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Compensation Schemes, Liquidity Provision, and Asset Prices: An Experimental Analysis

SAFE Working Paper No. 108

SAFE | Sustainable Architecture for Finance in Europe
A cooperation of the Center for Financial Studies and Goethe University Frankfurt

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Non-Technical Summary

The recent financial crisis highlighted the importance of compensation schemes for excessive risk taking in the financial industry, with consequences on asset price bubbles (Rajan, 2006; Bebchuk, 2009). To foster financial stability, a number of reforms have been discussed. Bonus caps have received the most attention and are now being implemented in the European Union. Another proposition suggests giving bankers more skin in the game, by making them liable for losses.

In an experimental setting in which investors can entrust their money to traders, we investigate how compensation schemes of traders affect liquidity provision and asset prices. Traders can trade assets that yield dividends and thus potentially high returns. As a consequence, investors face a trade-off between either entrusting their money and enjoying potentially higher returns but with the risk of dealing with an untrustworthy trader, or keeping their money and receiving a safe but low return.

We study how subjects solve this trade-off under different compensation schemes. First, we vary the extent to which traders are liable for losses. The introduction of limited liability creates a conflict of interest between the trader and the investor, because they value assets differently. Since traders have no downside risk, they highly value assets and are willing to buy them at a high price. By contrast, investors suffer all the losses while they share the gains. They are thus willing to pay less than traders. Since they anticipate that traders are ready to pay more, they can restrict liquidity provision to bring prices more in line with their valuation. Introducing limited liability should thus result in higher asset prices or lower liquidity provision if investors discipline traders.

We also study the effect of capping gains. A cap generates a different type of conflict of interest. It reduces the potential gains of the trader and increases those of the investor. Assets become less valuable to traders which can thus decrease the pressure on prices. At the same time, assets become more valuable to investors, who become willing to provide more liquidity. While caps can have the desired effect of reducing risk taking by traders, the higher liquidity could, at the same time, increase pressure on prices.

First, we find that liquidity provision is lowest when traders are liable for losses. This is unexpected given the absence of conflict of interest. Trust should be the highest. Liquidity provision is higher in the presence of a cap and/or limited liability. This implies that investors fail to discipline traders in the presence of limited liability. Also, the cap seems to improve liquidity provision by making the asset more valuable to investors.

Second, we find that asset prices are closer to the fundamental value when traders are liable for losses than under limited liability. This suggests that, as expected, traders take more risk when they are not liable for losses. Furthermore, the higher liquidity entrusted to traders increases asset prices. We indeed find that an inflow of liquidity is positively correlated with subsequent asset prices. The introduction of a cap does not have any major impact on asset prices. If anything, the cap seems to slightly increase prices in the presence of unlimited liability.

Our work also speaks to recent policy discussions on how to limit risk taking in the financial industry. Bonus caps do not seem to have an impact on bubbles. If anything, they foster bubbles by increasing liquidity provision. Making traders liable for losses thus seems more effective in reducing asset price bubbles. These results stand in stark contrast to the reforms currently been implemented that mostly focus on capping bonuses.

Compensation Schemes, Liquidity Provision, and Asset Prices: An Experimental Analysis*

Sascha Baghestanian[†], Paul Gortner[‡] and Baptiste Massenot[§]

1st June 2015

Abstract

In an experimental setting in which investors can entrust their money to traders, we investigate how compensation schemes affect liquidity provision and asset prices. Investors face a trade-off between risk and return. At the benefit of a potentially higher return, they can entrust their money to a trader. However this investment is risky, as the trader might not be trustworthy. Alternatively, they can opt for a safe but low return. We study how subjects solve this trade-off when traders are either liable for losses or not, and when their bonuses are either capped or not. Limited liability introduces a conflict of interest because it makes traders value the asset more than investors. To limit losses, investors should thus restrict liquidity provision to force traders to trade at a lower price. By contrast, bonus caps make traders value the asset less than investors. This should encourage liquidity provision and decrease prices. In contrast to these predictions, we find that under limited liability investors contribute to asset price bubbles by increasing liquidity provision and that caps fail to tame bubbles. Overall, giving investors skin in the game fosters financial stability.

Keywords: compensation, liquidity, experimental asset markets, bubbles
JEL Classifications: C90, C91, D03, G02, G12

*We gratefully acknowledge research support from the Research Center SAFE, funded by the State of Hessen initiative for research LOEWE.

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1 Introduction

The recent financial crisis highlighted the importance of compensation schemes on excessive risk taking in the financial industry, with consequences on asset price bubbles [Rajan, 2006, Bebchuk and Spamann, 2009]. To foster financial stability, a number of reforms have been discussed. Bonus caps have received the most attention and are now being implemented in the European Union. Another proposition suggests giving bankers more skin in the game, by making them liable for losses.

In an experimental setting in which investors can entrust their money to traders, we investigate how the compensation schemes of traders affect liquidity provision and asset prices. Traders can trade assets that yield dividends and thus potentially high returns. As a consequence, investors face a trade-off between either entrusting their money and enjoying potentially higher returns but with the risk of dealing with an untrustworthy trader or keeping their money and receiving a safe but low return.

We study how subjects solve this trade-off under different compensation schemes. First, we vary the extent to which traders are liable for losses. The introduction of limited liability creates a conflict of interest between the trader and the investor, because they value assets differently. Since traders have no downside risk, they highly value assets and are willing to buy them at a high price. By contrast, investors suffer all the losses while they share the gains. They are thus willing to pay less than traders. Since they anticipate that traders are ready to pay more, they can restrict liquidity provision to bring prices more in line with their valuation. Introducing limited liability should thus result in higher asset prices or lower liquidity provision if investors discipline traders.

We also study the effect of capping gains. A cap generates a different type of conflict of interest. It reduces the potential gains of the trader and increases those of the investor. Assets become less valuable to traders which can thus decrease the pressure on prices. At the same time, assets become more valuable to investors, who become willing to provide more liquidity. While caps can have the desired effect of reducing risk taking by traders, the higher liquidity could at the same time increase pressure on prices.

First, we find that liquidity provision is lowest when traders are liable for losses. This is unexpected given the absence of conflict of interest. Trust should be the highest. Liquidity provision is higher in the presence of a cap and/or limited liability. This implies that investors fail to discipline traders in the presence of limited liability. Also, the cap seems to improve liquidity provision by making the asset more valuable to investors.

Second, we find that asset prices are closer to the fundamental value when traders are liable for losses than under limited liability. This suggests that, as expected, traders take more risk when they are not liable for losses. Furthermore, the higher liquidity entrusted to traders increases asset prices. We indeed find that an inflow of liquidity is positively correlated with subsequent asset prices. The introduction of a cap does not have any major impact on asset prices. If anything, the cap seems to slightly increase prices in the presence of unlimited liability.

Overall, the results suggest that conflicts of interest in financial relationships can undermine financial stability. The absence of liability for traders fuels bubbles. While this could be contained if investors limited liquidity provision, we find that the opposite happens. Investors provide more liquidity when traders are not liable for losses. This might imply that investors want to ride the bubble as well.

Finally, our work also speaks to recent policy discussions on how to limit risk taking in the financial industry. Bonus caps do not seem to have an impact on bubbles. If anything, they foster bubbles by increasing liquidity provision. Making traders liable for losses thus seems more effective in reducing asset price bubbles. While these results stand in stark contrast to the reforms currently been implemented that mostly focus on capping bonuses, the standard concerns of external validity apply in such a highly stylized environment.

Our experimental design extends the standard asset market experiments [Smith et al., 1988] by endogenizing liquidity provision. The unlimited liability treatment is the closest to this literature, the only difference being the presence of investors who decide over liquidity provision. While the standard asset market experiment displays bubbles, prices under unlimited liability are close to the fundamental value in our setup. This suggests that the introduction of investors is not innocuous. A possible reason is that traders behave more responsibly to prevent a run from the investor.

Our work is related to the literature that studies the consequences of compensation schemes in asset market experiments [James and Isaac, 2000, Isaac and James, 2003, Robin et al., 2012, Holmen et al., 2014, Kleinlercher et al., 2014]. James and Isaac [2000] and Isaac and James [2003] investigate the amplifying effects of tournament incentives on asset prices. Robin et al. [2012] compare the frequency at which tournament-based bonus payments are paid to traders in terms of effects on asset prices. They find that markets with long-term bonus contracts lead to less severe price distortions than markets with short-term contracts if those markets have a larger share of male traders. Holmen et al. [2014] report that option-like incentive schemes induce higher asset prices than linear incentive schemes. Kleinlercher et al. [2014] compare different incentive schemes, such as bonuses and caps, and explore their effects on trading behavior and asset prices. They conclude that differences in incentive schemes, and bonus payments in particular, have a substantial impact on asset prices.

We extend these results to a setting in which liquidity provision is a choice variable of investors whose objectives might differ from those of traders. Our theoretical framework shows that the behavior of investors can have important effects on asset prices. Depending on the compensation schemes of traders, investors have an incentive to discipline traders by reducing liquidity provision. Indeed, we observe that lower asset prices under unlimited liability are partially generated by changes in trader behavior and further mitigated by lower liquidity provision. In contrast to conventional wisdom, we do not find that caps are effective at reducing bubbles. This is because caps have an ambiguous impact on asset prices once liquidity provision is endogenous.

The next section provides a theoretical framework and develops testable predictions. Section 3 introduces the experimental design. Section 4 presents the results and section 5 concludes.

2 Theoretical Framework

We consider an environment with a continuum of investors and traders each of mass 1. Each investor is paired to a trader for three periods. Investors are initially endowed with wealth W and decide to provide liquidity $L \leq W$ to their trader in period 1. Traders use this liquidity to trade assets in a market in period 2. The single asset (perfectly divisible) pays dividends D with probability γ and 0 otherwise in period 3. We assume that $W > D$ to ensure that wealth is sufficient to buy the asset at the highest conceivable price D. The maximum traders can buy is determined by their liquidity constraint

$$pN \leq L, \tag{1}$$

where p refers to the price of the asset and N to the quantity of assets bought.

We solve the game by backward induction. First, we analyze the behavior of the trader in period 2. The trader decides how many assets he wants to buy and at what price given his liquidity constraint. Then, we solve for the amount of liquidity that the investor is willing to provide in period 1. We look at four compensation schemes of the trader. Under unlimited liability (UL), traders and investors share both losses and gains. Under limited liability (LL), traders and investors also share the gains but traders are not liable for losses. Finally, we introduce a cap $C > 0$ that limits the possible gains of the trader both with unlimited liability (ULC) and with limited liability (LLC).

We first look at the UL case. A proportion α of the period-3 gains or losses goes to the trader and the rest goes to the investor. We first analyze the decision of the trader in period 2. With probability γ, the asset pays a dividend D and the trader receives $\alpha(D-p)N$. With probability $1-\gamma$, the asset does not pay a dividend and the trader loses $-\alpha pN$. The utility of the trader is:

$$U_{UL}^{T} = \alpha N\{\gamma(D-p) - (1-\gamma)p\} = \alpha N(\gamma D - p).$$

The trader chooses the number of assets N that maximizes his expected profit for a given asset price p under the liquidity constraint (1). As long as the budget constraint is slack, the trader is willing to pay up to $p = \gamma D$ for the asset. When the budget constraint is binding, the maximum quantity of assets the trader can buy is $N = L/p$.

In period 1, the investor anticipates the actions of the trader and maximizes his utility:

$$U_{UL}^{I} = (1-\alpha)N\{\gamma(D-p) - (1-\gamma)p\} = (1-\alpha)N(\gamma D - p).$$

The interests of the investor are perfectly aligned with those of the trader since the investor would also be willing to pay up to $p = \gamma D$. Thus, the investor is willing to give at least $L \geq \gamma D$ to the trader. Since $W > D$, the trader can buy the single asset at his maximum price γD. The equilibrium with UL is thus $p^*_{UL} = \gamma D$ and $N^*_{UL} = 1$.

We now look at the LL case. With probability γ, the asset pays a dividend D, yielding a profit $\alpha(D - p)N$ to the trader. With probability $1 - \gamma$, the asset yields no dividends generating a total loss $-pN$. Since the trader has limited liability, his payoff is 0 and the investor suffers the full loss. The utility function of the trader becomes:

$$U^T_{LL} = \gamma\alpha(D - p)N.$$

As long as the budget constraint is slack, the trader is willing to pay up to $p = D$ for the asset. When the budget constraint is binding, the maximum quantity of assets the trader can buy is $N = L/p$. Compared to UL, the trader is willing to pay a higher price for the asset. The reason, is that he does not face any downside risk and the asset brings him a higher expected value.

The utility function of the investor becomes:

$$U^I_{LL} = \gamma(1 - \alpha)(D - p)N - (1 - \gamma)pN = (1 - \alpha)\gamma DN - [(1 - \alpha)\gamma + 1 - \gamma]pN.$$

The investor is only willing to pay up to $p = \beta D$, where $\beta = \frac{\gamma(1-\alpha)}{1-\alpha\gamma} < \gamma$. The investor is willing to pay a lower price than in UL because he now faces the full downside risk, which decreases his expected value from the asset. The interests of traders and investors are no longer aligned since the trader is willing to pay a higher price than the investor. If $p = D$, every unit that the trader buys imposes expected losses on the investor. He can discipline the trader, though, by restricting liquidity to ensure $p = \beta D$. Since there is only one unit to buy, this equilibrium can be achieved by setting $L = \beta D$.

The equilibrium with LL is given by $p^*_{LL} = \beta D$ and $N^*_{LL} = 1$. Compared to UL, the equilibrium price is lower to reflect the fact that the investor suffers all the losses and thus derives a lower expected return from the asset. This lower price is achieved through a lower liquidity provision to restrain the buying power of the trader.

We now look at the LLC case. The utility remains the same as in LL as long as the cap is not binding, that is, if $C > \alpha(D - p)N$. When the cap is binding, the trader receives a flat payment equal to C. His utility becomes:

$$U^T_{LLC} = \gamma \min\{\alpha(D - p)N, C\}$$

The trader is willing to pay up to $p = D$ as in LL as long as neither the cap nor the liquidity constraint is binding. If the cap is binding, the trader receives a constant payment C and his utility does not depend on the quantity of assets N. The trader is thus indifferent between any combination of price and quantity that makes the cap bind. Figure 1 represents the demand for assets and the cap constraint on an N-p plane. The cap constraint is binding when $p = D - \frac{C}{\alpha N}$. All the N-p combinations on the right of this curve are associated with a binding cap constraint and leave the trader indifferent. They are represented by the thick line.

The utility of the investor is the same as in LL when the cap is not binding. When the cap is binding, he receives all the profits generated by the trader minus the cap. The utility function of the investor is:

$$U^I_{LLC} = \gamma \max\{(1-\alpha)(D-p)N, (D-p)N - C\} - (1-\gamma)pN.$$

As in LL, the incentives of both the trader and the investor are misaligned when the cap is not binding. The investor is still willing to pay up to $p = \beta D$ while the trader is willing to pay up to $p = D$. When the cap is binding, however, the investor is willing to pay a higher price, up to $p = \gamma D$. By contrast, the trader is indifferent between any price.

As long as the cap is not binding, the investor can restrict the liquidity to the trader to make sure he does not overpay for the asset as in the LL case. In the figure, this makes the demand for assets curve shift to the left. Let us first consider a case in which the cap is not too large such that the cap constraint curve first intersects with the demand for assets curve. This is the case represented in the figure. In this case, the equilibrium will be characterized by a binding cap constraint. The equilibrium could be anywhere on the thick line. The investor restricts the liquidity to the trader such that $p^*_{LLC} = \gamma D$ and $N^*_{LLC} \in \{\frac{C}{\alpha(1-\gamma)D}, 1\}$. Compared to LL, the price is higher to reflect the greater upside for the investor in case of a binding cap. Also, the market can have excess supply. Although liquidity provision is restricted, it could be higher than in LL if excess supply is limited. If the cap is sufficiently large, then we are back to the LL case. In the figure, the cap constraint would shift to the right and it would first intersect with the supply of assets.

Finally, we look at the ULC case. The utility remains the same as in UL as long as the cap is not binding. When the cap is binding, the trader receives a flat payment equal to C. His expected utility becomes:

$$U^T_{ULC} = \gamma \min\{\alpha(D-p)N, C\} - (1-\gamma)\alpha pN$$

The trader is willing to pay up to $p = \gamma D$ as in UL as long as neither the cap nor the liquidity constraint is binding. If the cap is binding, the utility function of traders depends negatively on the number of assets. They are thus willing to buy 0 assets at any price. This is in contrast to LLC where traders become indifferent once the cap binds.

The utility of the investor is the same as in UL when the cap is not binding. When the cap is binding, he receives all the profits generated by the trader minus the cap. The utility function of the investor is thus:

$$U^I_{ULC} = \gamma \max\{(1-\alpha)(D-p)N, (D-p)N - C\} - (1-\gamma)(1-\alpha)pN.$$

As in UL, the incentives of both the trader and the investor are perfectly aligned as long as the cap is not binding since the investor is still willing to pay up to $p = \gamma D$. When the cap is binding, however, the investor is willing to pay a higher price, up to $p = \delta D$, where $\delta = \frac{\gamma}{\gamma+(1-\gamma)(1-\alpha)} > \gamma$. By contrast, the trader is willing to pay $p = 0$ when the cap binds. To summarize, interests are aligned when the cap is not binding and the trader refuses to trade when the cap is binding, generating neither a loss nor a gain to the investor. The investor is thus willing to provide any amount of liquidity to the trader.

Figure 2 represents the demand for assets and the cap constraint on an N-p plane. The cap constraint is binding when $p = D - \frac{C}{\alpha N}$. All the N-p combinations on the right of this curve are associated with a binding cap constraint in which the trader refuses to trade. An equilibrium, thus, cannot lie in this region. Let us first consider a case in which the cap is not too large such that the cap constraint curve first intersects with the flat part of the demand for assets curve. This is the case represented in the figure. In this case, the equilibrium is given by $p^*_{ULC} = \gamma D$ and $N^*_{ULC} = \frac{C}{\alpha(1-\gamma)D}$. While the price is the same as in UL, the market has excess supply. If the cap is sufficiently large, then we are back to the UL case and the market clears. In the figure, the cap constraint would shift to the right and it would first intersect with the supply of assets. In UL, incentives are perfectly aligned and there is no excessive risk taking from the perspective of the investor. The introduction of a cap is unnecessary and only leads to a market failure.

To summarize, the main consequences of making traders liable for losses are:

1. Traders have a lower willingness to pay for the asset. If they are not liquidity constrained, asset prices should thus be lower.

2. The interests of investors and traders become better aligned. This increases liquidity provision.

The main consequences of capping bonuses are:

1. Traders have a lower willingness to trade for the asset when the cap binds. As a result, the market may have excess supply.

2. Investors value the asset more since they get more upside risk. As a result, they increase liquidity provision.

[Figure 1 about here.]

[Figure 2 about here.]

3 Experimental Design

We design a laboratory experiment in which investors can entrust money to traders who trade in an asset market. The setup allows to compare how different compensations schemes of traders affect liquidity provision and asset prices.

General Setup. Subjects were randomly assigned the roles of traders and investors. In a typical session 12 subjects participated, with half of them being assigned the roles of traders and the other half the roles of investors. Traders and investors were randomly and anonymously matched at the beginning of a session and remained paired over the course of the entire experiment, which lasted 15 periods. Payoffs were denoted in experimental currency units (Taler), where 200 Taler = 1 Euro. Investors were initially endowed with 2000 Taler. Traders started without cash or assets and received a fixed wage of 2000 Taler at the end.

Each asset was known to pay dividends of either 0, 8, 28 or 60 Taler, with equal probability, at the end of each of the 15 trading periods. Hence the asset had a fundamental value (FV) –the sum of the expected stream of dividends per period– of 360 Taler in the first period. The FV then decreased by 24 Taler every period. The maximum fundamental value (maxFV) is the highest possible sum of the expected stream of dividends in every period. It was equal to 900 in the first period and decreased by 60 Taler in every period.

In the first period, investors decided how much liquidity to provide to their trader. After receiving this initial transfer, traders then participated in an initial public offering (IPO) during which the initial allocation of shares was determined. Traders privately and simultaneously stated their desired number of assets and the maximum price they were willing to pay. These offers could not exceed the amount of money provided by investors. After aggregating all individual demands, the resulting demand function was intersected with a constant supply of 12 assets to determine the equilibrium asset price.

The Asset Market. After the IPO, traders participated in every period in standard open book multi-unit double auction markets. Each trading period lasted for 90 seconds. Both traders and investors could observe all the posted bids and asks and a chart with realized transaction prices. Investors could not trade themselves, could not communicate with their trader and did not know the bids and asks of their own trader. They only observed their portfolio (units and cash holdings) and its changes on a continuous basis. The trading screens observed by participants are provided in the instructions, which can be accessed in the online Appendix.[1]

At the end of each period, investors and traders learned about the dividend realization and were provided the hypothetical market value (MV) of their portfolio, which equaled their cash holdings (Cash) plus the stocks they held (S) multiplied by the period's average transaction price (p_t). Hence $MV_t = Cash_t + S_t p_t$. The market value of the portfolio thus provided an estimate

[1] They can be accessed via http://www.austrianeconomist.com/instructionscompensation.pdf.

for subjects as of how much money they could have obtained, hypothetically, if they had sold all their stocks at average market prices in the period. It was made clear to subjects that this market value is indeed a hypothetical value and does not correspond to actual cash holdings. A table also summarized the history of average prices, dividend realizations, stock holdings, cash holdings, and market value of the portfolio.

Then, investors decided each period whether they wanted to provide additional liquidity to their trader or instead withdraw money. Additional liquidity provision was transferred immediately and could thus be used in the same period for trading. Investors could withdraw up to the market value of their portfolio. Since this amount was not necessarily readily available, withdrawal was only carried out at the end of the period to give liquidity-constrained traders the time to liquidate their asset holdings. In case the trader was unable or unwilling to satisfy the withdrawal request, the investor received the entire current cash holdings of his trader.

Figure 3 summarizes the sequence of stages in a trading period.

[Figure 3 about here.]

Compensation. At the end of the experiment, investors and traders received a compensation that depended on their overall performance. We implemented four compensation schemes:

Unlimited liability (UL). In case of gains, that is, if the final cash holdings for a trader-investor pair exceeded 2000 Taler (the initial endowment of investors), the investor first received his 2000 Taler and half of the gains accrued over the course of the 15 periods. The trader received his fixed wage of 2000 Taler from the experimenter and also received the other half of the gains. In case of losses, that is, if the final cash holdings fell below 2000 Taler, the investor received all the remaining cash and half of the losses were deducted from the fixed wage of the trader and transferred to the investor. *Example*: If the final cash holdings were 3000 Taler, the investor and the trader each received 2500 Taler. If, on the other hand, the final cash holdings were 1000,the investor and the trader each received 1500 Taler.

Limited liability (LL). Only investors are now liable for losses. In case of gains the same procedures were employed as in UL, that is, gains were equally shared between traders and investors. In case of losses, the investor received all the final cash holdings. The trader only received his fixed wage. *Example*: If the final cash holdings were 3000 Taler, the investor and the trader each received 2500 Taler. If, on the other hand, the final cash holdings were 1000 the investor received 1000 Taler and the trader received his fixed wage, 2000 Taler.

Unlimited liability and cap (ULC). In case of gains lower than 600 Taler (30% of the initial endowment), the same procedures were employed as in UL, that is, gains were equally shared between traders and investors. If the gains exceeded 600, the trader received 300 Taler out of the total gains on top of his fixed wage and the investor received the remaining gains. Put differently, the bonus of traders was capped at 300. In case of losses, the same procedures were employed as in UL, that is, losses were shared equally. *Example*: If the final cash holdings were 3000 Taler, the investor received 2700 Taler and the trader received 2300 Taler. If, on the other hand, the final cash holdings were 1000 Taler, the investor and the trader each received 1500 Taler.

Limited liability and cap (LLC). In case of gains, the same procedures were employed as in ULC. In case of losses, the same procedures were employed as in LL. *Example*: If the final cash holdings were 3000 Taler, the investor received 2700 Taler and the trader received 2300 Taler. If, on the other hand, the final cash holdings were 1000 the investor received 1000 Taler and the trader received his fixed wage, 2000 Taler.

Elicitation of preferences and demographic information. We elicited the risk and social preferences of participants after market trading was concluded, but before investors and traders learned about their earnings from the market stage. Since dividends were random, risk preferences could affect the investment and trading behavior, as well as asset prices. Furthermore, our game has similar features to a trust game. Social preferences could thus affect how much liquidity investors are willing to provide and the extent to which traders behave in the interest of investors.

Risk preferences. We measured risk preferences using the bomb risk elicitation task (BRET) developed by Crosetto and Filippin [2013]. Subjects had to choose how many boxes to collect from a pile of 36 boxes. For each collected box the subjects earned a monetary payment of 10 Taler. One randomly chosen box, for each subject, contained a bomb. The participant didn't know in which box the bomb was located, and if he collected it, he earned nothing. Crosetto and Filippin [2013] show that a subjects' decision when to stop collecting is a good proxy for subjects' risk preferences. Another reason to choose this task is that it is easy to explain to subjects.

Social Value Orientation. To measure social preferences, we conducted a version of the social value orientation task (SVOT, also known as the ring test) developed by Murphy et al. [2011]. Subjects had to choose an allocation of money between themselves and a randomly allocated partner. The trade-offs between these two payoffs varied in a series of six tasks, one of which was randomly selected for payment. The resulting choices allow to compute the "SVO-angle", a measure for the social attitude of the participant. The test allows to discriminate between altruistic-, pro-social-, individualistic- and competitive types.

Procedures. All sessions were conducted at the Frankfurt Laboratory of Experimental Economics at the Goethe University Frankfurt in the winter of 2014. Subjects were recruited using

ORSEE [Greiner, 2003]. For each compensation scheme, we ran 5 sessions with 10-12 participants each (sixteen sessions with 12 subjects and four with 10 subjects). Each session lasted approximately 110 minutes. Average earnings were 20.25 euros, including a 5 Euro show-up fee.

After the experimenter read the instructions out loud at the beginning of the experiment, subjects answered a number of control questions to test understanding and played two practice rounds to familiarize themselves with the trading environment. Subjects also participated in one practice IPO-round to familiarize them with the call market structure. During the practice rounds participants did not know which role they would be assigned during the trading phase.

Instructions for the elicitation of risk and social preferences were provided on screen. Programming was done in z-Tree [Fischbacher, 2007]. At the end of the experiment, subjects were called forward one by one and paid privately.

4 Results

We analyze the determinants of, first, the aggregate and individual liquidity provision and, second, of prices and individual trading behavior.

4.1 Liquidity Provision

The distributions of initial liquidity provision are displayed in Figure 4. On average investors provided 1233.5 Taler to their traders in the first period, which corresponds to about 62% of their initial cash endowments. Initial average liquidity provision for each compensation scheme are: 1298.3 (LL), 1262.1 (LLC), 1076.1 (UL), 1289.7 (ULC) and are not significantly different (Kruskall-Wallis test p-value: 0.26).

[Figure 4 about here.]

Investors can provide or withdraw liquidity from their corresponding trader in all the subsequent periods. Figures 5 and 6 depict the evolution of the average stock of liquidity for each session and compensation scheme. Investors provide less liquidity in UL and LLC than in ULC and LL. We also observe that aggregate liquidity is rather stable in the first half of the experiment and and only starts decreasing towards the end.

[Figure 5 about here.]

We further investigate the determinants of average liquidity at the session level using OLS regressions. We control for the compensation scheme dummies, gender, average risk-seeking and average SVO. We also include past dividend realizations to the regressions to control for exogenous inflow of liquidity and past price changes to measure the sensitivity of liquidity provision with respect to changes in the portfolio's market value. The results are shown in Table 1.

The regressions confirm that participants provide significantly less liquidity in UL and LLC than in LL at a 5% significance level. The differences amount, on average, to 72 (UL) and 38 (LLC) Taler per period. We also observe that lagged price changes – a proxy for the overall change in portfolio's value – have a significant and positive effect on liquidity at a 5% level. Average SVO is significant, although only at a 10% level, and negative, suggesting that more liquidity provision correlates with more selfish behavior. Risk seeking has the expected positive sign –more risk seeking investors provide more liquidity– but is not significant.

Since conflicts of interest are largest with limited liability, we expected investors to provide less liquidity than with unlimited liability. We actually observe the opposite. This suggests that investors do not try to constrain or discipline their trader as predicted by the model. The positive coefficient on past price changes rather suggests that investors provide more liquidity as the market value of their portfolios increases, which is more consistent with a desire to ride the bubble along with the trader.

[Table 1 about here.]

4.2 Trading

The IPO. We depict the distribution of IPO prices and initial stock distributions in Figures 7a and 7b. First, the average IPO prices do not differ significantly across treatments.[2] While there are no significant differences in IPO prices across treatments, prices are significantly lower than the asset's FV at the 10% level in all treatments but LL.[3] In terms of initial stock distributions we observe that in all but one sessions all 12 units were distributed amongst traders. Only 11 assets were allocated in the remaining session. We observe slight differences in the initial distributions of stocks, which suggest that ownership is marginally more concentrated in LL compared to the other treatments. However, a Kruskall-Wallis test suggests that these differences are not statistically significant (p-value: 0.89).

[Figure 6 about here.]

Asset prices. We compute the volume-weighted average prices per session and treatment. The resulting prices for each treatment, together with the asset's FV and the maxFV are shown in Figures 8a - 9b.

We observe that under limited liability (LL and LLC) prices are higher than with unlimited liability (UL and ULC). Prices essentially converge up to the maxFV and sometimes crash back to the FV towards the end of the experiment. In six out of the ten limited liability sessions prices

[2] Pairwise Mann-Whitney tests cannot reject the null hypothesis of equal median IPO prices at any reasonable significance levels. The pairwise p-values are as follows: LL vs LLC: 0.53, LL vs UL: 0.20, LL vs ULC: 0.40, LLC vs UL: 0.38, LLC vs ULC: 0.67, UL vs ULC: 0.91. A similar picture of no significant differences arises if we focus on posted bids, rather than equilibrium prices.

[3] Wilcoxon signed rank tests generate the following p-values: 0.06 (LLC), 0.04 (UL), 0.08 (ULC)), 0.23 (LL).

remained close to or exceeded the highest possible dividend realization even in the last period. Under unlimited liability, prices are less dispersed and more closely track the FV. Caps do not seem to have a substantial effect on prices.

[Figure 7 about here.]

A more refined analysis using different bubble measures confirms these initial observations. Bubbles are larger with limited liability than with unlimited liability. Caps do not mitigate bubbles. We use standard bubble measures to compare treatments, such as the relative absolute deviation (RAD), to measure mis-pricing, and the relative deviation (RD), to measure over-valuation (Stöckl et al. [2010]). We further use the geometric price disturbance (GPD), suggested in Powell [2014], to measure mis-pricing, weighing each transaction price individually. We then compute the average GPD over all 15 periods for a given session. Lastly, we also compute the turnover per session to check whether we observe more or less intense trading in certain treatments. The resulting bubble measures, for each session and treatment, are displayed in Table 2. We then run pairwise Mann-Whitney tests to compare our treatments. The resulting p-values are displayed in Table 3. The binary comparisons suggest significant differences between LL and UL as well as LL and ULC at a 5% level.[4]

[Table 2 about here.]

[Table 3 about here.]

Next, we run OLS regressions, using the corresponding bubble measures as dependent variables, to further control for session-specific characteristics. The results are shown in Tables 4 and 5. The coefficients of the treatment dummies confirm the initial results. Furthermore, the bubbles do not depend on the average risk aversion of traders or investors or their average SVO. We also control for the concentration of the allocation of assets after the IPO, measured as the standard deviation of initial stock holdings per session, to test whether the differences in initial stock distributions from the IPO have an effect on subsequent prices. This measure has no effect on bubbles. The fraction of males increases bubbles across treatments, consistent with Eckel and Füllbrunn [2013].

[Table 4 about here.]

[Table 5 about here.]

[4] We also run another series of Mann-Whitney tests, pooling observations from the unlimited and limited liability treatments, independently of the cap. The differences in terms of RAD, RD and GPD are significant at a 1% level. Next, we pool observations from the cap and no-cap treatments, independently of the liability structure, and run a last series of Mann-Whitney tests. The differences in bubble measures are not significant at any reasonable significance level. Hence, prices differ along the liability but not along the cap dimension. Finally, we observe no differences in turnover in any of our pairwise comparisons, suggesting that our treatment effects on prices are not driven by differences in the quantities traded.

According to our model, such high prices can only be observed with limited liability if investors fail to constrain traders by limiting liquidity provision. This is possible since the previous section shows that liquidity provision is higher under limited liability. Since traders only hold upside risk under limited liability and since they are provided with plenty of liquidity, they could push up prices to the highest possible dividend realization. We further explore this hypothesis by investigating the determinants of prices. We run OLS regressions using the change in prices as a dependent variable. Standard errors are clustered at the session level. The results are shown in Table 6.

An inflow of liquidity has a significant and positive effect on prices. This suggests that investors contributed to the formation of bubbles by increasing liquidity provision in LL. This finding is also consistent with Caginalp et al. [1998] and various follow up studies, who show that cash-to-asset ratios have positive effects on asset price bubbles.

We also find that requests from investors to withdraw liquidity at the beginning of a period is associated with lower subsequent prices. Traders might indeed induce a drop in prices if they are cash-constrained and have to liquidate their positions to satisfy the demand of their investors. We also observe that exogenous liquidity provision, due to past positive dividend realizations, also contribute to an increase in prices.

[Table 6 about here.]

Traders' behavior. The higher prices observed under limited liability relative to UL can be explained by the higher liquidity provision in this treatment. However, this does not seem to be the whole story. In particular, there is no significant difference in aggregate liquidity between ULC and LL. Bubbles, by contrast, are significantly more pronounced in LL than in ULC. Similarly, there are significant differences in liquidity provision in LLC and LL but there are no significant differences in prices across those treatments. We now investigate whether the behavior of traders can explain these additional differences.

We now explore whether compensation schemes affect the behavior of traders. We use two variables based on posted bids and asks to measure the behavior of traders. We define a measure of carelessness and a measure of conservatism along the lines of Großer and Reuben [2013]. Carelessness is defined as the average between the separate volatilities of bids and asks per trader and period. An increase in this measure indicates a larger noise amplitude of bids and asks. Conservatism is defined as the fraction of bids below- and asks above the FV, out of the total number of bids and asks per trader and by period. A value of 1 for conservatism indicates that the trader only wants to buy the asset at prices below the FV and sell it at prices above the FV. We expect an increase in average carelessness and a decrease in average conservatism to increase asset prices.

We run OLS regressions using carelessness and conservatism as dependent variables. In addition to treatment dummies, we control for the risk aversion and SVO of the trader, gender, as well as session dummies. To control for learning we include a trend variable in our regression. To control for the initial distribution of stocks, we include the number of units each trader held after the IPO. The results of several nested models are shown in Tables 7 and 8.

Traders are more careless with limited liability than without. This effect thus reinforces the effects of liquidity provision by making bubbles larger with limited liability than without. It can also potentially explain why bubbles are larger in LL than in ULC, something that liquidity provision failed to achieve.

Traders are not significantly more conservative in ULC than in LL. This suggests that conservatism cannot explain why bubbles are different in these two treatments. There are, however, other treatment differences in conservatism. It is larger in UL than in LL, which could contribute to the smaller bubbles observed in UL. It is also lower in LLC than in LL. Since the coefficient is also lower in ULC than in UL, this suggests that the presence of a cap makes traders less conservative. The earlier analysis, however, suggests that this difference is not strong enough to translate into significant price differences. The observation that caps make traders less conservative might also explain why the lower liquidity provision in LLC relative to LL does not result in lower price levels.

[Table 7 about here.]

[Table 8 about here.]

5 Conclusion

In a setting in which investors can entrust their money to traders, we investigate how the compensation schemes of traders affect liquidity provision and asset prices. When the interests of investors and traders are perfectly aligned, that is, when they share both losses and gains, we expect that investors should fully trust their trader and provide them with all the necessary liquidity. We also expect that rational traders would trade at prices close to the fundamental value of the asset.

Against this benchmark, the introduction of limited liability generates a conflict of interest because the asset becomes more valuable to the trader than to the investor. Left on their own, even rational traders would be willing to pay a price higher than the fundamental value. Investors might thus want to restrict liquidity provision to move prices closer to their own valuation. The introduction of a cap also introduces a conflict of interest. The asset now becomes more valuable to the investor and less to the trader. As a result, liquidity provision would remain high but prices might decrease because of the lower valuation of traders.

We then tested these predictions in a laboratory experiment. We observe that investors did not discipline their trader by withdrawing funds when bubbles emerged. The opposite actually occurred. Following price increases, investors increased liquidity provision thus further fueling the bubble. Furthermore, caps failed to tame asset price bubbles. The results stand in stark contrast to recently proposed policy measures that mostly focus on bonus caps. Our work instead emphasizes the importance of making traders liable for losses to foster financial stability.

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Tables

	(1) Avg. Liqu.	(2) Avg. Liqu.	(3) Avg. Liqu.	(4) Avg. Liqu.	(5) Avg. Liqu.	(6) Avg. Liqu.
LLC	-16.44	-34.36*	-36.14*	-35.86**	-36.44**	-38.32**
	(14.16)	(18.98)	(18.02)	(16.62)	(15.28)	(17.71)
UL	-28.86	-51.97	-52.47	-49.86	-63.83*	-72.19**
	(17.88)	(32.09)	(31.36)	(30.69)	(32.13)	(30.69)
ULC	-10.80	-25.76	-28.16*	-17.70	-22.95	-29.25
	(13.60)	(16.67)	(14.65)	(13.57)	(14.00)	(17.11)
Δp_{t-1}		0.305**	0.326**	0.327**	0.316**	0.319**
		(0.107)	(0.109)	(0.109)	(0.110)	(0.112)
$Dividend_{t-1}$			-0.446	-0.412	-0.334	-0.322
			(0.476)	(0.496)	(0.491)	(0.486)
GenderInvestor				-39.28	-25.02	-49.48
				(39.13)	(45.51)	(51.93)
SVOInvestor					-2.420	-3.006*
					(1.404)	(1.543)
RiskSeekingInvestor						5.260
						(3.357)
N	300	199	199	199	199	199
R^2	0.001	0.038	0.044	0.045	0.052	0.059

Heteroscedasticity corrected standard errors in parentheses,
clustered on a session level * $p < 0.10$, ** $p < 0.05$.

Table 1: **Aggregate liquidity regressions.** LLC, UL and ULC correspond to treatment specific dummy variables. $Dividend_{t-1}$ is the lagged dividend realization. Δp^s_{t-1} is the lagged first difference of session specific prices. GenderInvestor measures the fraction of male traders/investors per session. RiskSeekingInvestor measures the average risk-seekingness of investors (BRET-choice). SVOInvestor measures the average social value orientation of investors.

Measure: RAD, $RAD = \frac{1}{15}\sum_t \frac{|P_t - FV_t|}{mean(FV_t)}$

Treatment → Session ↓	LL	LLC	UL	ULC
Session 1	0.73	0.21	0.12	0.06
Session 2	1.14	0.74	0.31	0.62
Session 3	1.28	1.25	0.42	0.76
Session 4	1.32	1.40	0.69	0.85
Session 5	1.47	1.46	0.84	1.01
Average	1.19	1.01	0.48	0.66

Measure: RD, $RD = \frac{1}{15}\sum_t \frac{P_t - FV_t}{mean(FV_t)}$

Treatment → Session ↓	LL	LLC	UL	ULC
Session 1	0.72	0.19	0.12	0.06
Session 2	1.14	0.73	0.31	0.35
Session 3	1.23	1.18	0.34	0.75
Session 4	1.30	1.40	0.68	0.84
Session 5	1.47	1.42	0.82	1.01
Average	1.17	0.98	0.45	0.60

Measure: GPD, $GPD = \frac{1}{15}\sum_t GPD_t$, with $GPD_t = \prod_i (\frac{p^i_{t,s}}{FV_t})^{\frac{\omega_i}{\sum_i \omega}}$

Treatment → Session ↓	LL	LLC	UL	ULC
Session 1	1.40	1.08	0.94	1.04
Session 2	2.07	1.60	1.10	1.34
Session 3	2.08	2.10	1.24	1.51
Session 4	2.15	2.25	1.41	1.73
Session 5	2.61	2.35	1.68	1.82
Average	2.06	1.88	1.27	1.49

Measure: Turnover, $Turnover = \frac{1}{TSU}\sum_t Q_t$

Treatment → Session ↓	LL	LLC	UL	ULC
Session 1	1.22	2.15	1.67	1.62
Session 2	1.77	2.31	2.30	1.91
Session 3	3.07	2.42	2.42	2.67
Session 4	3.79	3.08	3.39	3.13
Session 5	4.33	3.14	3.62	3.17
Average	2.83	2.60	2.66	2.48

Table 2: **Bubble measures.** P_t is the corresponding session price in period t, Q_t is the overall quantity traded in period t, TSU is the total sum of units, $p^i_{t,s}$ is the i^{th} transaction price in period t and session s, and ω_i is the quantity of stocks traded at the i^{th} transaction price.

		RAD	RD	GPD	Turnover
LL vs. UL N=10	p-value	**0.016**	**0.016**	**0.028**	0.754
LL vs. LLC N=10	p-value	0.754	0.754	0.917	0.917
LL vs. ULC N=10	p-value	**0.047**	**0.047**	**0.047**	0.754
UL vs. LLC N=10	p-value	0.117	0.117	0.117	0.834
UL vs. ULC N=10	p-value	0.347	0.347	0.251	0.917
LLC vs. ULC N=10	p-value	0.251	0.251	0.175	0.602
(LLC & LL) vs. (ULC & UL) N=20	p-value	**0.010**	**0.010**	**0.010**	0.850
(LL & UL) vs. (LLC & ULC) N=20	p-value	0.940	0.940	0.821	0.678

Table 3: **Mann-Whitney tests**. The Table shows p-values for pairwise Mann-Whitney tests to compare the bubble measures from Table 2. Bold entries indicate significance at a 5% level.

	(1) RAD	(2) RAD	(3) RAD	(4) RAD	(5) RD	(6) RD	(7) RD	(8) RD
LLC	-0.175	-0.131	-0.152	-0.217	-0.188	-0.145	-0.168	-0.236
	(0.268)	(0.247)	(0.232)	(0.281)	(0.265)	(0.243)	(0.234)	(0.287)
UL	-0.713**	-0.612**	-0.645**	-0.511**	-0.719**	-0.617**	-0.644**	-0.509**
	(0.181)	(0.193)	(0.185)	(0.215)	(0.179)	(0.193)	(0.203)	(0.224)
ULC	-0.529**	-0.497**	-0.732**	-0.759**	-0.568**	-0.535**	-0.754**	-0.799**
	(0.206)	(0.212)	(0.180)	(0.213)	(0.215)	(0.222)	(0.196)	(0.217)
SD-Initial		0.560	0.357	0.477		0.561	0.350	0.581
		(0.399)	(0.395)	(0.642)		(0.392)	(0.403)	(0.637)
GenderTrader			-0.348	-0.655			-0.372	-0.653
			(0.366)	(0.763)			(0.408)	(0.749)
GenderInvestor8			1.015**	0.926*			0.970**	0.801
			(0.332)	(0.484)			(0.328)	(0.485)
SVOTrader				-0.0209				-0.0238
				(0.0266)				(0.0258)
SVOInvestor				0.0168				0.0165
				(0.0102)				(0.0108)
RiskSeekingTrader				0.0243				0.0240
				(0.0398)				(0.0407)
RiskSeekingInvestor				0.0331				0.0496
				(0.0416)				(0.0377)
N	20	20	20	20	20	20	20	20
R^2	0.408	0.465	0.624	0.688	0.414	0.470	0.617	0.697

Heteroscedasticity corrected standard errors in parentheses,
clustered on a session level * $p < 0.10$, ** $p < 0.05$

Table 4: **Bubble measure regressions.** In columns (1) - (4) we use RAD as dependent variable. Columns (5) - (8) use RD as dependent variable. LLC, UL and ULC correspond to treatment specific dummy variables. SD-Initial is the session-specific standard deviation of initial endowments arising from the IPO. GenderX measures the fraction of male traders/investors per session. RiskSeekingX measures the average risk-seekingness of traders/investors (BRET-choice). SVOX measures the average social value orientation of traders/investors.

	(1) GPD	(2) GPD	(3) GPD	(4) GPD	(5) Turnover	(6) Turnover	(7) Turnover	(8) Turnover
LLC	-0.185	-0.162	-0.174	-0.0798	-0.216	-0.192	-0.263	0.303
	(0.306)	(0.308)	(0.303)	(0.381)	(0.624)	(0.621)	(0.675)	(0.631)
UL	-0.788**	-0.735**	-0.764**	-0.784**	-0.159	-0.103	-0.00200	0.229
	(0.232)	(0.276)	(0.321)	(0.310)	(0.691)	(0.704)	(0.686)	(0.881)
ULC	-0.571**	-0.554**	-0.734**	-0.792*	-0.337	-0.319	-0.115	-0.174
	(0.239)	(0.255)	(0.332)	(0.398)	(0.669)	(0.682)	(0.802)	(0.832)
SD-Initial		0.289	0.157	0.961		0.308	-0.0290	3.462
		(0.418)	(0.453)	(0.936)		(0.740)	(0.866)	(2.001)
GenderTrader			-0.217	0.569			-0.787	3.164
			(0.496)	(1.204)			(0.861)	(2.179)
GenderInvestor			0.747*	0.283			-0.252	-2.046
			(0.378)	(0.678)			(1.082)	(1.632)
SVOTrader				-0.00311				-0.0105
				(0.0326)				(0.126)
SVOInvestor				-0.00844				-0.00112
				(0.0160)				(0.0558)
RiskSeekingTrader				-0.0549				-0.292**
				(0.0725)				(0.109)
RiskSeekingInvestor				0.0682				0.207
				(0.0570)				(0.144)
N	20	20	20	20	20	20	20	20
R^2	0.427	0.440	0.511	0.567	0.023	0.029	0.068	0.358

Heteroscedasticity corrected standard errors in parentheses,
clustered on a session level. * $p < 0.10$, ** $p < 0.05$

Table 5: **Bubble measure regressions.** In columns (1) - (4) we use GPD as dependent variable. Columns (5) - (8) use Turnover as dependent variable. LLC, UL and ULC correspond to treatment specific dummy variables. SD-Initial is the session-specific standard deviation of initial endowments arising from the IPO. GenderX measures the fraction of male traders/investors per session. RiskSeekingX measures the average risk-seekingness of traders/investors (BRET-choice). SVOX measures the average social value orientation of traders/investors.

	(1)	(2)	(3)	(4)	(5)
	Δp_t^s	Δp_t^s	Δp_t^s	Δp_t^s	Δp_t^s
LLC	2.957	2.561	2.995	4.373	10.92
	(6.321)	(6.958)	(7.021)	(6.004)	(7.472)
UL	0.395	6.583	7.667	5.312	4.450
	(6.012)	(6.353)	(6.445)	(5.609)	(7.226)
ULC	-6.666	-4.773	-4.337	-11.64	-8.031
	(8.434)	(8.446)	(8.458)	(8.163)	(7.820)
$Liquidity_t$		0.0865^{**}	0.0872^{**}	0.0856^{**}	0.0817^{**}
		(0.0275)	(0.0277)	(0.0279)	(0.0288)
$DesiredMoney_t$		-0.0748^{**}	-0.0745^{**}	-0.0778^{**}	-0.0814^{**}
		(0.0278)	(0.0279)	(0.0283)	(0.0300)
$Dividend_{t-1}$		0.379^{**}	0.380^{**}	0.367^{**}	0.373^{**}
		(0.155)	(0.156)	(0.155)	(0.169)
SD-Initial			5.216	13.99	20.89
			(10.59)	(9.841)	(29.18)
GenderTrader				19.82^{*}	43.82
				(11.39)	(34.50)
GenderInvestor				13.72	11.50
				(13.12)	(22.05)
SVOTrader					0.879
					(0.890)
SVOInvestor					-0.362
					(0.445)
RiskSeekingTrader					-1.809
					(2.133)
RiskSeekingInvestor					-0.866
					(2.405)
N	211	211	211	211	211
R^2	0.003	0.115	0.116	0.120	0.124

Heteroscedasticity corrected standard errors in parentheses, clustered on a session level. * $p < 0.10$, ** $p < 0.05$

Table 6: **Price change regressions.** We use price changes as dependent variable. LLC, UL and ULC correspond to treatment specific dummy variables. $Liquidity_t$ is the average additional net amount of money invested by investors in the beginning of the period. $DesiredMoney_t$ is the average desired amount of money requested by investors at the beginning of the period. $Dividend_{t-1}$ is the asset's dividend realization in period $t-1$. SD-Initial is the session-specific standard deviation of initial endowments arising from the IPO GenderX measures the fraction of male traders/investors per session. RiskSeekingX measures the average risk-seekingness of traders/investors (BRET-choice). SVOX measures the average social value orientation of traders/investors. $Dividend_{t-1}$ is the dividend realization in period $t-1$.

	(1) careless	(2) careless	(3) careless	(4) careless	(5) careless	(6) careless
LLC	30.85	32.62	34.16	36.36	36.19	38.32*
	(23.73)	(22.78)	(23.27)	(23.41)	(23.44)	(22.69)
UL	-44.15**	-43.88**	-43.37**	-47.02**	-48.35**	-47.66**
	(14.39)	(12.24)	(12.33)	(12.91)	(14.36)	(13.72)
ULC	-28.73**	-29.10**	-28.60**	-33.50**	-33.87**	-33.02**
	(13.68)	(12.35)	(12.33)	(12.81)	(12.98)	(12.62)
Trend	-4.193**	-4.292**	-4.323**	-4.297**	-4.301**	-4.312**
	(0.701)	(0.805)	(0.827)	(0.825)	(0.825)	(0.822)
$BindingCap_{t-1}$		-12.76	-11.88	-13.34	-13.21	-13.14
		(10.70)	(11.68)	(11.73)	(11.73)	(11.93)
Initial-Stock			-0.919	-1.198	-1.187	-1.301
			(2.396)	(2.429)	(2.433)	(2.456)
GenderTrader				7.144	6.905	6.408
				(7.920)	(8.217)	(8.066)
SVOTrader					-0.0610	-0.0700
					(0.254)	(0.253)
RiskSeekingTrader						0.385
						(0.516)
N	601	571	571	571	571	571
R^2	0.133	0.142	0.142	0.144	0.144	0.144

Heteroscedasticity corrected standard errors in parentheses, clustered on an individual level. * $p < 0.10$, ** $p < 0.05$

Table 7: **Carelessness regressions.** Carelessness (care) is the dependent variable. It is defined as the sum of the volatility of bids and the volatility of asks times 0.5. LLC, UL and ULC correspond to treatment specific dummy variables. BindingCap is a dummy variable which takes a value of one in LLC and ULC treatments, whenever the cap was binding for the trader. GenderTrader is a dummy variable which takes a value of one for male traders. RiskSeekingTrader measures the risk-seekingness of traders (BRET-choice). SVOTrader measures the social value orientation of traders. Initial-Stock is the initial number of stocks after the IPO per trader.

	(1)	(2)	(3)	(4)	(5)	(6)
	cons	cons	cons	cons	cons	cons
LLC	-0.137**	-0.152**	-0.152**	-0.150**	-0.153**	-0.156**
	(0.0531)	(0.0584)	(0.0588)	(0.0575)	(0.0570)	(0.0584)
UL	0.106**	0.117**	0.117**	0.112*	0.105*	0.107*
	(0.0530)	(0.0584)	(0.0589)	(0.0585)	(0.0597)	(0.0598)
ULC	0.000695	-0.00342	-0.00340	-0.0112	-0.0146	-0.0115
	(0.0355)	(0.0404)	(0.0408)	(0.0428)	(0.0438)	(0.0443)
Trend	-0.0440**	-0.0455**	-0.0455**	-0.0455**	-0.0455**	-0.0455**
	(0.00225)	(0.00249)	(0.00249)	(0.00249)	(0.00249)	(0.00248)
$BindingCap_{t-1}$		-0.0507	-0.0501	-0.0521	-0.0512	-0.0528
		(0.0518)	(0.0535)	(0.0537)	(0.0542)	(0.0545)
Initial-Stock			-0.000633	-0.000979	-0.000707	-0.000790
			(0.00723)	(0.00729)	(0.00728)	(0.00739)
GenderTrader				0.0111	0.0110	0.0120
				(0.0226)	(0.0227)	(0.0225)
SVOTrader					-0.000502	-0.000476
					(0.000651)	(0.000656)
RiskSeekingTrader						-0.00188
						(0.00187)
N	1396	1297	1297	1297	1297	1297
R^2	0.266	0.259	0.259	0.259	0.259	0.260

Heteroscedasticity corrected standard errors in parentheses, clustered on an individual level. * $p < 0.10$, ** $p < 0.05$

Table 8: **Conservatism regressions.** Conservatism (cons) is the dependent variable in our regressions. It is defined as the fraction of bids below and asks above the FV out of the total bids and asks for a given period and investor. LLC, UL and ULC correspond to treatment specific dummy variables. BindingCap is a dummy variable which takes a value of one in LLC and ULC treatments, whenever the cap was binding for the trader. GenderTrader is a dummy variable which takes a value of one for male traders. RiskSeekingTrader measures the risk-seekingness of traders (BRET-choice). SVOTrader measures the social value orientation of traders. Initial-Stock is the initial number of stocks after the IPO per trader.

Figures

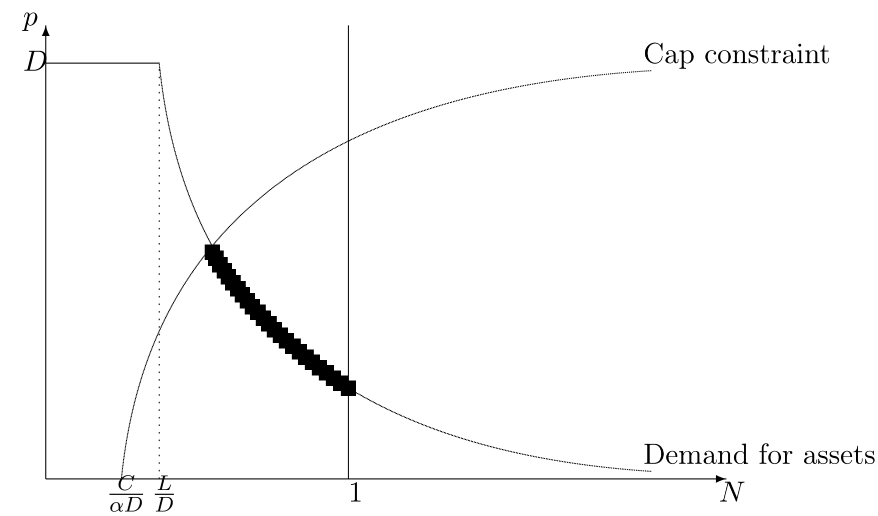


Figure 1: Equilibrium in LLC

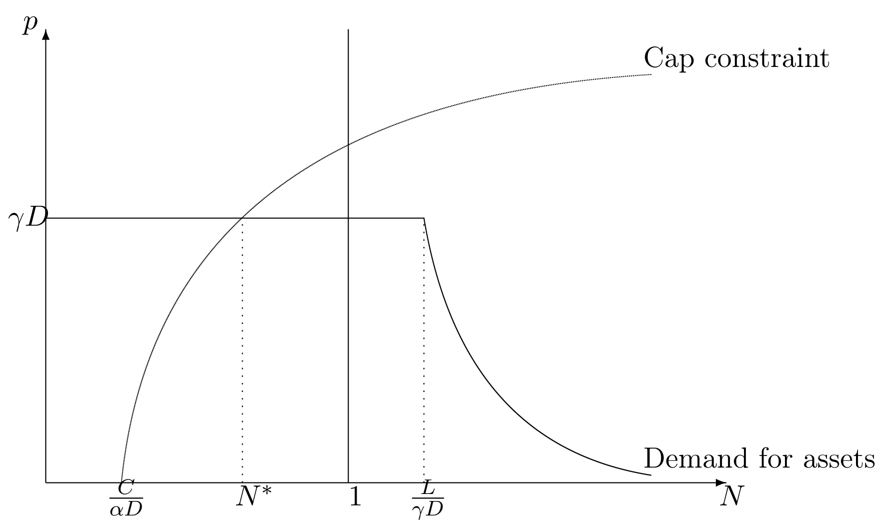


Figure 2: Equilibrium in ULC

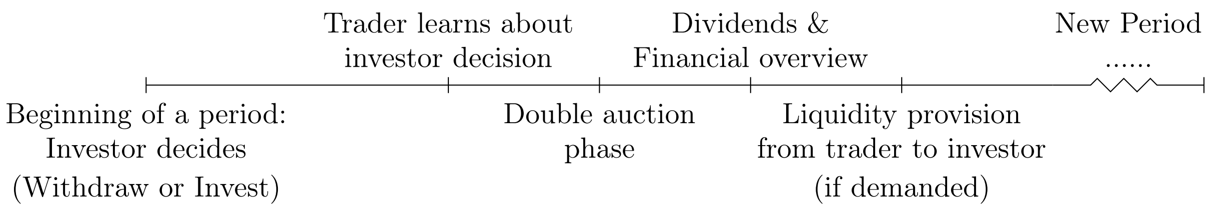


Figure 3: **Timeline of a typical period, other than the first (IPO):** The period starts with an investment or withdrawal decision of the investor and is followed by a trading stage. Dividends are then realized and participants are informed about their financial situation. Finally, transfers take place if applicable.

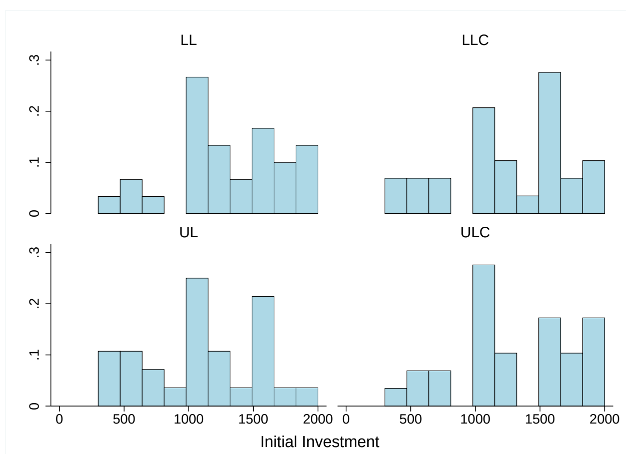
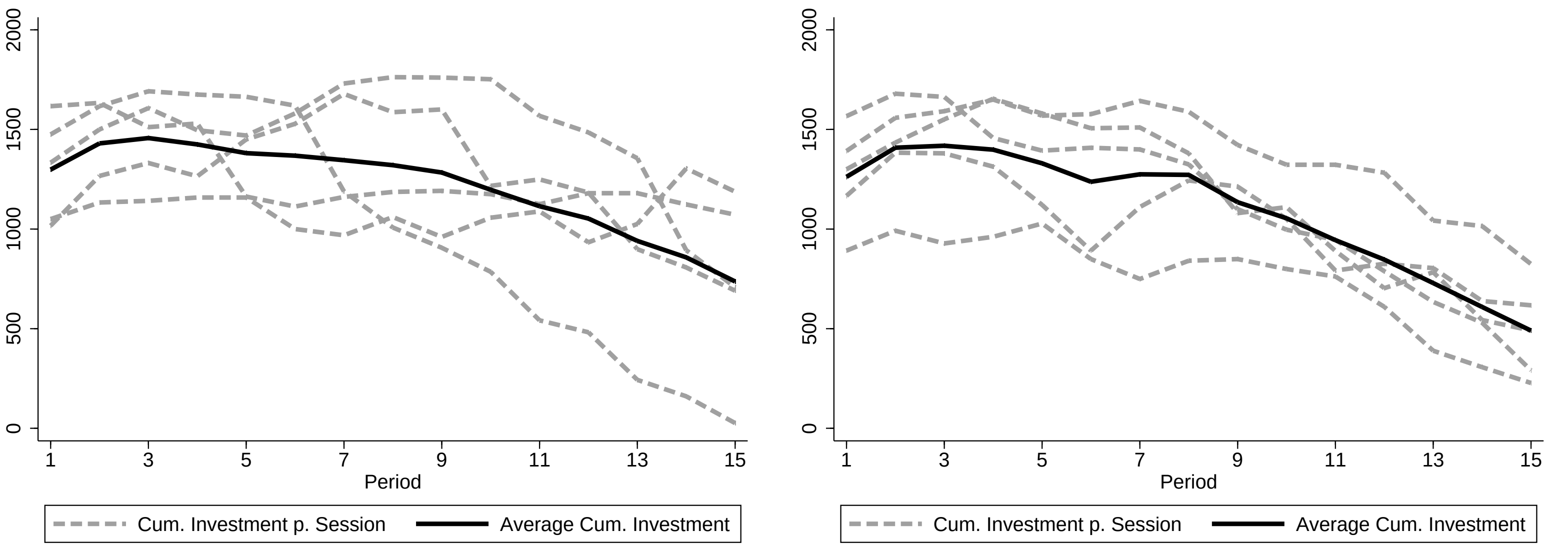


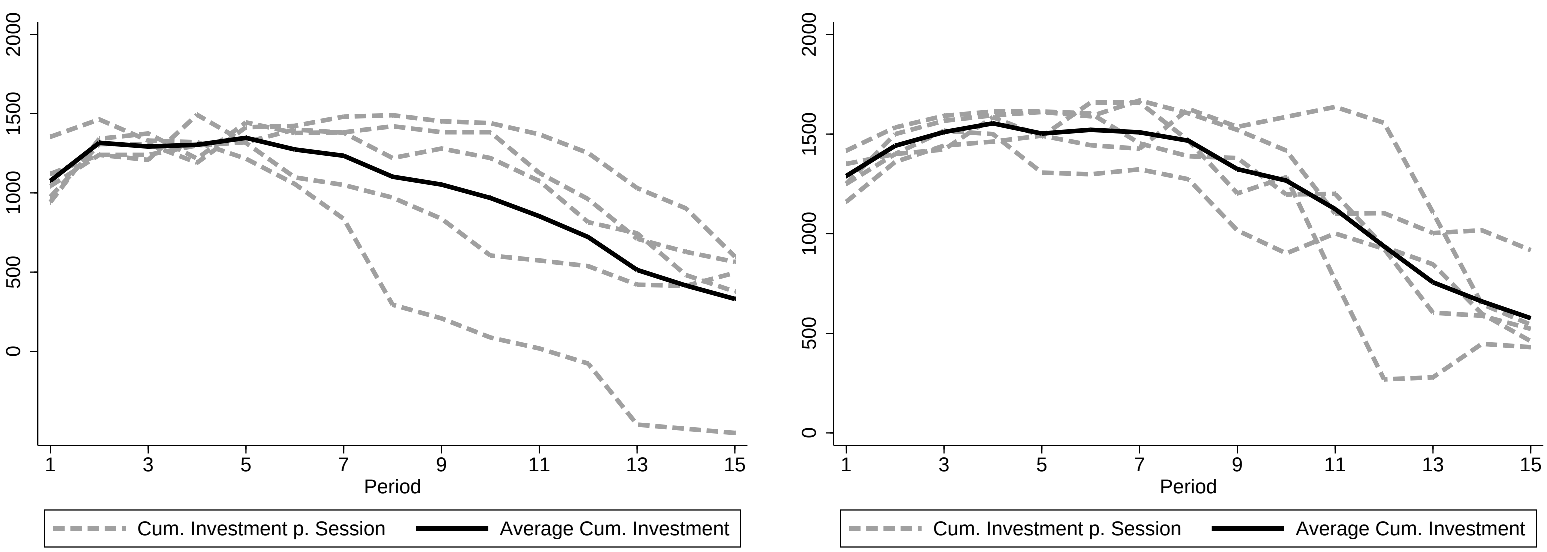
Figure 4: **IPO Investment.** The distributions of initial investment levels prior to the IPO do not differ significantly across treatments at the 10% levels using a Kruskal-Wallis test.



(a) Average liquidity provision under limited liability (LL).

(b) Average liquidity provision under limited liability & Cap (LLC).

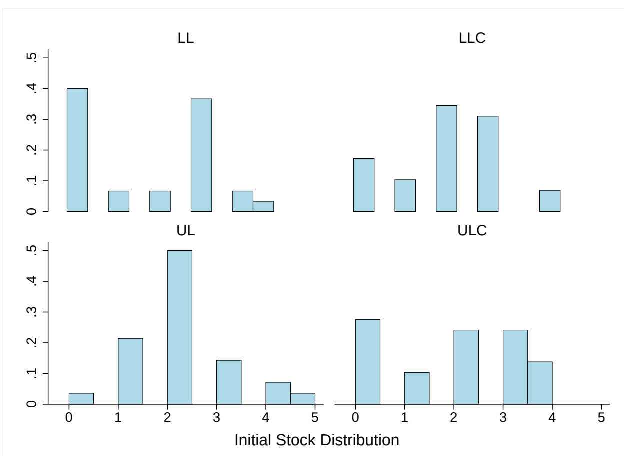
Figure 5: **Liquidity provision.** The figure shows the treatment specific session and average cumulated liquidity provide by an investor over time.



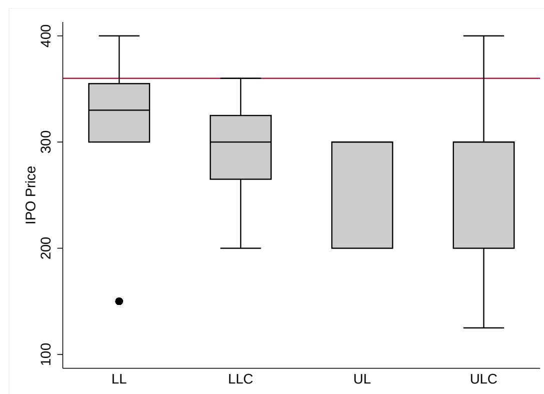
(a) Average liquidity provision under unlimited liability (UL).

(b) Average liquidity provision under unlimited liability & Cap (ULC).

Figure 6: **Liquidity provision.** The figure shows the treatment specific session and average cumulated liquidity provide by an investor over time.

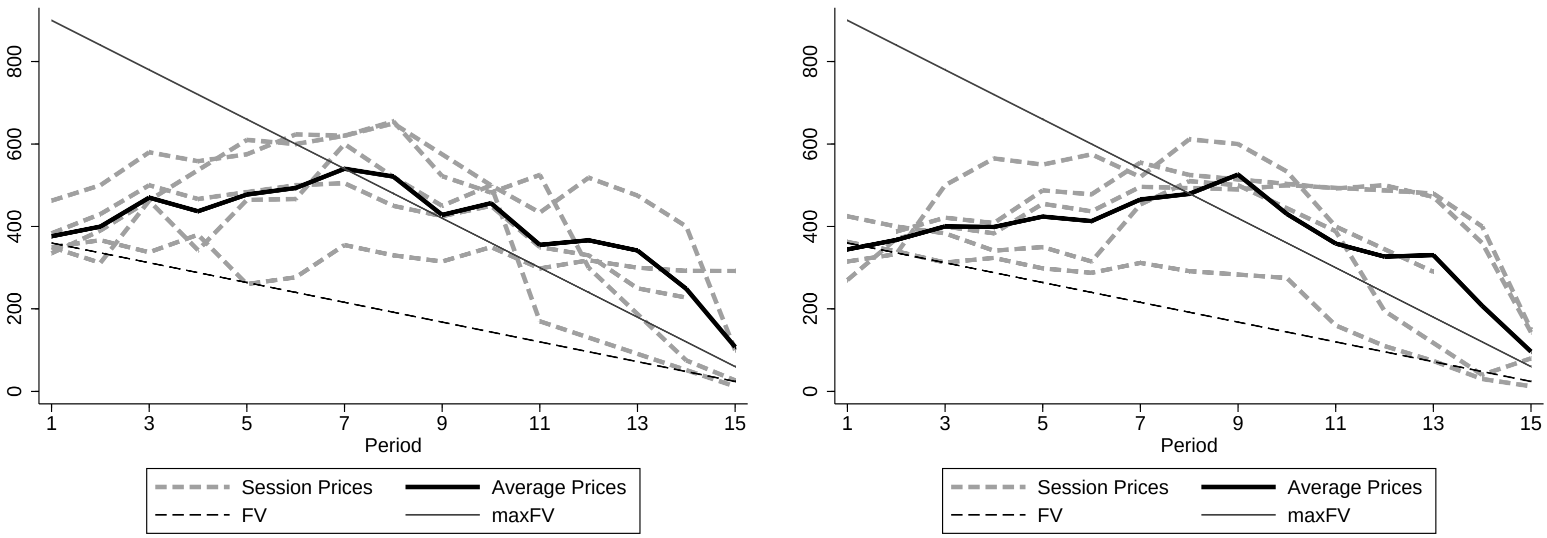


(a) Distribution of stocks after the IPO.



(b) Box plot of IPO prices across treatments.

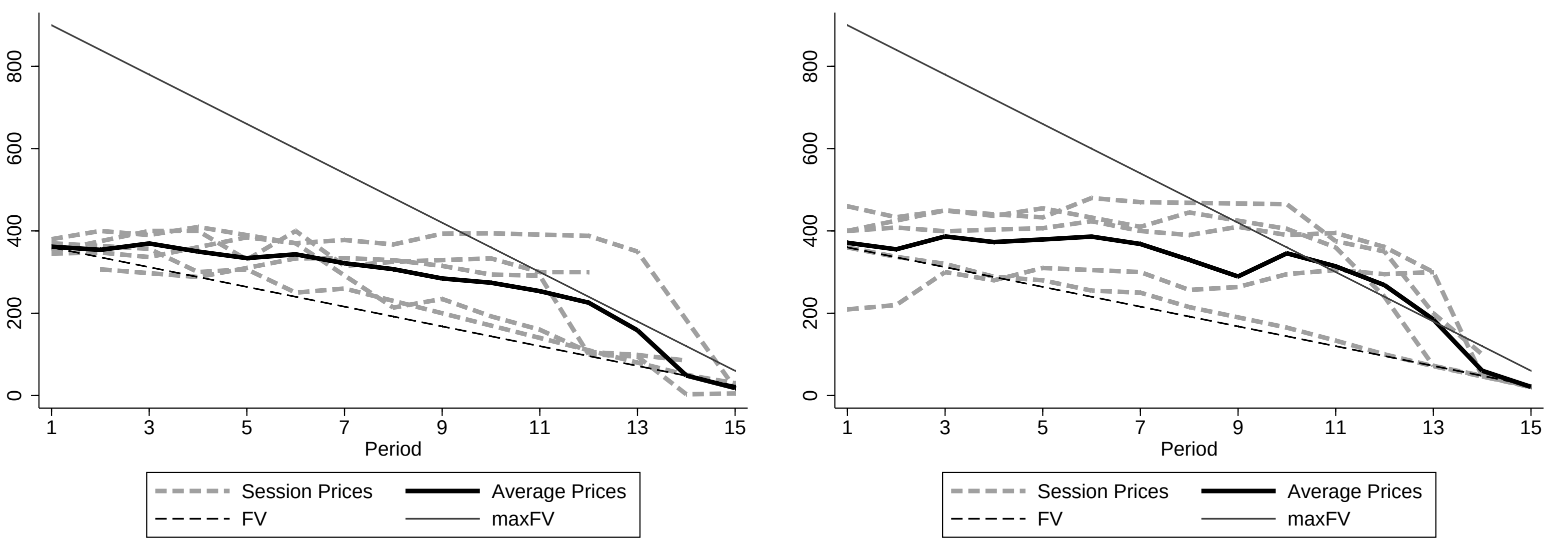
Figure 7: **IPO results.** The distributions of stocks after the IPO nor the IPO prices themselves differ significantly across treatments at 10% levels using Kruskal-Wallis tests. The horizontal line in panel (b) corresponds to the FV of the asset (360 Taler).



(a) Average prices under limited liability (LL).

(b) Average prices under limited liability & Cap (LLC).

Figure 8: **Volume weighted average prices.** The figure shows the treatment specific session and average prices, the fundamental value and the maxFV for LL and LLC.



(a) Average prices under unlimited liability(UL).

(b) Average prices under unlimited liability & Cap (ULC).

Figure 9: **Volume weighted average prices.** The figure shows the treatment specific session and average prices, the fundamental value and the maxFV for UL and ULC.

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