgroups and this difference is statistically significant.[11] This is also reflected in the right panel of Figure 1 which is, compared to the left and middle panel, more uniformly distributed over the different levels of premia.

In the empirical analysis below, we run a regression based on the full sample of 1,450 observations and we truncate the sample by leaving out the 164 observations where we observe a premium larger than 50 percent to explore the robustness of our results.[12]

3.2 Explanatory Variables and Hypotheses

Campaign Characteristics. Our first set of explanatory variables reflects campaign characteristics, which are observable to all backers on the portal website. For each startup, Innovestment reports an assessment of the firm's value, which varies from EUR 420,000 to EUR 10,000,000 in our sample of 44 funding campaigns.[13] In addition, each firm has to announce a funding goal, which varies from EUR 36,000 to EUR 150,000. We conjecture that the backers can interpret both, the firm value and the funding goal as effective signals in the spirit of Spence (1973) for potentially lucrative investments. This is because the valuation and funding goal are both easily observable and if chosen too high, they are costly for the founder since the campaign might receive not enough or no funding at all. As for the funding goal, a higher funding goal signals to the crowd that the entrepreneur is confident that he will at least collect the pre-determined amount of money. If the threshold is not met, the money pledged is given back to the funders and the campaign fails. However, in case of the prevaluation there is also a channel, which works in the opposite direction. A higher prevaluation implies, for a single investment ticket, a lower share of future cash flows and, consequently, makes such an investment less attractive.[14] Accordingly, our first set of hypotheses is as follows:[15]

[11] The results of variance-comparison tests across subgroups are as follows: Goal Not Reached vs. Goal Reached: f = 1.12; Goal Not Reached vs. Limit Reached: f = 0.49**; Goal Reached vs. Limit Reached: f = 0.44**. **/* indicates significance at the 1%/5% level.

[12] One reason for leaving out relatively large premia is to avoid typing errors by the investors. For instance, in 25 cases we observe a premium of 100 percent and it might be the case that investors wanted to buy two tickets without any premium instead of one ticket with a premium of 100 percent.

[13] Table A1 in the Appendix sets out descriptive statistics for the explanatory variables.

[14] Unfortunately, the dataset at hand does not allow for a differentiation of the two opposing effects.

[15] Our empirical model does not contain campaign-fixed effects. Otherwise, we would not be able to identify the influence of campaign characteristics (and the price per ticket presented in H2) on the premium.

H1: The effect of the firm's prevaluation on the premium is ambiguous.
The premium is increasing in the funding goal.

Backer Sophistication. We conjecture that more sophisticated backers tend to understand the underlying auction mechanism better than their less sophisticated counterparts. As mentioned before, we expect no extensive investment premia in the first phase of the auction, although backers anticipating the second stage of the auction might rationally post their reservation price, which may lie well above the minimum ticket price. In addition, we expect sophisticated backers to indicate their true willingness to pay for cash flow rights in the second and third stage. The differences across different types of backers might even be more relevant under transaction costs as more sophisticated backers typically face relatively low costs when investing as they are more specialized in evaluating startup companies. Since we cannot make any conjectures about how the willingness to pay differs among sophisticated and unsophisticated investors, we do not have a firm prior about conditional differences in the premium across groups.

However, since we want to learn more about investor behavior to put forward implications for regulatory policy, for instance, whether or not the government should implement policies to protect investors, we include a second set of explanatory variables that aims at proxying backer sophistication. First, relatively large investments are typically undertaken by more sophisticated investors. Consequently, we consider the number of tickets bid for by a single investor in a specific transaction, which varies between 1 and 40, as explanatory variable. Similarly, a higher minimum price per ticket as defined by Innovestment can be seen as an entrance barrier for small investors. Thus, it is more likely that more sophisticated investors undertake bids if the minimum ticket price, which varies between EUR 500 and EUR 25,000, is relatively high. Next, Innovestment requires every backer to complete a short questionnaire about past investment experience in the following seven categories when registering with the portal: Bonds, commodities, funds and certificates, real estate, stocks, term deposits, other equity. Backers who claim to have prior experience in at least one of these categories conducted 52.3 percent of the bids. In the empirical analysis below, we include a set of dummy variables for all seven categories, which take the value 1 if a

backer has prior experience in that particular category and 0 otherwise.[16] Finally, Innovestment records the postal code of each backer. Thus, we are able to include the average income in the backer's home region in 2011, which varies between EUR 16,239 and EUR 28,900 in our sample, as a proxy for the backer's income and sophistication.[17] Therefore, our second set of hypotheses is as follows:[18]

H2: The premium might differ in the number of tickets bought, the price per ticket, the backer's previous experience, and the average income in the backer's home region.

Progress in the funding campaign. A third set of hypotheses takes into account the progress in the funding campaign. Backers are well aware of the overall percentage of targeted funding which has been accomplished at the time of their decision. As the auction mechanism of Innovestment allows for bids even after the funding goal or limit has been reached,[19] the accomplished funding share at the time of a bid varies between 0 percent and 100 percent. Consequently, we include another explanatory variable, which measures the funding share in percent. In addition, backers know whether or not the funding goal or the funding limit has been reached. Thus, we also consider two non-disjunctive dummy variables, which measure (i) if the funding goal was reached but the funding limit has not yet been reached and (ii) if the funding limit has been reached. Since reaching the funding goal removes the uncertainty whether the funding actually takes place, backers with strong liquidity preferences no longer have to fear that they are simply putting their money on hold because the campaign in the end fails.[20] Furthermore, reaching the funding goal and funding limit might be a signal of demand for the particular investments opportunity and the potential quality of the startup. Hence, we expected a strong positive influence of these two dummy variables on the

[16] We also employed (i) an index ranging from 0 to 7 for prior experience in the seven categories queried by Innovestment and (ii) a dummy variable which takes the value 1 if a backer has prior experience in at least one of the seven categories and 0 otherwise instead the set of seven dummy variables. The results of the other explanatory variables are robust to this modification. To conserve space, we do not report these additional tables, which are available on request.

[17] We cannot retrieve this information for some of the foreign investors and, therefore, lose a part of the 1,627 observations due to the inclusion of this variable.

[18] Our empirical model does not contain backer-fixed effects. Otherwise, we would not be able to identify the influence of prior experience and the average income in the investor's region on the premium.

[19] 47.8 (28.4) percent of all bids have been recorded when the funding goal (limit) was reached.

[20] However, backers still can be outbid at this stage.

premium and, in particular, for the funding limit. Thus, our third set of hypotheses is as follows:[21]

H3: The premium is increasing in the share of targeted funding which has been accomplished and is higher if the funding goal or funding limit has been reached.

Herding. Herding is a well-documented phenomenon in financial markets (Scharfstein and Stein, 1990). It was recently observed in crowdlending (Herzenstein, Dholakia, and Andrews, 2011b; Lee and Lee, 2012) and in crowdinvesting (Hornuf and Schwienbacher, 2015; Vismara, 2015) as well. To test whether herding affects the pricing of cash flow rights on Innovestment we include the sum of investment bids into a startup, which were made earlier on the same day, as additional explanatory variable. The variation in this variable is astonishing as it varies between EUR 0 and EUR 217,000. Thus, our next hypothesis aims at whether herding behavior in crowdinvesting affects the premium offered by backers:

H4: The premium is increasing in the sum of bids which were made earlier on the same day into a particular startup.

Stock Market Volatility. Our sample period consists of episodes of financial market stress, in particular during the euro and sovereign debt crisis. Consequently, stock market volatility as measured by the German VDAX varies considerably over this period between 11.47 and 37.28 percent. Moreover, portfolio diversification of equity investors largely increased during the financial crises as investors had a higher demand for similar but uncorrelated assets (Vermeulen, 2013). Thus, if backers consider stocks and crowdinvestments as substitutes, higher stock market volatility might lead to larger

[21] We do not differentiate between the different stages of the auction in the empirical model since including a dummy variable for the third stage of the auction alongside interaction terms of this dummy with the funding share, the funding goal, and the funding limit does neither generate significant estimates nor change the results of the other explanatory variables.

demand for this asset class and a larger premia being paid for crowdinvestments.[22] Thus, our next hypothesis aims at detecting such a substitution effect:[23]

H5: The premium is increasing in the stock market volatility.

Distance Backer/Startup. Next, we consider the distance between the backer and the startup as additional explanatory variables. This variable takes values between 0 and 644 km in our sample. A higher distance to a specific investment might imply higher search costs to obtain accurate information about a startup and, as a consequence, less interest to invest and a lower premium. In addition, we often observe a local bias in financial markets (Cumming and Dai, 2010; Baltzer, Stolper, and Walter, 2014), which in the context of crowdinvesting would correspond to choosing a more closely located investment over a more distant startup, and accordingly, a higher premium for startups closely located to the backer. Both aforementioned channels potentially indicate a negative relationship between distance and premium, which leads to our sixth hypothesis:

H6: The premium is decreasing in the distance between the backer and the startup.

Sniping. One well-known phenomenon in auctions is sniping, that is, the auction price increases drastically towards the end of the auction process (Roth and Ockenfels, 2002; Ariely, Ockenfels, and Roth, 2005). Given the design of the Innovestment auction mechanism, backers might bid late to avoid revealing information about their willingness to pay regarding the cash flow right of a startup to other backers, which could ultimately drive up the price per ticket. Indeed, roughly 25 percent of the bids are made on the last day of the auction, which provides some descriptive evidence in favor of sniping. To test if sniping is also relevant in a multivariate analysis we include the remaining time measured in days as additional explanatory variable. To test for potential non-linearities and to capture the often-documented massive increase towards the end of the auction we also include a quadratic term measuring squared remaining

[22] Dorn, Dorn, and Sengmueller (2015) document that investors consider investment and gambling products as substitutes.

[23] Our empirical model does not contain time-fixed effects as, for instance, monthly dummies. Otherwise, it would be difficult to identify the influence of stock market volatility on the premium.

time in days. If sniping is prevalent, we would observe a negative sign, that is, the premium is lower the more time is remaining in the auction process. Thus, our last hypothesis is as follows:

H7: The premium is decreasing in the remaining time.

Table 2 provides an overview over all seven hypotheses and explanatory variables employed in the empirical analysis.

Table 2: Summary of Hypotheses

H1: Campaign Characteristics	*H2: Backer Sophistication* (+/−)
Prevaluation (+/−)	Number of Tickets (+/−)
Funding Goal (+)	Price per Ticket (+/−)
	Previous Investment Experience (+/−)
H3: Progress in the Funding Campaign	Average Income/Region (+/−)
Funding Share (+)	
Funding Goal Reached (+)	*H4: Herding (+)*
Funding Limit Reached (+)	
	H6: Distance Backer/Startup (–)
H5: Stock Market Volatility (+)	
H7: Remaining Time (–)	

3.3 Econometric Model

We explain the relative premium over the ticket price with all explanatory variables described in the previous subsection. Econometrically, we use a standard OLS model and standard errors that are clustered at the backer level. In Section 4, we present two sets of results. First, we show estimates that are based on the full sample of all 1,450 observations. Second, we explain only those 1,286 investments where the premium is lower or equal to 50 percent of the ticket price. In the Appendix, we additionally show modifications where we control for day of the week effects with Monday as reference. However, in both regressions the day of the week effects can be jointly excluded (see Table A2 in the Appendix) and, as a consequence, we present the results without day of the week effects in Section 4.

4. Empirical Results

Table 3 sets out the results for the full sample (left panel) and the restricted sample where we only explain premia up to 50 percent (right panel).

Table 3: Explaining Crowdinvesting Premia

	Full Sample		Premia ≤ 50%	
Prevaluation	0.000	(0.001)	0.001	(0.001)
Funding Goal	0.258 **	(0.050)	0.077 **	(0.024)
Number of Tickets	0.321	(0.193)	0.147	(0.089)
Initial Price/Ticket	–0.795	(0.627)	–0.978 **	(0.319)
Bonds	–1.565	(2.899)	0.684	(1.355)
Commodities	–3.243	(2.687)	–0.729	(1.404)
Funds / Certificates	3.598	(3.317)	–0.123	(1.797)
Real Estate	–5.272	(2.908)	–2.813 *	(1.300)
Stocks	3.605	(2.801)	2.906	(1.794)
Term Deposits	–1.914	(3.197)	–1.733	(1.532)
Other Equity	3.029	(2.304)	1.187	(1.134)
Disposable Income	0.129	(0.287)	0.138	(0.141)
Funding Share	0.026	(0.033)	0.018	(0.018)
Funding Goal Reached	3.957	(2.278)	3.523 **	(1.132)
Funding Limit Reached	18.107 **	(2.320)	7.254 **	(1.070)
Bids for Startup Earlier That Day	0.083 **	(0.020)	0.122 **	(0.009)
VDAX	0.789 **	(0.148)	0.498 **	(0.064)
Distance Backer/Startup	0.223	(0.382)	–0.159	(0.181)
Days Remaining	–0.056	(0.251)	0.471 **	(0.095)
Days Remaining^2	0.005	(0.007)	–0.011 **	(0.003)
Constant	–28.13 **	(6.652)	–14.80 **	(3.644)
Adjusted R-squared	0.255		0.350	
Observations	1450		1286	

Notes: Dependent variable: Premium (in percent). Standard errors (clustered at the backer level) are in parentheses. **/* indicates significance at the 1%/5% level.

Campaign Characteristics. In both panels, we find evidence that the premium is increasing in the size of the funding goal, which partly confirms H1. Backers are willing to offer a premium of 25.8 basis points (bps) (full sample) and 7.7 bps (restricted sample) for each EUR 1,000 increase in the funding goal, which is evidence that the funding goal indeed serves as a signal to potential investors. To put this figure into perspective we compare two different groups of campaigns and use the more conservative estimate in the right panel of Table 3. In our dataset, we have 15 campaigns with a funding goal of EUR 50,000 and another 14 campaigns with a funding goal of EUR

70,000. This difference of EUR 20,000 corresponds to a *ceteris paribus* difference of 1.54 percentage points (pp) in the premium. In contrast, the firms' prevaluation does not significantly influence the size of the premium in both panels.

Backer Sophistication. Two out of the four proxies of backer sophistication significantly influence the offered premium but only when we consider premia up to 50 percent (right panel).[24] First, each EUR 1,000 increase in the minimum price per ticket leads to 97.8 bps decrease in the premium. This implies that the total difference between campaigns with EUR 500 tickets (6 campaigns) and EUR 1,000 tickets (29 campaigns) is 48.9 bps. Second, backers with previous experience in real estate investments offer a significantly lower premium compared to backers without any experience in that category. One potential driver of this difference of –2.81 pp could be prior experience in assessing a financing plan. In contrast, the number of tickets bid for and the average income in the backer's region are insignificant in both panels. To summarize, we do not find strong differences between sophisticated and unsophisticated investors.

Progress in the funding campaign. Confirming H3, the progress in the funding campaign positively influences the premium offered by backers. The premium of bids made after the funding goal was reached is, on average, 3.96 pp (left panel)[25] and 3.25 pp (right panel) larger compared to bids made before the goal was reached. Reaching the funding limit has an additional impact on the premium in both panels as we observe a 18.11 pp (left panel) and 7.25 pp (right panel) higher premium for campaigns where the funding limit was reached. Finally, the accomplished funding share itself does not significantly influence the premium.

Herding. In case of the sum of investment bids into a startup, which were made earlier on the same day, we observe positive and significant coefficients in both panels of Table 3. The premium increases by 8.3 bps (left panel) and 12.2 bps (right panel) for each EUR 1,000, which is a clear indication of herding behavior and confirms H4. Multiplying the point estimate of 12.2 bps with the standard deviation of this variable (EUR 38.023) indicates that the variation in the premia caused by herding behavior is also economically relevant (4.64 pp).

Stock Market Volatility. Confirming H5, Backers tend to bid higher premia during episodes of financial market stress and consider stocks and crowdinvestments as

[24] The estimate of the dummy variable for prior experience in real estate investment is significant at the ten percent level in case of the full sample.

[25] This estimate is significant at the ten percent level.

substitutes. A one unit increase in the VDAX leads to a 78.9 bps (left panel) and 49.8 bps (right panel) larger premium. To put this point estimate into perspective, we consider the effect of a one standard deviation change in the VDAX (6.752 percent). This back of the envelope calculation reveals that the VDAX accounts for a variation of 3.36 pp in the premium.

Distance Backer/Startup. The distance between a backer and a startup is insignificant in both panels. Consequently, we do not find any evidence for a significant local bias, which rejects H6.

Sniping. In case of the full sample, the point estimates for the days remaining and (days remaining)^2 are individually and jointly insignificant ($F(2,498) = 1.47$). When considering only premia up to 50 percent, we have evidence for a hump-shaped influence of the remaining time on the premium. From 0 to 22 days remaining, the premium is increasing and thereafter it is decreasing. We interpret this as backers posting their reservation price at some point of the auction, which is well in line with the dominant strategy in Vickrey auctions. Nevertheless, we do not find any evidence for sniping behavior towards the end of the auction, which rejects H7.

5. Conclusions

In this paper, we analyze the pricing of cash flow rights in startup companies based on a unique dataset of crowdinvesting backers. Our sample consists of 44 campaigns and includes 1,450 bids made by 499 backers during the period from November 6, 2011 to March 25, 2014 on the German crowdinvesting portal Innovestment. In contrast to all other European crowdinvesting portals, Innovestment is running a multiunit sealed bid second price auction where backers can specify the price they are willing to pay for an investment ticket with the portal and startup specifying a lower threshold. We exploit this unique auction mechanism to analyze the backers' willingness to pay for cash flow rights in a startup company.

First, campaign characteristics play an economically meaningful role in the determination of the backers' willingness to pay. The average difference in the premium over the minimum price between startups with funding goals of EUR 50,000 and EUR 70,000 is 1.54 pp. Second, backer sophistication also plays a significant role as backers with previous experience in real estate investments offer, on average, a premium which is 2.81 pp lower than their counterparts without any experience in real estate

investments. Furthermore, the difference between campaigns with EUR 500 and EUR 1,000 minimum prices per ticket is 48.9 bps. Third, market forces are of particular relevance, as reaching the funding goal leads to an increase in the premium by 3.52 pp (compared to investments where the funding goal has not been reached) as does reaching the funding limit with an additional increase of 7.25 pp. Fourth, backers respond to the sum of investment bids into a startup, which were made earlier on the same day. Taking into account the standard deviation of this variable indicates that the variation in the premia caused by herding behavior is also economically relevant (4.64 pp). Fifth, backers tend to bid higher premia during episodes of financial market stress and consider stocks and crowdinvestments as substitutes. Another back of the envelope calculation using the standard deviation of the VDAX reveals that stock market volatility accounts for a variation of 3.36 pp in the premium. Finally, we do not find any evidence for a significant local bias or sniping by backers posting higher prices at the end of the auction.

Our results contribute to the scarce literature on portal design in crowdinvesting. They suggest a limited scope for legal interventions with regard to backers. By contrast, portal design and the self-imposed rules of how to run a crowdinvesting campaign significantly influence backers' willingness to pay for future cash flow rights in a startup. In order to dampen herding behavior and to guard investors from mistakenly placing excessive bids, crowdinvesting portals like Innovestment should implement some of the rules that are common to electronic trading systems such as Xetra, which have been implemented on regulated markets. Some of these electronic trading systems, for example, define price floors, which put orders on hold if the resulting price would deviate too far from historic patterns. Similar rules could also be implemented by industry codes of best practice in the crowdinvesting arena.

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Appendix

Table A1: Descriptive Statistics: Explanatory Variables

	Mean	Std. Dev.	Min.	Max.	Yes	Corr	
Prevaluation (in EUR 1,000)	1,051.350	770.547	420	10,000		–0.047	
Funding Goal (in EUR 1,000)	60.325	14.904	36	150		0.050	
Number of Tickets	2.270	2.821	1	40		0.019	
Initial Price/Ticket (in EUR 1,000)	1.136	1.577	0.5	25		–0.019	
Bonds	0.303	0.460			439	0.005	
Commodities	0.228	0.420			331	–0.030	
Funds / Certificates	0.416	0.493			603	0.047	
Real Estate	0.306	0.461			443	–0.013	
Stocks	0.460	0.499			667	0.049	
Term Deposits	0.434	0.496			629	0.025	
Other Equity	0.309	0.462			448	0.036	
Disposable Income 2011 (in EUR 1,000)	21.219	2.569	16.239	28.900		0.025	
Funding Share (in %)	69.469	36.353	0	100		0.240	**
Funding Goal Reached	0.478	0.500			693	0.309	**
Funding Limit Reached	0.284	0.451			412	0.419	**
Bids for Startup Earlier That Day (in EUR 1,000)	15.660	38.023	0	217		0.227	**
VDAX (in %)	19.568	6.752	11.47	37.28		0.271	**
Distance Backer/Startup (in 100 km)	2.942	1.758	0	6.440		0.033	
Days Remaining	14.911	14.101	–0.047	76.058		–0.061	*
Tuesday	0.112	0.316			163	–0.072	**
Wednesday	0.157	0.364			228	–0.055	*
Thursday	0.114	0.318			165	–0.045	
Friday	0.140	0.347			203	–0.007	
Saturday	0.105	0.306			152	–0.036	
Sunday	0.292	0.455			423	0.191	**

Note: Column 'Yes' indicates if a dummy variable takes the value 1. Column 'Corr' shows bivariate correlations with the premium. **/* indicates significance at the 1%/5% level.

Table A2: Explaining Crowdinvesting Premia: Day of the Week Effects

	Full Sample DOTW		Premia ≤ 50% DOTW	
Prevaluation	0.000	(0.001)	0.001	(0.001)
Funding Goal	0.272 **	(0.052)	0.073 **	(0.024)
Number of Tickets	0.303	(0.198)	0.134	(0.089)
Initial Price/Ticket	–0.921	(0.633)	–0.948 **	(0.323)
Bonds	–1.734	(2.894)	0.836	(1.353)
Commodities	–3.374	(2.697)	–0.802	(1.401)
Funds / Certificates	3.970	(3.304)	–0.030	(1.794)
Real Estate	–5.299	(2.901)	–2.819 *	(1.290)
Stocks	3.673	(2.771)	2.841	(1.789)
Term Deposits	–2.106	(3.167)	–1.934	(1.522)
Other Equity	3.056	(2.279)	1.254	(1.130)
Disposable Income	0.123	(0.290)	0.150	(0.142)
Funding Share	0.028	(0.033)	0.020	(0.018)
Funding Goal Reached	3.755	(2.341)	3.542 **	(1.162)
Funding Limit Reached	17.855 **	(2.353)	6.970 **	(1.112)
Bids for Startup Earlier That Day	0.081 **	(0.020)	0.116 **	(0.009)
VDAX	0.781 **	(0.148)	0.494 **	(0.064)
Distance Backer/Startup	0.233	(0.379)	–0.176	(0.182)
Days Remaining	–0.012	(0.259)	0.506 **	(0.098)
Days Remaining^2	0.004	(0.007)	–0.012 **	(0.003)
Tuesday	–0.907	(2.335)	1.342	(1.310)
Wednesday	–1.230	(2.440)	0.699	(1.369)
Thursday	0.289	(2.918)	–0.573	(1.260)
Friday	2.748	(2.765)	0.627	(1.461)
Saturday	0.151	(2.883)	–0.731	(1.415)
Sunday	1.450	(2.722)	1.601	(1.280)
Constant	–29.51 **	(7.003)	–15.49 **	(3.703)
Adjusted R-Squared	0.255		0.351	
Exclusion Test Day of the Week	F(6,498) = 0.76		F(6,471) = 1.29	
Observations	1450		1286	

Notes: Dependent variable: Premium (in percent). Standard errors (clustered at the backer level) are in parentheses. **/* indicates significance at the 1%/5% level.