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

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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, two outcomes that are important for financial stability. Compensation schemes can drive a wedge between how investors and traders value the asset. Limited liability 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 increase prices. In contrast to these predictions, we find that under limited liability investors increase liquidity provision and asset price bubbles are larger. Bonus caps have no clear effect on liquidity provision and they fail to tame bubbles. Overall, giving traders skin in the game fosters financial stability.

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

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1 Introduction

Excessive bonuses in the financial industry might have contributed to the recent financial crisis by encouraging excessive risk-taking [Rajan, 2006, Bebchuk und Spamann, 2009]. To foster financial stability, a number of reforms have been discussed. Bonus caps have received the most attention and have already been implemented in the European Union (directive 2013/36/EU). Another proposition suggests giving bankers more skin in the game, by making them liable for losses.

We investigate the consequences of different compensation schemes on financial stability in a laboratory experiment. Investors can entrust their money to traders whose job is to buy or sell assets. Within this setup, two outcomes that affect financial stability are liquidity provision and asset prices. A low level of liquidity may prevent financial markets from operating efficiently. At the same time, a high level of liquidity may also be detrimental to financial stability if it pushes prices above the fundamental value. Such asset price bubbles then put the buyers at the risk of large capital losses.

Compensation schemes can have consequences on financial stability within this framework because they introduce a divergence in the interests of the trader and investor. We implement four schemes: unlimited liability, limited liability, each with and without capping bonuses. When traders are not liable for losses, they value the asset more than investors. Traders indeed face no downside risk while investors suffer the full losses and still share the gains. Provided with enough liquidity, traders are willing to pay high prices possibly leading to an asset price bubble. If investors anticipate this, they might want to restrict liquidity provision to prevent traders from overpaying, potentially leading to insufficient liquidity.

By contrast, capping bonuses makes the asset more valuable to the investor. Indeed, it reduces the potential gains of the trader and increases those of the investor. Traders are thus willing to trade at lower prices. At the same time, investors are willing to provide more liquidity since there is no risk that traders will overpay for the asset. While caps can have the desired effect of reducing risk taking by traders, the higher liquidity could at the same lead to an upward pressure on prices.

Next, we compare these predictions to the experimental evidence. Liquidity provision is lower when traders are liable for losses than when they are not. This is the opposite of what we expected since there are no conflicts of interest when traders are liable for losses and this should encourage liquidity provision. We also find that the introduction of a cap has no clear effect. It decreases liquidity provision when traders have limited liability but it slightly increases it in the case of unlimited liability.

We observe asset price bubbles in all treatments. However, assets trade closer to the fundamental value when traders are liable for losses than when they are not. This suggests that, as expected, traders take more risk when they face less downside risk. Furthermore, we find that an inflow of liquidity is positively correlated with subsequent asset prices, suggesting that the higher liquidity entrusted to traders under limited liability contributes to the higher prices. The introduction of a cap does not have any significant impact on asset prices.

Overall, the results suggest that conflicts of interest in financial relationships can undermine financial stability. Limited liability 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.

A possible explanation is that investors want their trader to speculate, that is, to buy the asset in the hope of reselling it at a higher price. Investors can encourage speculation by providing more liquidity to their trader when the bubble forms. Why would investors be more willing to encourage speculation in case of limited liability? A common rationale for speculation is momentum trading [de Long et al., 1990]. Following an increase in prices, traders believe that prices will keep increasing thus justifying speculation. As a result, the steeper the initial boom the more liquidity investors should provide. We indeed observe that booms are steeper in the presence of limited liability. This may encourage speculation by investors and thus increase liquidity provision. Traders can then contribute to the larger bubbles in the presence of limited liability both because they believe in momentum and because they received more liquidity.

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 a clearcut impact on financial stability. By contrast, making traders liable for losses seems more effective in reducing asset price bubbles. Liquidity provision is also lower but this actually has a stabilizing effect since it does not seem to prevent asset markets from functioning smoothly. 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.

The paper provides an implementation of a standard principal-agent relationship with conflicts of interest [Jensen und Meckling, 1976]. An important result of this literature is that agency costs can be reduced when the interests of the agent and of the principal are better aligned. A large literature tests and typically finds support for this hypothesis by comparing the performance and risk taking of different financial institutions with different incentive schemes. For example, Elton et al. [2003] find that incentive-fee mutual funds are better at picking stocks, take more risk and also have larger inflows than non-incentive-fee funds and Agarwal et al. [2009] show that hedge-funds with better-aligned incentives deliver superior performance. While our results are broadly in line with this literature, the experimental approach allows us to take a more aggregate perspective by studying the consequences of all traders adopting a given incentive scheme on macro-financial stability.

Our experimental design extends the standard asset market experiment [Smith et al., 1988] by endogenizing liquidity provision to allow for the joint study of a principal-agent relationship and financial stability. Earlier work has varied the level of exogenous liquidity provision by studying environments with different initial cash-to-asset ratios [Caginalp et al., 1998] and found that more liquidity leads to larger bubbles. Consistent with this result, we find that asset prices are subsequently larger when investors decide to provide more liquidity. However, our design does not allow us to establish causality.

Our work extends the literature studying the consequences of compensation schemes in asset market experiments. James und Isaac [2000] and Isaac und James [2003] investigate the amplifying effects of tournament incentives on asset prices. Robin et al. [2012] vary how frequently tournament based bonuses are paid out. 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. Like us, Kleinlercher et al. [2014] find that the combination of limited liability and bonuses fuels asset price bubbles. They also report that the introduction of a cap has a small negative effect on 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 might be 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 $L_{UL}^{*} \in [\gamma D, W]$, $p_{UL}^{*} = \gamma D$ 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:

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

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:

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

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 $L^*_{UL} = \beta D$, $p^*_{LL} = \beta D$ 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:

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

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 thus 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.

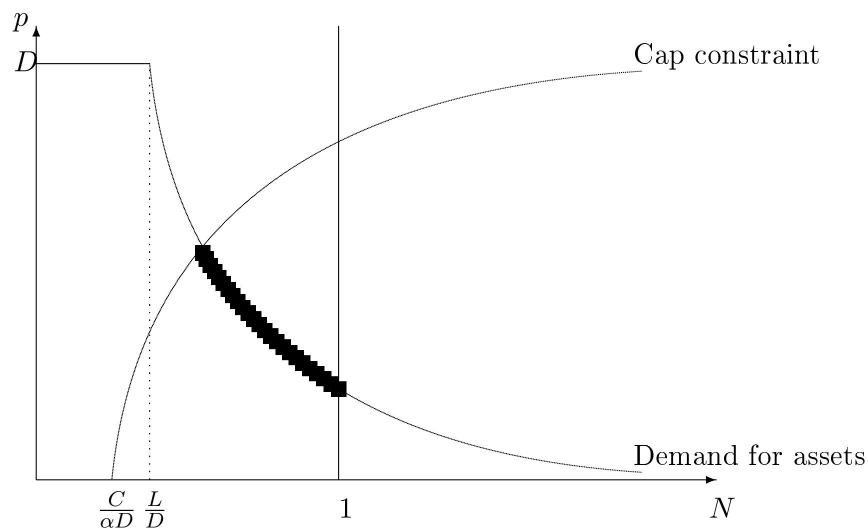


Figure 1: Equilibrium in LLC

3 Experimental Design

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

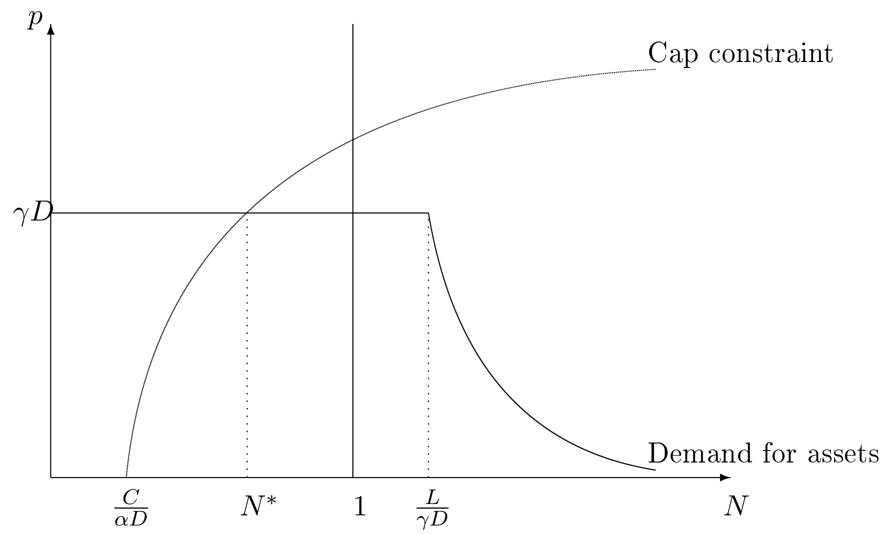


Figure 2: Equilibrium in ULC

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 role of traders and the other half the role 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 assets 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 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.

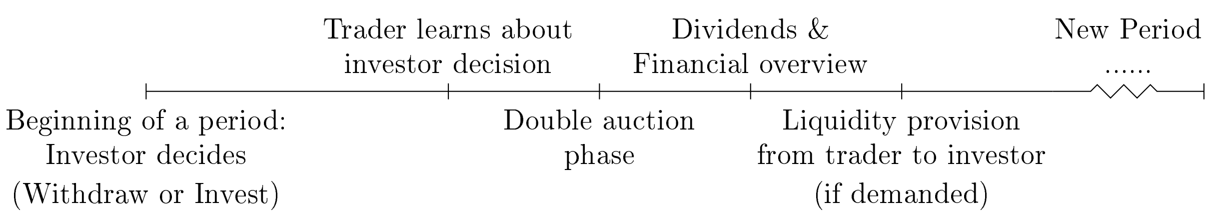


Figure 3: **Timeline of a typical period, other than the first (IPO):** The period starts with an investment or withdrawal decision of the investor and is followed by a trading stage. Dividends are then realized and participants are informed about their financial situation. Finally, transfers take place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

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

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

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, social preferences could 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 und 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 und 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. The Spearman-correlation between SVO and risk preferences is small $\rho = -0.059$ and insignificant $p = 0.398$.

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 to during the game.

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

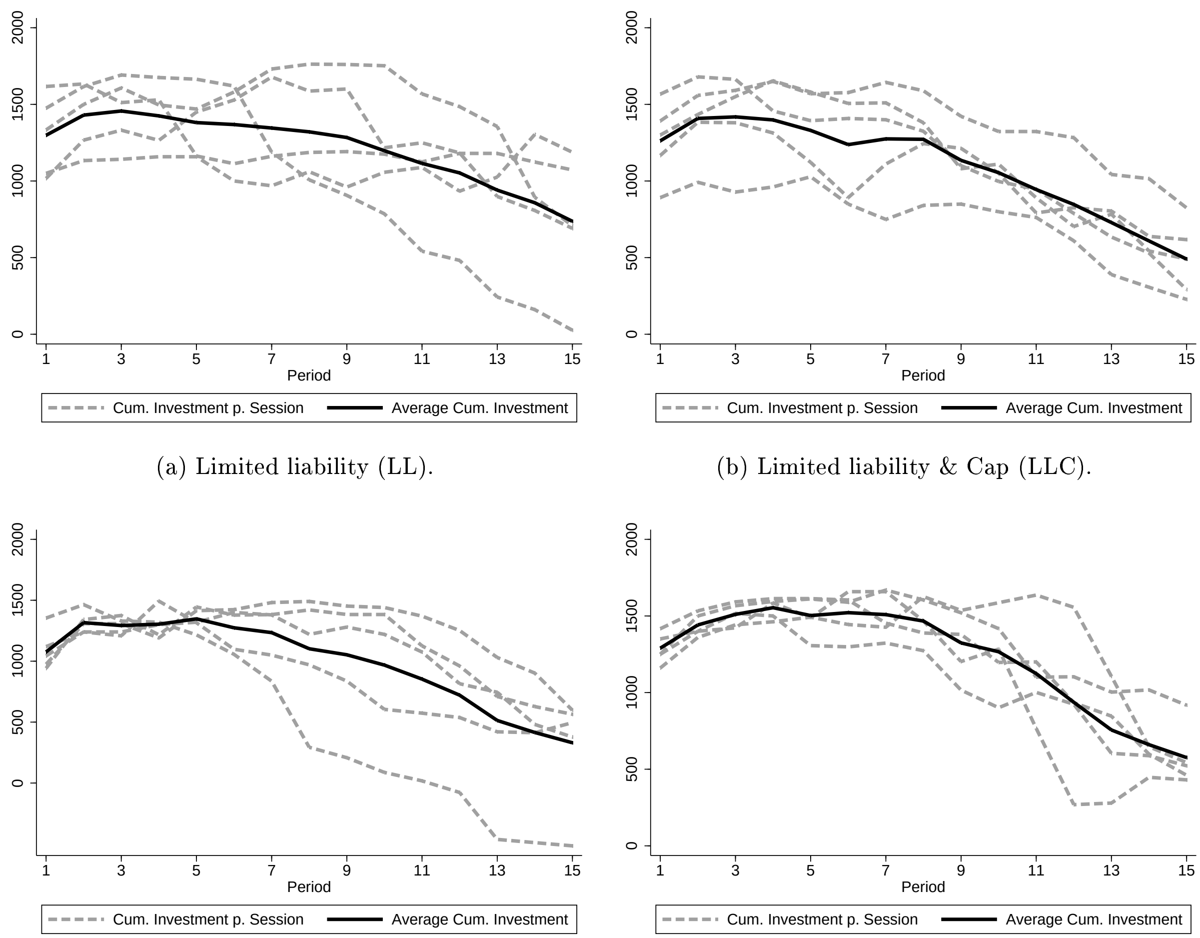
We analyze the determinants of, first, the aggregate and individual liquidity provision and, second, of prices and individual trading behavior.

4.1 Liquidity Provision

On average investors provided about 62% of their initial cash endowments to their trader in the first period, which corresponds to 1233.5 Taler. Table 1 shows that the initial average liquidity provision for each compensation scheme are: 1298.3 (LL), 1262.1 (LLC), 1076.1 (UL), 1289.7

(ULC). Table 2 shows that investors provide on average significantly less liquidity in UL than in LL, ULC and LLC and in LLC than in ULC.

Investors can provide or withdraw liquidity from their corresponding trader in all the subsequent periods. Figure 4 depicts the evolution of the average stock of liquidity for each session and compensation scheme. We also observe that aggregate liquidity is rather stable in the first half of the experiment and only starts decreasing towards the end. Investors asked some money back in 649 out of 1624 possible cases. In 150 of these cases, the trader did not return the full amount. Those illiquid traders returned on average 41% of the amount demanded.



(a) Limited liability (LL).

(b) Limited liability & Cap (LLC).

(c) Unlimited liability (UL).

(d) Unlimited liability & Cap (ULC).

Figure 4: **Liquidity provision.** The figure shows the evolution of the session-average cumulative liquidity provided by an investor for each compensation scheme.

Next, we investigate whether apart from compensation schemes also individual characteristics of investors can explain investment at the individual level. To this end, we run regressions of liquidity provided by each investor either during the first period or aggregated over the whole

	First Period Liquidity					Average Liquidity			
Treatment →	LL	LLC	UL	UL	Treatment →	LL	LLC	UL	ULC
Session ↓					Session ↓				
Session 1	1616.7	1300	1354	1350.2	Session 1	1183.58	1045.53	350.61	917.19
Session 2	1016.7	891.7	1120	1416.7	Session 2	1117.21	625.84	978.6	1148.73
Session 3	1050	1166.7	1043.3	1250	Session 3	939.06	903.57	749.32	976.09
Session 4	1475	1566.7	941.7	1160.2	Session 4	877.09	1020.48	1004.66	1182.79
Session 5	1333.3	1391.7	975	1250	Session 5	1088.09	1041.86	836.47	1278.92
Average	1298.3	1262.7	1076.1	1289.7	Average	1088.1	966.4	836.5	1097.9

Table 1: **Liquidity provided during the first period and average liquidity over all periods for each session and compensation scheme.**

		1st P. Liq.	Avg. Liq.
LL vs. UL	N = 58 p-value	0.079	**0.001**
LL vs. LLC	N = 59 p-value	0.848	0.061
LL vs. ULC	N = 59 p-value	0.916	0.819
UL vs. LLC	N = 57 p-value	0.916	**0.037**
UL vs. ULC	N = 57 p-value	0.120	**0.001**
LLC vs. ULC	N = 58 p-value	0.112	**0.019**
(LLC & LL) vs. (ULC & UL)	N =116 p-value	0.246	0.318
(LL & UL) vs. (LLC & ULC)	N = 116 p-value	0.330	0.216

Table 2: **Mann-Whitney tests**. The Table shows p-values for pairwise Mann-Whitney tests to compare the liquidity measures from Table 1. Bold entries indicate significance at a 5% level.

session on treatment dummies, and individual characteristics of investors such as gender, SVO, and risk aversion. Additionally, we control for exogenous inflows of liquidity by including the average dividend paid out by one unit of the asset. The results are shown in Table 3. This analysis confirms that liquidity provision is lower in UL than in LL. The other treatment effects are not significantly different from 0 and neither are the individual characteristics of investors.

We further investigate the dynamics of liquidity provision at the individual level using fixed-effect regressions. We include past dividend realizations in the regressions to control for the 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. Additionally, we include cash holding of both investor and trader, as well the amount of stock the trader holds. Moreover, both dummies for illiquid traders and for traders where the compensation cap is binding are

	(1)	(2)	(3)	(4)
	Avg. Liq.	Avg. Liq.	1 st Per. Liq.	1 st Per. Liq.
LLC	-83.84	-82.06	-36.26	-41.09
	(0.178)	(0.192)	(0.767)	(0.743)
UL	-151.1**	-139.1*	-222.3*	-147.3
	(0.043)	(0.078)	(0.064)	(0.288)
ULC	-25.96	-13.00	-8.609	39.33
	(0.594)	(0.821)	(0.945)	(0.782)
Avg. Dividend	-7.585*	-8.183		
	(0.079)	(0.238)		
GenderInvestor		4.994		-211.0
		(0.942)		(0.263)
SVOInvestor		1.147		3.886
		(0.826)		(0.629)
RiskSeekingInvestor		-5.990		-0.870
		(0.541)		(0.963)
Constant	755.2***	824.3***	1298.3***	1283.8***
	(0.000)	(0.000)	(0.000)	(0.000)
Observations	116	116	116	116
R^2	0.360	0.376	0.037	0.048

p-values in parentheses
Standard errors (1) and (2) clustered on session level,
(3) and (4) heteroskedasticity corrected.
* p<0.10, ** p<0.05, *** p<0.01

Table 3: **Liquidity regressions.** In columns (1) and (2) the dependent variable is liquidity provided prior to the IPO. In columns (3) and (4) the dependent variable is average liquidity provided over all 15 periods. LLC, UL and ULC correspond to treatment specific dummy variables. Avg. dividend is the average dividend paid out by one stock for a given session. RiskSeekingInvestor measures the risk-seekingness of investors (BRET-choice). SVOInvestor measures the social value orientation of investors. GenderInvestor is a dummy variable equal to 1 if the investor is a male.

included. The results are shown in Table 4.

The regressions confirm that there is a significant downward trend in liquidity provision. We also observe that lagged price changes – a proxy for the overall change in a portfolio's value – have a significant and positive effect on liquidity at a 5% to 10% level. The coefficient on the trader's cash balance is significant and negative, so that investors tend to withdraw more money from traders who have more liquidity. In case of an illiquid trader, investors further withdraw money, so that the trader has to liquidate his assets if he wants to meet the investor's demands.

Since conflicts of interest are largest with limited liability, investors should 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.

4.2 Trading

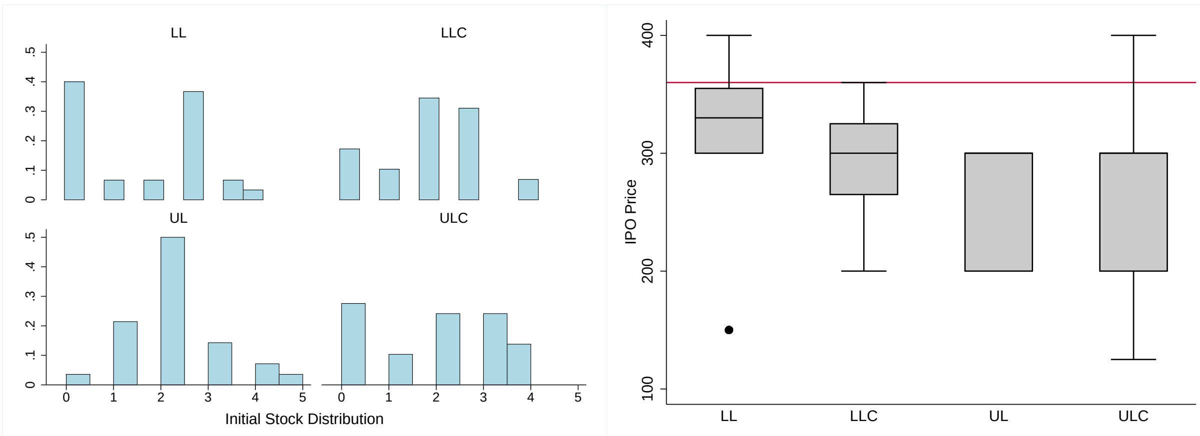
The IPO. We depict the distribution of IPO prices and initial stock distributions in Figure 5. First, prices are significantly lower than the asset's FV at the 10% level in all treatments but

	(1)	(2)	(3)	(4)	(5)
	ΔLiq$_t$	ΔLiq$_t$	ΔLiq$_t$	ΔLiq$_t$	ΔLiq$_t$
Period	-8.520*	-2.950	-19.23*	-20.71*	-21.89*
	(0.083)	(0.705)	(0.075)	(0.070)	(0.067)
Sum Dividend	-0.108	-0.194	-0.333	-0.00202	-0.0753
	(0.563)	(0.633)	(0.520)	(0.997)	(0.900)
Δp_{t-1}		0.361*	0.291*	0.283*	0.282*
		(0.054)	(0.085)	(0.092)	(0.090)
Cash			0.292***	0.148**	0.132**
			(0.000)	(0.034)	(0.041)
CashTrader				-0.174***	-0.158***
				(0.005)	(0.009)
StockTrader				-30.52	-28.12
				(0.152)	(0.208)
Illiquid Trader					-161.1**
					(0.018)
Bind. Cap Trader					137.3
					(0.423)
Constant	35.95*	7.134	-92.09**	210.4*	371.6***
	(0.084)	(0.774)	(0.026)	(0.086)	(0.004)
Observations	1624	998	998	998	998
R^2	0.013	0.012	0.137	0.151	0.161

p-values in in parentheses
Standard errors clustered on session level.
* p <0.10, ** p<0.05, *** p<0.01

Table 4: **Liquidity dynamics regressions.** The dependent variable is the change in liquidity provided between period t and $t-1$. LLC, UL and ULC correspond to treatment specific dummy variables and Period to a time trend. Sum Dividend is the sum of all dividend realizations for a single asset in a given session. Δp_{t-1} is the lagged difference of session specific prices. InvestorCash is the cash balance of the investor, StockTrader is the trader's stock, and CashTrader is the trader's cash balance. IlliquidTrader is a dummy, that is one if the trader's cash balance fell to zero in the prior period. BindCapTrader is one if in either LLC or ULC the trader has reached the compensation cap in the last period.

LL.[2] Furthermore, the average IPO prices do not differ significantly across treatments.[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).



(a) Distribution of stocks after the IPO.

(b) Box plot of IPO prices across treatments.

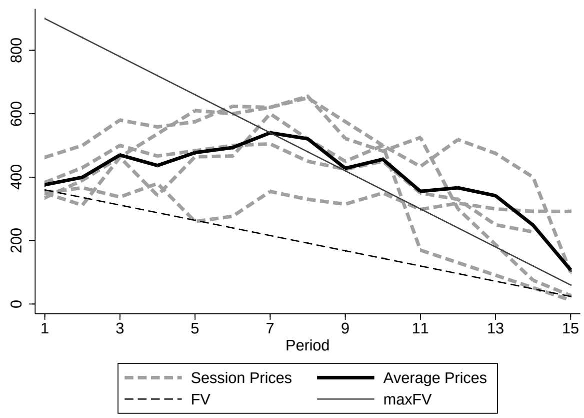
Figure 5: **IPO results.** Neither, the distributions of stocks after the IPO nor the IPO prices themselves differ significantly across treatments at 10% levels using Kruskal-Wallis tests. The horizontal line in panel (b) corresponds to the FV of the asset (360 Taler).

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 Figure 6. Asset prices almost always exceed the fundamental value of the asset and display the typical bubble-crash pattern found in standard experimental asset markets. We observe that under limited liability (LL and LLC) prices are higher than with unlimited liability (UL and ULC). In six out of the ten limited liability sessions prices remained close to or exceeded the highest possible dividend realization even in the last period. Caps do not seem to have a substantial effect on prices.

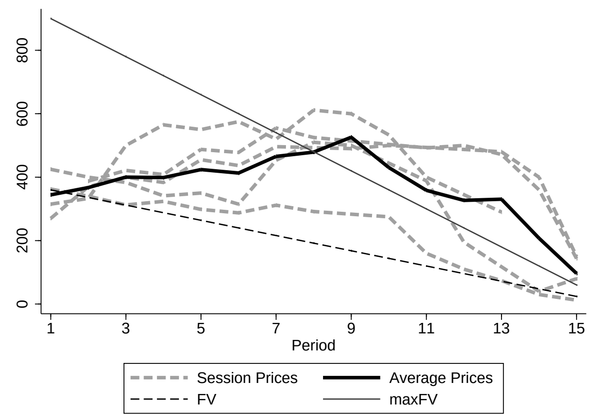
A more refined analysis using different bubble measures confirms these initial observations. We use standard bubble measures to compare treatments, such as the relative absolute deviation (RAD), to measure mis-pricing, and the relative deviation (RD), to measure over-valuation (Stöckl et al. [2010]). We further use the geometric average deviation (GAD), suggested in

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

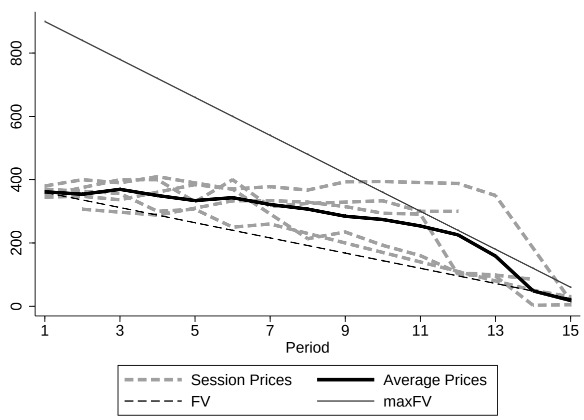
[3] Pairwise Mann-Whitney tests cannot reject the null hypothesis of equal median IPO prices at any reasonable significance levels. The pairwise p-values are as follows: LL vs LLC: 0.53, LL vs UL: 0.20, LL vs ULC: 0.40, LLC vs UL: 0.38, LLC vs ULC: 0.67, UL vs ULC: 0.91. A similar picture of no significant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



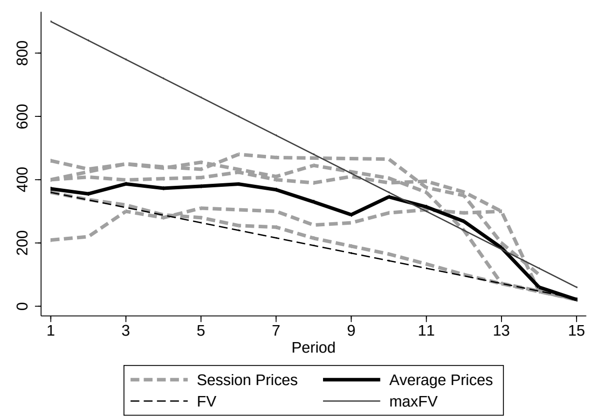
(a) Limited liability (LL).



(b) Limited liability & Cap (LLC).



(c) Unlimited liability(UL).



(d) Unlimited liability & Cap (ULC).

Figure 6: **Evolution of asset prices.** The figure shows the evolution of session-average asset prices for each compensation scheme, the fundamental value (FV) and the maximum fundamental value (maxFV).

Powell [2015], that measures mispricing independent of the numeraire. We then compute the average GAD over all 15 periods for a given session. Lastly, we 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 5. We then run pairwise Mann-Whitney tests to compare the treatments. The resulting p-values are displayed in Table 6. The binary comparisons suggest significant differences between LL and UL as well as between LL and ULC at a 5% level. The other treatment differences are not significant.[4]

Measure: RAD, $RAD = \frac{1}{15}\sum_t \frac{\lvert P_t - FV_t \rvert}{mean(FV_t)}$					Measure: RD, $RD = \frac{1}{15}\sum_t \frac{P_t - FV_t}{mean(FV_t)}$				
Treatment →	LL	LLC	UL	ULC	Treatment →	LL	LLC	UL	ULC
Session ↓					Session ↓				
Session 1	0.73	0.21	0.12	0.06	Session 1	0.72	0.19	0.12	0.06
Session 2	1.14	0.74	0.31	0.62	Session 2	1.14	0.73	0.31	0.35
Session 3	1.28	1.25	0.42	0.76	Session 3	1.23	1.18	0.34	0.75
Session 4	1.32	1.40	0.69	0.85	Session 4	1.30	1.40	0.68	0.84
Session 5	1.47	1.46	0.84	1.01	Session 5	1.47	1.42	0.82	1.01
Average	1.19	1.01	0.48	0.66	Average	1.17	0.98	0.45	0.60

Measure: GAD, $GAD = exp\left(\frac{1}{15}\sum_t \lvert \ln\left(\frac{P_t}{FV_t}\right) \rvert\right) - 1$					Measure: Turnover, $Turnover = \frac{1}{TSU}\sum_t Q_t$				
Treatment →	LL	LLC	UL	ULC	Treatment →	LL	LLC	UL	ULC
Session ↓					Session ↓				
Session 1	1.05	1.72	0.61	0.59	Session 1	1.22	2.15	1.67	1.62
Session 2	1.32	1.58	1.32	0.61	Session 2	1.77	2.31	2.30	1.91
Session 3	1.27	0.60	0.35	0.75	Session 3	3.07	2.42	2.42	2.67
Session 4	0.99	0.26	1.01	1.12	Session 4	3.79	3.08	3.39	3.13
Session 5	1.42	2.26	0.13	0.06	Session 5	4.33	3.14	3.62	3.17
Average	1.21	1.28	0.68	0.63	Average	2.83	2.60	2.66	2.48

Table 5: **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.

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 Table 7. The coefficients of the treatment dummies confirm the initial results. Bubbles are significantly larger in limited liability treatments. Furthermore, the extent of bubbles does not depend on

[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 GAD are significant at a 5% 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 level. Hence, prices differ along the liability but not along the cap dimension. Finally, we observe no differences in turnover in any of the pairwise comparisons, suggesting that the treatment effects on prices are not driven by differences in the quantities traded.

		RAD	RD	GAD	Turnover
LL vs. UL	N	10	10	10	10
	p-value	**0.016**	**0.016**	0.095	0.754
LL vs. LLC	N	10	10	10	10
	p-value	0.754	0.754	0.691	0.917
LL vs. ULC	N	10	10	10	10
	p-value	**0.047**	**0.047**	**0.032**	0.754
UL vs. LLC	N	10	10	10	10
	p-value	0.117	0.117	0.310	0.834
UL vs. ULC	N	10	10	10	10
	p-value	0.347	0.347	0.841	0.917
LLC vs. ULC	N	10	10	10	10
	p-value	0.251	0.251	0.310	0.602
(LLC & LL) vs. (ULC & UL)	N	20	20	20	20
	p-value	**0.010**	**0.010**	**0.023**	0.850
(LL & UL) vs. (LLC & ULC)	N	20	20	20	20
	p-value	0.940	0.940	0.800	0.678

Table 6: **Mann-Whitney tests**. The Table shows p-values for pairwise Mann-Whitney tests to compare the bubble measures from Table 1. Bold entries indicate significance at a 5% level.

the average risk aversion of traders or investors or their average SVO. We also control for the weighted average market power, that is, the concentration of assets and cash after the IPO weighted by risk preferences [Breaban und Noussair, 2015]. Market power in the hands of risk averse traders could in principle lead to different price trajectories than market power in the hand of risk seeking traders. This measure, however, has no effect on bubbles. The fraction of males has an ambiguous impact on price patterns.

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 as shown in the previous section, liquidity provision is higher under limited liability. Because traders only hold upside risk under limited liability and are provided with plenty of liquidity, they could push up prices. We further explore this hypothesis by investigating the determinants of prices. We run FE regressions using the change in prices as a dependent variable. The results are shown in Table 8.

An inflow of liquidity has a significant and positive effect on subsequent prices. This suggests that investors contribute 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, which show that cash-to-asset ratios have positive effects on asset price bubbles. Our design does not allow to establish causality, though. We also find that requests from investors to withdraw liquidity at the beginning of a period are followed by 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

	(1) RAD	(2) RAD	(3) RD	(4) RD	(5) GAD	(6) GAD	(7) Turnover	(8) Turnover
LLC	-0.175	-0.267	-0.188	-0.288	-0.0258	0.0409	-0.216	-0.394
	(0.268)	(0.302)	(0.265)	(0.297)	(0.182)	(0.226)	(0.624)	(0.784)
UL	-0.713***	-0.558**	-0.719***	-0.552**	-0.305**	-0.173	-0.159	-0.615
	(0.181)	(0.210)	(0.179)	(0.219)	(0.136)	(0.138)	(0.691)	(1.191)
ULC	-0.529**	-0.756***	-0.568**	-0.795***	-0.330**	-0.315*	-0.337	-0.148
	(0.206)	(0.213)	(0.215)	(0.214)	(0.120)	(0.170)	(0.669)	(0.746)
Weighted MP		-0.143		-0.304		-0.335		3.606
		(0.967)		(0.978)		(0.686)		(2.242)
GenderTrader		-1.038*		-1.134**		-0.619*		0.894
		(0.502)		(0.498)		(0.332)		(1.295)
GenderInvestor		1.175**		1.145**		0.768**		-1.703
		(0.412)		(0.440)		(0.271)		(1.492)
SVOTrader		-0.0170		-0.0177		0.0245		-0.0257
		(0.0334)		(0.0322)		(0.0262)		(0.137)
SVOInvestor		0.0134		0.0120		-0.00168		-0.0141
		(0.0123)		(0.0129)		(0.00913)		(0.0652)
RiskSeekingTrader		0.0619		0.0837		0.0430		-0.516*
		(0.126)		(0.128)		(0.0868)		(0.251)
RiskSeekingInvestor		0.00311		0.00817		-0.0439		0.164
		(0.0718)		(0.0709)		(0.0523)		(0.150)
Constant	1.188***	0.423	1.172***	0.321	0.791***	0.617	2.835***	4.870**
	(0.126)	(0.555)	(0.125)	(0.609)	(0.0372)	(0.432)	(0.589)	(1.766)
Observations	20	20	20	20	20	20	20	20
R^2	0.408	0.680	0.414	0.687	0.269	0.675	0.023	0.361

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

Table 7: **Bubble measure regressions.** The dependent variable is relative absolute deviation (RAD) in columns (1) - (2), relative deviation (RD) in columns (3) - (4), geometric average deviation (GAD) in columns (5) - (6), and turnover in columns (7) - (8). LLC, UL and ULC correspond to treatment specific dummy variables. Weighted MP corresponds to the weighted market power of traders after 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.

positive dividend realizations contributes to an increase in prices.

	(1)	(2)	(3)
	Δ p_t	Δ p_t	Δ p_t
Δ Liquidity$_t$	0.0371***	0.0289**	0.0289**
	(0.0108)	(0.0108)	(0.0107)
DesiredMoney$_t$		-0.103***	-0.101***
		(0.0339)	(0.0346)
Dividend$_{t-1}$			0.473**
			(0.222)
Constant	-22.93***	-1.882	-14.13*
	(0.840)	(6.767)	(7.714)
Observations	196	196	196
R^2	0.034	0.096	0.119

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.01

Table 8: **Price change regressions.** We use price changes as dependent variable. ΔLiquidity$_t$ 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 $t-1$.

Traders' behavior. The higher prices observed under LL relative to UL can be explained by the different patterns of liquidity provision. However, this does not seem to be the whole story. In particular, there is no significant difference in aggregate liquidity between LL and ULC. Bubbles, by contrast, are significantly more pronounced in LL than in ULC. Similarly, there are weakly significant differences in liquidity provision between 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 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 und 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 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 risk aversion and SVO of the trader, gender, as well as session dummies. To control for learning, we include a trend variable. To control for the initial distribution of stocks, we include weighted market power after the IPO. The results are shown in Table 9.

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

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.

One additional channel that might contribute to the emergence of bubbles is the behavior of traders who are out of the money. In treatments where traders are protected by limited liability, their payoff cannot decrease further if they already incurred losses, so they might try to gamble for resurrection. They could do so following two strategies. Either, buy assets below the maximal fundamental value and hold these against future dividend realizations, or buy assets while hoping to sell them in the future for an even higher price. Both imply that out of the money traders increase their stock holdings. We run a fixed effect regression to evaluate this hypothesis. The dependent variable is the change in stock holdings, and the independent variable is a dummy that takes on the value 1 if a trader is out of the money. Results are reported in table 10 column (1). Consistent with gambling for resurrection, traders who are out of the money on average buy 0.6 units of stock per period and the effect is highly significant. Such a behavior can further fuel bubbles in limited liability treatments. Investors in turn might want to cut liquidity upon noticing that their traders have nothing to lose. We investigate whether they do, again with a FE regression. The dependent variable is the change in liquidity provided, while the coefficient of interest is on the out of money dummy. Column (2) shows that investors do not withdraw liquidity from traders who are out of the money and thus do not prevent them from gambling for resurrection.

5 Conclusion

In an experimental setting in which investors can entrust their money to traders, we investigate how compensation schemes affect liquidity provision and asset prices, two outcomes that are important for financial stability. Compensation schemes can drive a wedge between how investors and traders value the asset. Limited liability 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 increase prices.

In contrast to these predictions, we find that under limited liability investors increase liquidity

	(1)	(2)	(3)	(4)
	care	care	cons	cons
LLC	30.85	37.73	-0.137**	-0.161***
	(26.70)	(26.98)	(0.0572)	(0.0614)
UL	-44.15***	-50.05***	0.106*	0.104
	(15.43)	(17.31)	(0.0581)	(0.0640)
ULC	-28.73*	-32.63**	0.000695	-0.0154
	(15.01)	(16.34)	(0.0589)	(0.0653)
Period	-4.193***	-4.373***	-0.0440***	-0.0458***
	(0.705)	(0.762)	(0.00217)	(0.00250)
BindingCap$_{t-1}$		-19.00		-0.0738
		(20.49)		(0.0711)
Weighted MP		3.239*		-0.0166**
		(1.885)		(0.00774)
GenderTrader		6.119		0.0166
		(8.483)		(0.0237)
SVOTrader		-0.122		-0.000346
		(0.256)		(0.000744)
RiskSeekingTrader		0.0368		-0.000636
		(0.610)		(0.00185)
Constant	116.1***	108.9***	1.032***	1.099***
	(14.87)	(22.06)	(0.0431)	(0.0609)
Observations	601	571	1396	1297
R^2	0.133	0.147	0.266	0.263

Heteroscedasticity corrected standard errors in parentheses, clustered on an individual level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 9: **Conservatism and carelessness regressions.** Carelessness (care) is the dependent variable in columns (1) and (2). It is defined as the sum of the volatility of bids and the volatility of asks times 0.5. Conservatism (cons) is the dependent variable in columns (3) and (4). 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 a 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. Weighted MP corresponds to the weighted market power of traders after the IPO.

	(1)	(2)
	Δ Stock	Δ Liq.
OutofMoney	0.600***	39.13
	(0.108)	(27.98)
Constant	-0.181***	17.23
	(0.0324)	(31.18)
Further Controls	No	Yes
Observations	826	826
R^2	0.056	0.014

Heteroscedasticity corrected standard errors in parentheses, clustered on session level. * p<0.10, ** p<0.05, *** p<0.01

Table 10: **Out of the money traders.** In column (1) the change of a trader's stock holding between two periods is the dependent variable. In column (2) liquidity provided is the dependent variable. OutofMoney is a dummy that takes on the value of one for traders in limited liability treatments who are out of the money. Further controls in column (2) are past dividend realizations and a time trend. Only observations from LL and LLC are included.

provision and asset price bubbles are larger. While the earlier literature emphasizes the increased risk-taking by traders as the main driving force of higher asset prices [Holmen et al., 2014, Kleinlercher et al., 2014], our work shows that this result is amplified once liquidity is endogenous. Investors indeed do not seem to be willing to restrict their trader from trading at too high prices by cutting on liquidity provision. The results suggest that investors also want to ride the bubble and thus provide more liquidity.

Bonus caps have received a lot of attention recently as a potential cure for excessive risk-taking in the financial industry and have even been implemented in the European Union. Our results suggest that they are not very effective at containing asset price bubbles. Our main policy recommendation is that giving traders skin in the game by forcing them to share losses with investors leads to the lowest asset price bubbles. Liquidity provision also becomes lower, but it stays high enough such that asset markets keep functioning smoothly.

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