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Accounting Standards and Financial Market Stability: An Experimental Examination

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Comments

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Accounting Standards and Financial Market Stability: An Experimental Examination

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Abstract

We examine the effect on asset mispricing of different accounting methods in an experimental asset market characterized by bubbles and crashes. In particular, we study three alternative asset value reporting treatments: (1) Fair Value (also known as Mark-to-Market – M2M), (2) Historical Cost (HC) and (3) Marked to Fundamental Value (M2F). In addition, each of these treatments is replicated in two different financial leverage conditions. In the first condition (No Loan) traders must purchase assets from their available cash balances without the option of borrowing. In the second condition, (Loan), traders are given the option of taking out loans based on their balance sheet to finance asset purchases. In the No Loan condition, we find that reporting accounting values alone to subjects in a balance sheet format does not have a significant effect on mispricing for any of our alternative accounting method treatments. In the Loan conditions, however, the M2F and M2M accounting methods exacerbate asset mispricing, yet the two differ in leverage dynamics. M2F markets are completely immune to defaults, while M2M markets experience the most frequent as well as most severe defaults.

1. Introduction

The use of fair value accounting by banks and other financial institutions has been posited to be a factor that contributed to the financial crisis in 2008.[1] Fair value accounting, which is sometimes referred to as "mark-to-market," is the practice of increasing or decreasing the reported value of assets in a firm's balance sheet to reflect changes in the market prices of those assets. As a result, the balance sheet reports the current value of those assets rather than the outdated (historical) cost at which those assets were acquired. Since 1992, financial institutions have been required to use fair value accounting to report some of the financial assets presented in bank balance sheets. Advocates of fair value accounting argue that these reported values provide a more accurate measure of the financial health and viability of financial institutions and a better measure of capital adequacy, particularly for regulatory purposes (Morris and Sellon, 1991; Barth, 1994; Carey, 1995; Barth, Landsman and Wahlen, 1995). In addition, reported asset values based on fair value are assumed to be more relevant for most economic decisions than historical cost valuations. This value relevance is supported by empirical data (Barth, 1994; Eccher, Ramesh, and Thiagarajan, 1996; Cornett, Rezaee, and Tehranian, 1996). This virtue, however, depends on the reliability of the fair value measures. Reliability refers to the extent to which the fair value of an asset reflects its underlying fundamental economic value.

Critics have argued that fair value accounting increases the volatility of reported earnings and capital of financial institutions, causing unintended consequences for the management of capital reserves. Market volatility can force firms to engage in short-term modifications of their investment positions in order to meet capital requirements imposed by bank regulators. The bursting of the real estate bubble in 2007 and the subsequent financial crisis in 2008 is a prime example. During the preceding decade, steadily increasing home prices led to increased aggregate investment in real estate. When the bubble burst, the precipitous drop in real estate prices led to increased foreclosures and a corresponding decline in the value of bank assets. The decline in asset values immediately hit balance sheets because of fair value accounting. Some banks were forced to sell assets at "fire-sale" prices in order to maintain

[1] "… market-to-market accounting was in place during the Great Depression. Milton Friedman blames it for causing a majority of bank failures in the 1930s. It was suspended in 1938… The U.S. economy did just fine between 1938 and 2007. During those 69 years, there were no panics or depressions. But when the Financial Accounting Standards Board (FASB) – the rule-setting body for U.S. accounting standards – put a stringent fair value accounting rule (Rule 157) back into place in November 2007, all hell broke loose. This is not a coincidence. Fair value accounting is a disaster. " Brian S. Wesbury, "It's not as bad as you think", 2009, John Wiley & Sons, Inc., Hoboken, New Jersey

liquidity and regulatory capital. The sell-off of assets further depressed market prices which, in turn, depressed the asset values of other banks, creating a contagion effect.

Perhaps it is not surprising that most of the complaints about fair value accounting are voiced during periods of market distress. However, in order to avoid repeating past mistakes, it is important that we understand what factors caused the bubble in the first place. That is, did fair value accounting contribute to distortions in asset values that were later unwound during the financial crisis? In this study, we examine the effect of three different accounting regimes on asset market prices in an experimental market setting that has been shown to be prone to a pattern of bubble and crash. Specifically, we examine how balance sheets that report asset values using either historical cost (HC), fair value (M2M) or fundamental value (M2F)[2] affect the size and duration of asset market bubbles.

We test these three accounting alternatives in laboratory asset market modeled by Smith, Suchanek and Williams (1988). The market has been used widely in the literature and is prone to price bubbles followed by crashes. Various explanations have been proposed for why price bubbles arise in a market with common knowledge in the underlying asset value[3]. The purpose of our study is to examine different accounting methods in a market environment that provides stress tests on the robustness of these accounting methods of asset valuation.

In theory, the accounting method used to report an asset's value should not have any impact on the amount a buyer would be willing to pay to acquire that asset. Nor should the reported value affect a seller's reservation price for the same asset. Hence, we do not expect that asset value reporting, alone, will have much effect on the market prices of assets. However, when the reported value of an asset is used to determine potential debt capacity for a borrower, the accounting valuation may have an effect on the amount borrowed and subsequently invested. If market prices are inflated, as is the case in a bubble, reported asset values would also be overstated under fair value accounting. This could potentially result in higher debt balances and greater market liquidity. When the bubble bursts and

[2] This method is akin to a "mark-to-model," where the asset value is set equal to the value determined by an accepted valuation model using parameter values obtained from public sources. An example is the use of a discounted cash flow model with a quoted discount rate to value a bond. At best, this method uses market inputs as parameter values, so the same caveats regarding reliability apply as with mark-to-market values. For our purposes, the fundamental value is defined as the undiscounted expected dividend paid on an asset. As such, it is unambiguously determined independent of market prices. However, unlike the other two accounting methods of which the numbers can be obtained from either current prices or past prices, fundamental values are usually costly to obtain.

[3] These factors include liquidity, experience, transparency, novelty of environment and speculation (Caginalp, Porter, and Smith, 2001; Dufwenberg, Lindqvist, and Moore, 2005, Hussam, Porter, and Smith, 2008; Lei, Noussair, and Plott, 2001) Lei, Noussair, and Plott (2001) find that bubbles do not disappear in markets in which speculation is not possible. Kirchler, Huber, and Stöckl (2012) argue that bubbles are related to the declining fundamental value because traders do not fully comprehend the process. Noussair and Ruffieux (2001) find bubbles in markets with constant fundamental values. For a survey of bubbles in experimental assets see Palan (2014).

asset market prices fall, accounting values are adjusted downward and outstanding debt may no longer be adequately backed by the assets, creating a potential for default. To address the effect of reported asset values on debt capacity and market liquidity, we evaluate two financial leverage conditions for each of the accounting alternatives examined. In one of these conditions, subjects were required to purchase assets from available cash balances without the option of borrowing. In the other condition, subjects are allowed to borrow funds secured by the accounting value of the assets they own. The potential effect of this additional debt capacity is to increase liquidity in the market. The amount of debt available depends on the reported value of the assets and, consequently, distortions in asset values based on the accounting method used can have an impact on market liquidity.

Our results suggest that the alternative reporting methods have little direct impact on the magnitude or the duration of asset market bubbles. However, when reported asset values are used to determine debt capacity, we find that traders borrow more in a fair value reporting environment and this increased liquidity leads to larger price bubbles of greater duration. Furthermore, loan defaults were more likely in markets where assets were reported using fair value accounting than in markets using historical cost or fundamental value.

We find that the defaults are related to the traders' leverage levels and leverage dynamics can explain why the three accounting alternatives perform differently. In M2F, loans are closely anchored on the fundamental value regardless of the market prices; as fundamental values decline over time, traders are de-leveraged automatically. Throughout all M2F markets, no default is observed though the overall amount of debt is initially comparable to that of M2M. In M2M, financial leverage increases over time as prices appreciate and move in the opposite direction of asset fundamentals. Those traders with high leverage positions are the most likely to be unable to raise sufficient capital to pay back loans at maturity. In these experimental asset markets, prices tend to begin below fundamental value and then race above fundamental value until they run out of steam and crash. With this type of price pattern, the HC treatment provides for a lower debt capacity that eases the unwinding of individual loan positions.

We also find that those subjects who default have the largest discrepancy between their true debt levels (defined as the ratio of debt to total assets at fundamental value) and reported debt levels (the ratio of debt to reported asset values). M2M has a larger discrepancy than HC, that is, M2M understates reported debt levels the most.

The remainder of the paper is organized as follows. Section 2 describes our experimental market design and loan mechanism. Section 3 reports on the bubble characteristics, loan adoptions and defaults, followed by an examination of the leveraging process across treatments. The last section concludes.

2. Experimental Design

We employ a 3×2 experimental design using three different asset reporting treatments and two financial leverage conditions. The alternative accounting treatments include (1) Fair Value (also known as Mark-to-Market -- M2M)), (2) Historical Cost (HC) and (3) Mark-to-Fundamental Value (M2F). Each of these accounting treatments represents an alternative asset valuation framework. In addition, each of these treatments is replicated in two different financial leverage conditions. In the first condition (No Loans – NL) traders must purchase assets from their available cash balances without the option of borrowing. In the second condition, (Loans – L), traders are given the option of taking out loans to finance asset purchases. This design structure is summarized in Table 1.

2.1 Asset Market

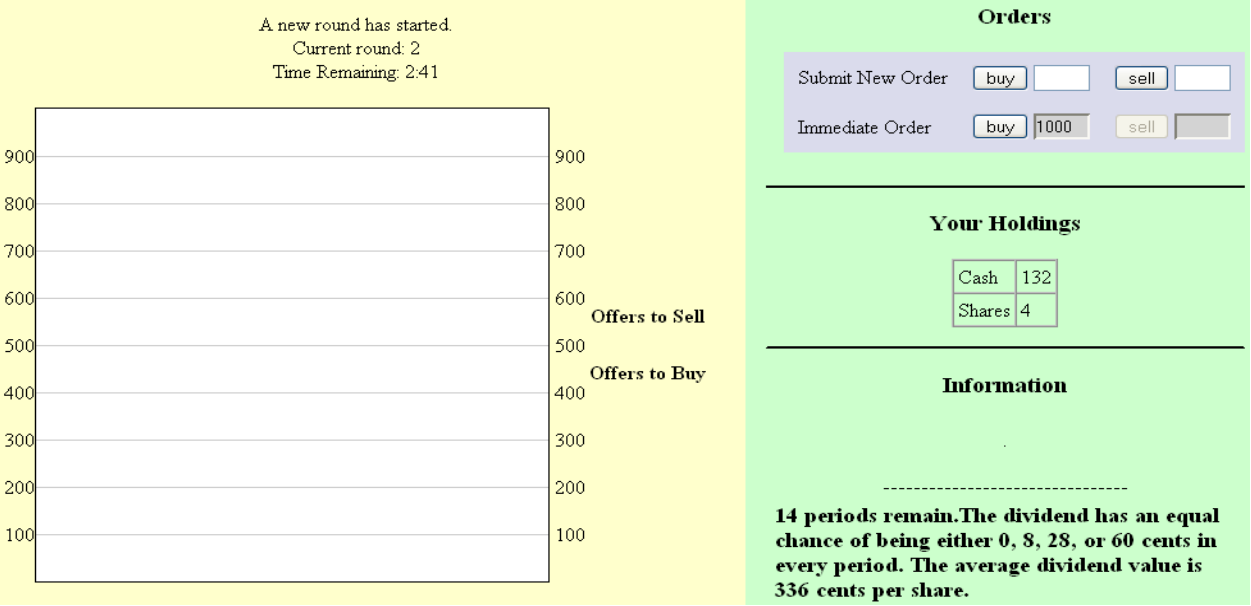
Our market structure follows the type of asset market initiated by Smith, Suchanek and Williams (1988). This design has been used in hundreds of studies and bubbles/crashes are frequent in these markets. Hence, the design is suitable for introducing volatility into the market and offers stress tests for alternative asset value measurement methods.

Our economic environment consisted of a risky asset (a *Share*) that paid a series of dividends with common knowledge on the distribution. The asset was traded in a double auction market during a *trading period*. All prices, dividends, and earnings were denominated in US cents (¢), and paid out at a ratio of 1:1 at the end of the experiment.

Each market is divided into 15 periods. Each share pays a random dividend at the end of each period. The dividend is set at either 0¢, 8¢, 28¢ or 60¢ per period per share. Each of these four amounts is equally likely to occur and dividend draws in different periods are independent from each other. Hence, each share is expected to earn the owner an average dividend of 24¢ per period. Over a lifetime of 15 periods, a share is expected to generate a total dividend payout of 360¢. Dividend earnings are realized at the end of each period and are added to the holder's cash account immediately. Each trader's cash and share holdings carry over to the next period. As periods continue, the expected value of the remaining share dividends is estimated to decline by 24¢ each period. In period 15, there would be one last dividend payment. After that, all shares expire worthless. Thus, a participant's earnings are equal to whatever amount of cash she has at the end of period 15. Trading in each period lasts for 3 ½ minutes. The market setting is common knowledge to all participants. A screenshot of the market information is provided in Figure 1.

Nine subjects were recruited for each market. They each were endowed with a starting portfolio of cash and shares. 3 types of endowments were used: (1080¢, 3 shares), (720¢, 4shares) and (360¢, 5 shares). 3 subjects were allocated with each type of portfolio. The endowments were exactly the same as the "Share Rich" treatment of Caginalp, Porter, and Smith (2001). The endowments were the same for all sessions. Thus, all subjects started with the same expected portfolio wealth of $21.60.

Figure 1: Market Screen Shot



2.2 Accounting Method Treatments

As stated previously, three treatments of accounting methods are tested: (M2F), (HC) and (M2M). At the end of a trading period, a financial report is provided to each subject. The report tells each subject their period dividend earnings and also ***the value of one's share holdings*** determined under the specific accounting rule used in that session.

In the M2F treatment each share is valued at its fundamental value, which is the remaining expected dividend value. For example, at the end of the first period, each share is valued at 24¢×14= 336¢; at the end of the second period, at 24¢×13= 312¢, etc. In practice, this value is not commonly known as it is in our experiment, but it used herein as an idealized benchmark

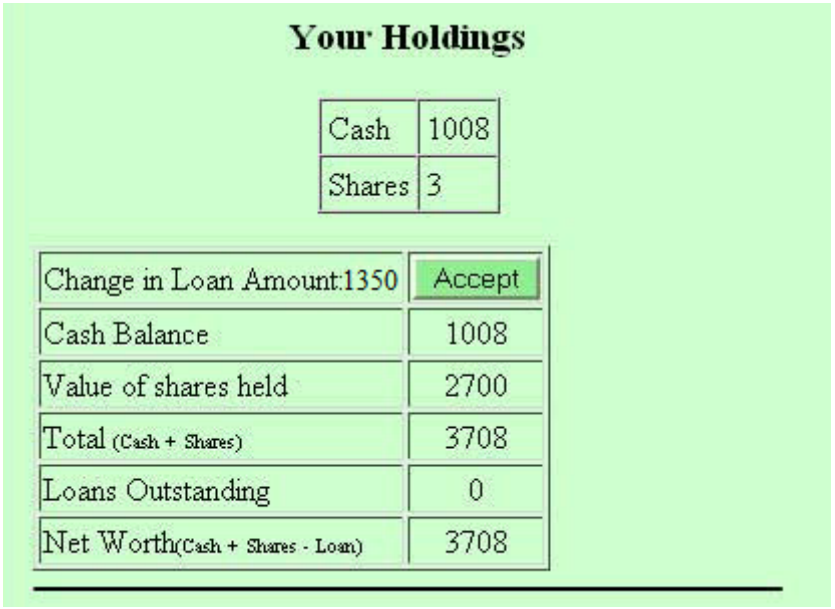
which we can use to contrast with against the other, generally accepted accounting valuation methods.

For the HC treatment each share is valued at its acquisition cost. If a share was purchased at 300¢, it is valued at 300¢. For the originally endowed shares, they were considered as being purchased at 360¢. Since shares are likely to be purchased at different prices we use a first-in-first-out (FIFO) rule to value the inventory after a sale. For example, if a participant made 3 purchases sequentially at 300¢, 350¢ and 400¢, when she sells one share, the total share value based on HC becomes (350¢+400¢=) 750¢.

Finally, for M2M, each share is valued at the closing price of a period. If no trade occurred in a period, the last trade price in the preceding period was used. This event never occurred in our experiments.

To reinforce the reported account values, we asked each subject to write down their share holding values on a piece of paper at the end of each period. The end-of-period accounting report screen can be found in Figure 2.

Figure 2: End-of-Period Financial Report



2.3 Loan Adoption

We evaluate the performance of accounting methods under both a No Loan (NL) and Loan (L) condition. Thus, we have a 3 accounting methods × 2 loan conditions design (See Table I). The three NL treatment end-of-period reports only list "Cash Balance", "Values of Shares Held" and "Net Worth (Cash +Shares)", without mentioning any loan related items. The three Loan treatments allow subjects to accept loans based upon the value of their shares held.

Once asset values were determined by the accounting methods, subjects in Loan treatments were allowed to borrow up to 50% of their reported asset holding values. Specifically, at the end of each period, the loan algorithm evaluated whether to offer more loans to the subject or reduce the outstanding loan amount based on a trader's share value determined by the specific accounting method. At the end of a period, a subject's debt capacity was set at 50% of her current share values. When "Loans Outstanding" was below 50% of share value, the subject was offered the option to take on more debt. In the case when Loans Outstanding exceeded 50% of share value, the excess amount was automatically reduced from the subject's cash balance (a margin call). The new loan availability (available debt capacity) was automatically reflected in "Change in Loan Amount" in the financial report at the end of each round (See Figure 2).

Loans first became available to subjects at the end of period 1. All loans matured in period 13 and were required to be repaid in full at the end of that period. At the end of period 1 through period 12, subjects were given the option to adjust their loan amounts. All loans were provided at zero interest rate for simplicity.

A loan *default* was triggered when the Loans Outstanding amount had to be reduced but the trader's cash position was insufficient to cover the loan repayment. In this case, the trader's account was frozen and she could not trade until she had accumulated enough cash to cover the outstanding loan amount. In the next period, her shares were liquidated by computer algorithm until the excess loan amount was covered. The algorithm was set to automatically sell one of the liquidated shares to the highest available bid in the market every 10 seconds. Once the sale had generated enough revenue to cover the required loan repayment, the account was immediately released back to the trader. In the situation when even complete liquidation did not generate enough revenue to repay the outstanding loan, the account was closed. The subject was considered bankrupt and had zero earnings; any remaining loss was absorbed by the experimenter.

Table I: Design Structure

	Accounting Methods		
Loan Condition	Fundamental Value (M2F)	Historic Cost (HC)	Mark-to-Market (M2M)
No Loan (NL)	3 sessions	3 sessions	3 sessions
Loan (L)	6 sessions	6 sessions	6 sessions

2.4 Subjects, Training, and Incentives

All participants went through intensive training for the experiment. Participants engaged in a 20-minute instruction session, which includes a slideshow with a pre-recorded reading of the instructions in a PowerPoint presentation. After the instructions were read, subjects answered a series of quiz questions about the fundamental value structure, earnings calculation, loan eligibility and requirements, and trading operations. The instructions and quiz questions are provided in Appendix.

When the instructions were concluded, subjects participated in a 2-period practice session to become familiar with the trading and accounting interfaces. Subjects were told that the practice was not related to their earnings and they should feel free to try out the program. At the end of the first practice period, the financial report was explained to them item by item. In the second period, trading continued and at the end of the period the financial report information was reviewed again.

Each participant was paid one dollar for every 100 cents earned through endowments or trading. On average, subjects made $21.86, plus a show-up fee of $7.

3. Results

Let $\overline{P}_t$ be the mean price of period t; FV_t the fundamental value of period *t*; $\overline{FV}$ the mean fundamental value in the market; $MedianP_t$ the median price in period t; N the total number of periods. Following Stöckl, Huber and Kirchler (2010), we analyze the following eight metrics of asset prices:

- Magnitude: $MAG = \frac{1}{N}\sum_{t=1}^{N}(\overline{P}_t - FV_t)$.
- Price Amplitude: $PA = \max(\overline{P}_t - FV_t)/FV_1 - \min(\overline{P}_t - FV_t)/FV_1$
- Total Dispersion: $TD = \sum_{t=1}^{N}\left|MedianP_t - FV_t\right|$
- Average Bias: $AB = \frac{1}{N}\sum_{t=1}^{N}(MedianP_t - FV)$
- Haessels R^2: $HR^2 = R^2$ of the OLS regression $\overline{P}_t = \alpha + \beta FV_t + \varepsilon$
- Duration: $DUR = \max\{N : \overline{P}_t - FV_t < \overline{P}_{t+1} - FV_{t+1} < \cdots < \overline{P}_{t+(N-1)} - FV_{t+(N-1)}\}$
- Relative Absolute Deviation: $RAD = \frac{1}{N}\sum_{t=1}^{N}|\overline{P}_t - FV_t| / |\overline{FV}|$
- Relative Deviation: $RD = \frac{1}{N}\sum_{t=1}^{N}(\overline{P}_t - FV_t)/|\overline{FV}|$

These eight measures all provide information on price deviations. For Magnitude, Price Amplitude, Average Bias Duration and Relative Deviation, higher values are associated with larger bubbles. Total Dispersion, Haessels R^2 and Relative Absolute Deviation measure how well prices track the fundamental value and provide another perspective on mispricing.

3.1 Accounting Treatments with no Loans

Figure 3 plots the average price per period for the no loan cases. We also report in Table II the bubble characteristics for these cases. We find the typical pattern as with markets when an accounting balance sheet is not provided. In all three treatments, the markets start with under-valuations followed by overvaluations and end with a crash toward the fundamental value. However, the average price in the M2M treatment is higher across periods than either the HC or M2F treatments. M2M by itself seems to make the market more ebullient, however, no statistically significant difference between treatments is found[4]. We next examine how this

[4] Permutation tests with 1500 reps on all pairings do not produce any p-value less than 0.10. Given the size of our sample, the power of our tests is limited.

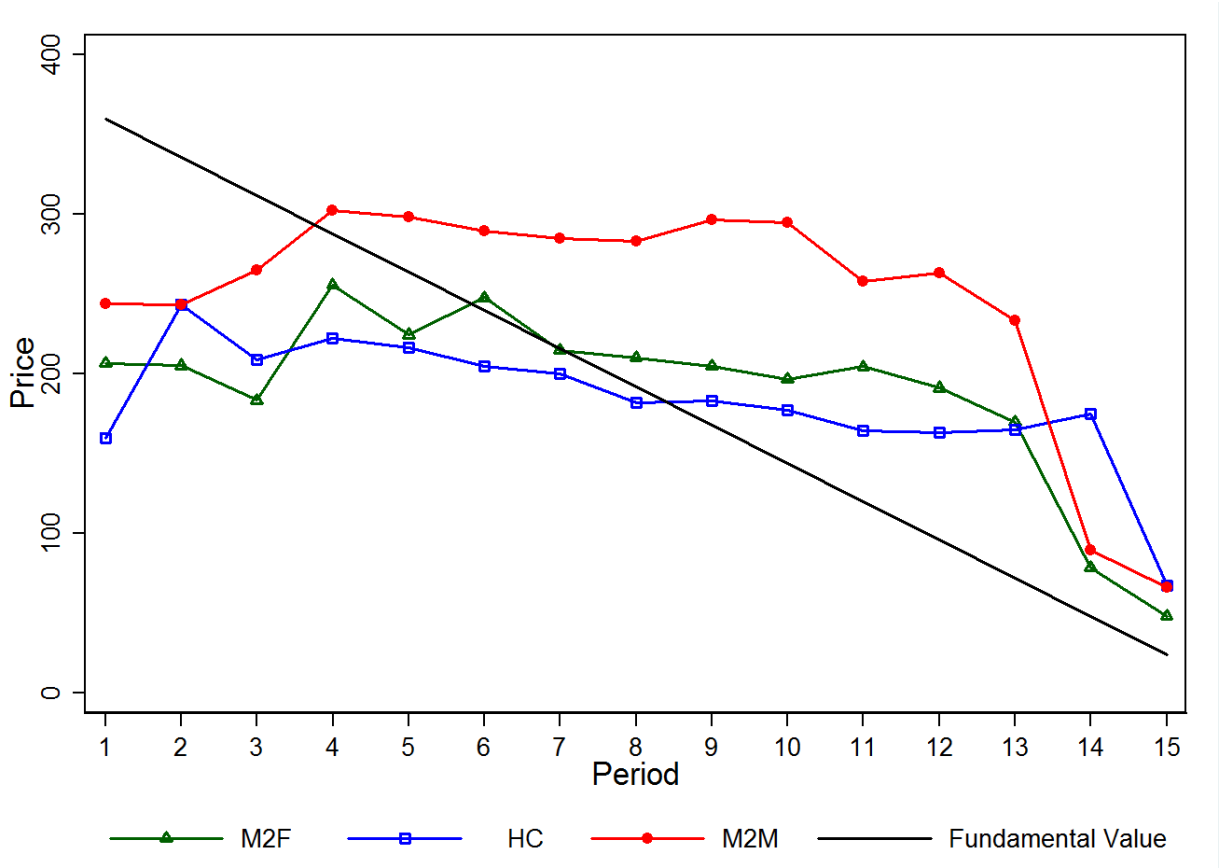
accounting interacts on the financial side of the ledger when this accounting information is used to obtain loans.

Table II. Bubble Measures for the Accounting Treatments without Loans

Bubble Measures for No Loan Sessions

	Magnitude	Price Amplitude	Total Dispersion	Average Bias	Haessel R^2	Duration	Relative Average Deviation	Relative Deviation
M2F	-4.98	0.79	1070.00	-2.78	0.30	7.00	0.37	-0.03
HC	-7.91	0.67	962.17	-6.32	0.35	9.00	0.34	-0.04
M2M	56.76	0.78	1266.33	53.84	0.46	10.33	0.44	0.30

Figure 3 Mean Prices for No Loan treatments



3.2 Accounting Treatments with Loans

Figure 4 plots the average transaction prices across periods for the loan cases. As can be seen, M2M markets have higher mean prices than HC markets in all 15 periods. M2F has higher average prices than HC in all periods but the last two periods. Comparing M2M with M2F, the prices in the M2M markets start lower than the corresponding prices in M2F markets, then are higher in periods 10 through 15. Overall, the loan markets produce higher prices than the no loan markets.[5] This is not surprising since there is increased liquidity in periods 2-13 as traders take on more debt.

Figure 4: Mean Prices for Loan Treatments

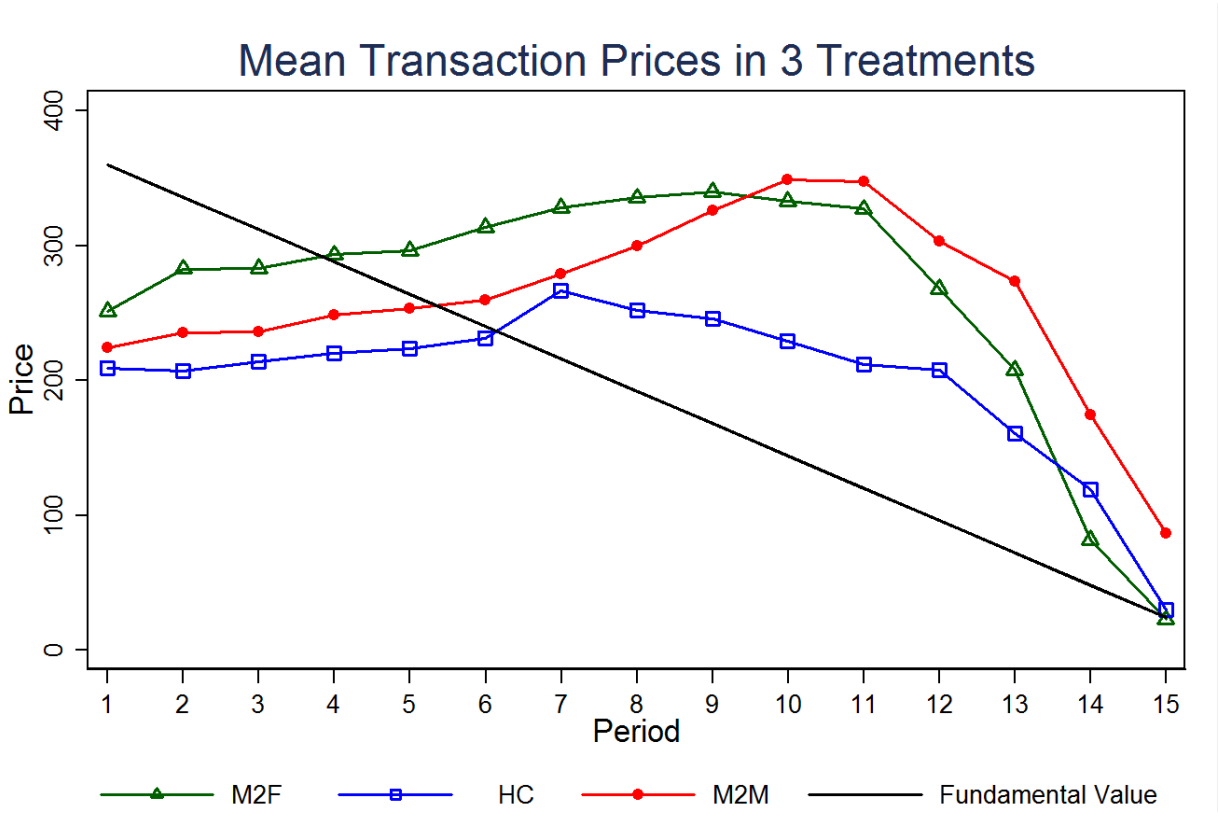


Table III Panel A reports the means of each bubble measure across treatments for the loan cases; Panel B provides p-values from student t tests (1-sided, assuming equal variances) on treatment difference. One striking result is that even if we report asset prices in the

[5] The magnitude, price amplitude and duration of the bubbles were higher for the loan (L) markets than for the no loans (NL) markets for each of the three accounting method treatments. These differences are statistically significant based on a one-sided permutation test on the pooled data (magnitude: $p=0.08$, price amplitude: $p<0.01$, duration: $p=0.04$).

accounting reports at the ***known*** fundamental value (M2F) we still get bubbles that are similar to those that are generated using either of the standard accounting methods to value assets. However, between the two standard methods of asset valuation (M2M and HC), there is a difference in the character of the bubbles. In particular, the size of the bubble and extent of asset mispricing are significantly larger under M2M. One reason for this difference is the effect on market leverage that is created from these two methods. We examine this feature of our experimental design next.

Table III. Bubble Measures for the Accounting Treatments with Loans

Panel A: Bubble Measures for Loan Sessions

	Magnitude	Price Amplitude	Total Dispersion	Average Bias	Haessel R^2	Duration	Relative Absolute Deviation	Relative Deviation
M2F	**72.40**	0.97	1580.33	**72.84**	0.31	9.67	0.542	**0.38**
	(33.64)	(0.33)	(504.42)	(33.76)	(0.26)	(2.42)	(0.17)	(0.18)
HC	8.77	0.90	1577.58	8.11	0.36	11.17	0.540	0.04
	(88.07)	(0.30)	(603.59)	(88.24)	(0.32)	(2.32)	(0.21)	(0.46)
M2M	71.89	**1.23**	**1894.17**	68.68	**0.08**	**11.83**	**0.67**	0.37
	(62.03)	(0.39)	(588.86)	(59.16)	(0.10)	(1.33)	(0.21)	(0.32)

Standard deviations in parenthesis: 6 observations in each treatment. The numbers in bold represent the highest values across 3 treatments.

Panel B: Student *t* test within Loan Sessions

	Magnitude	Price Amplitude	Total Dispersion	Average Bias	Haessel R^2	Duration	Relative Absolute Deviation	Relative Deviation
M2F v.s. HC	0.065*	0.353	0.497	0.062*	0.381	0.149	0.493	0.064*
HC v.s. M2M	0.091*	0.068*	0.190	0.096*	0.033**	0.277	0.161	0.091*
M2M v..s M2F	0.493	0.126	0.172	0.442	0.037**	0.042**	0.143	0.493

Panel B lists the p-values from the 1-sided student *t* test assuming equal variances. * denotes 0.10 significance; ** denotes 0.05 significance.

3.3 Loan Activity

Table IV, Panel A lists the average amount of total debt in the three treatments. Panel B formally tests the differences with a two-sample t test with equal variances and with a two-sample Mann-Whitney test. Again, there is no statistical difference in the debt levels in the M2M and HC treatments relative to using fundamental value accounting (M2F treatment). However, M2M markets have significantly higher debt levels than HC markets.

The higher amounts of debt in M2M and M2F coincide with the higher magnitude and amplitude of the bubbles relative to HC. The liquidity provided by loan availability appears to be fueling the bubble. We formally test this observation using Fama-MacBeth Regression (Fama and MacBeth, 1973). We have 18 markets with 12 periods in each where subjects can take out loans. The Fama-MacBeth regression corrects for the fact that each market is autocorrelated. We begin by first regressing each period's mean price against the corresponding total debt level for every market; second, we measure the average and the standard errors of the coefficients obtained from the first step across 18 markets. The standard errors correct for time-series correlation. Table V provides the regression results. The debt variable has positive and significant on the mean price in each period. This is consistent with the findings of Caginalp, Porter and Smith (2001) that liquidity fuels bubbles. Given the debt exposure in these markets, we now turn to default behavior in these markets.

Table IV. Debt Levels

Panel A

Treatment	Average Total Debt per Period
M2F	2023.5
	(543.7)
HC	1574.0
	(1146.1)
M2M	2507.6
	(1045.2)

Standard deviations in parenthesis. 6 observations in each treatment.

Panel B

Null Hypothesis	*t* test *p*-value	Mann-Whitney Test *p*-value
Loan (M2F)≥Loan(M2M)	0.169	0.100
Loan (HC)≥Loan(M2M)	0.086*	0.055*
Loan (HC)≥Loan(M2F)	0.203	0.261

* indicates 0.10 significance.

Table V: Fama-MacBeth Regression on the Effect of Debt on Market Price

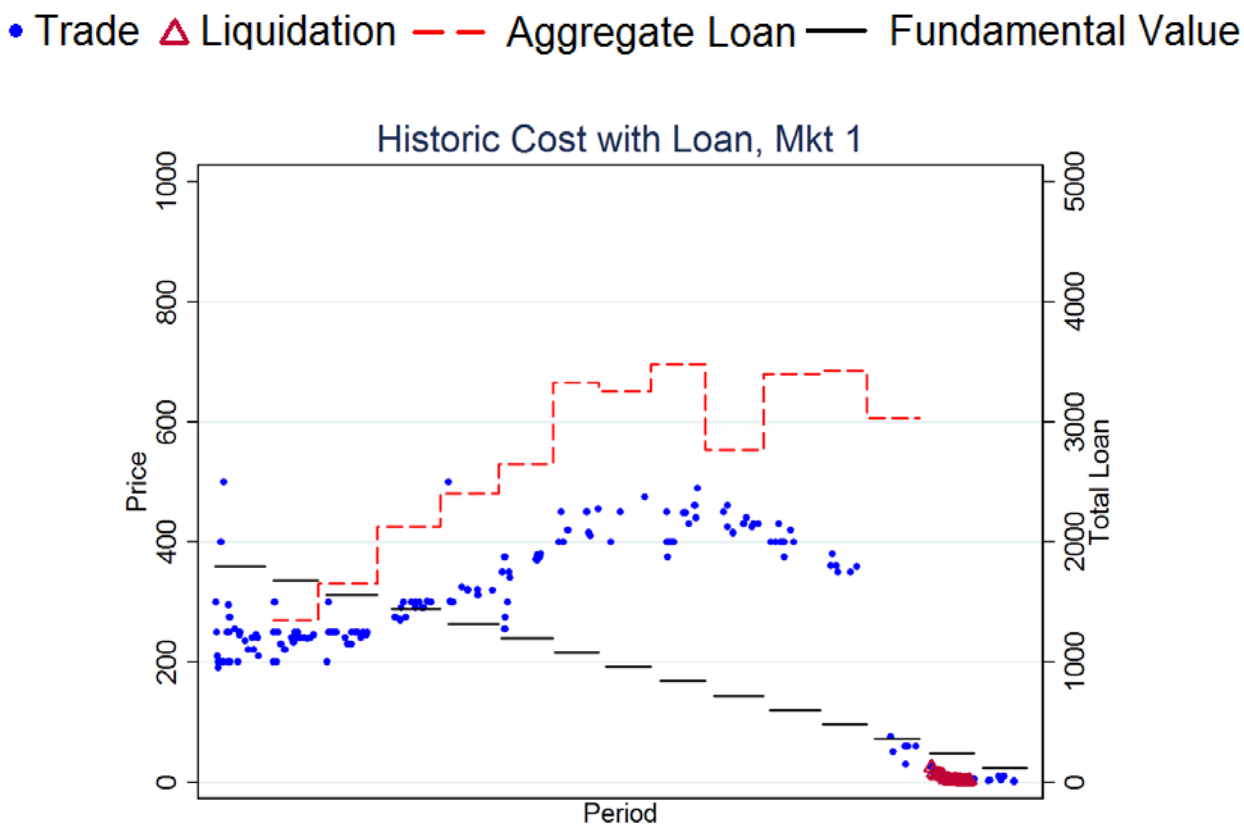
Mean Price	Coef.	Std. Err.	t-stat	P>t
Debt	0.055	0.004	12.46	0.000
constant	155.623	4.866	31.98	0.000
n=216, R-squared=0.372				

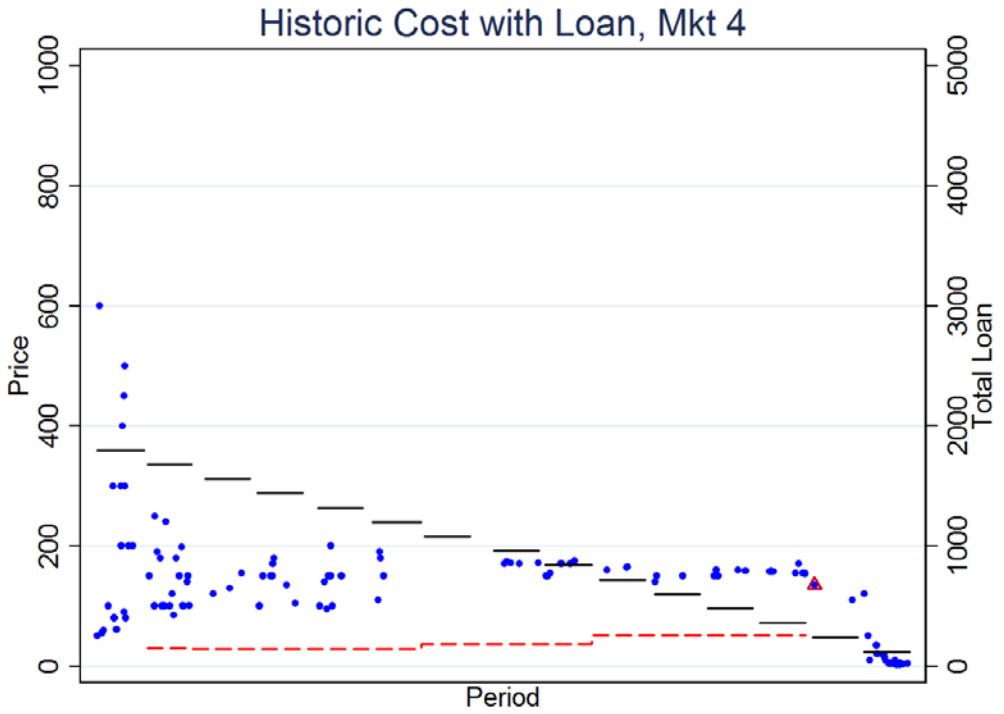
3.4 Defaults

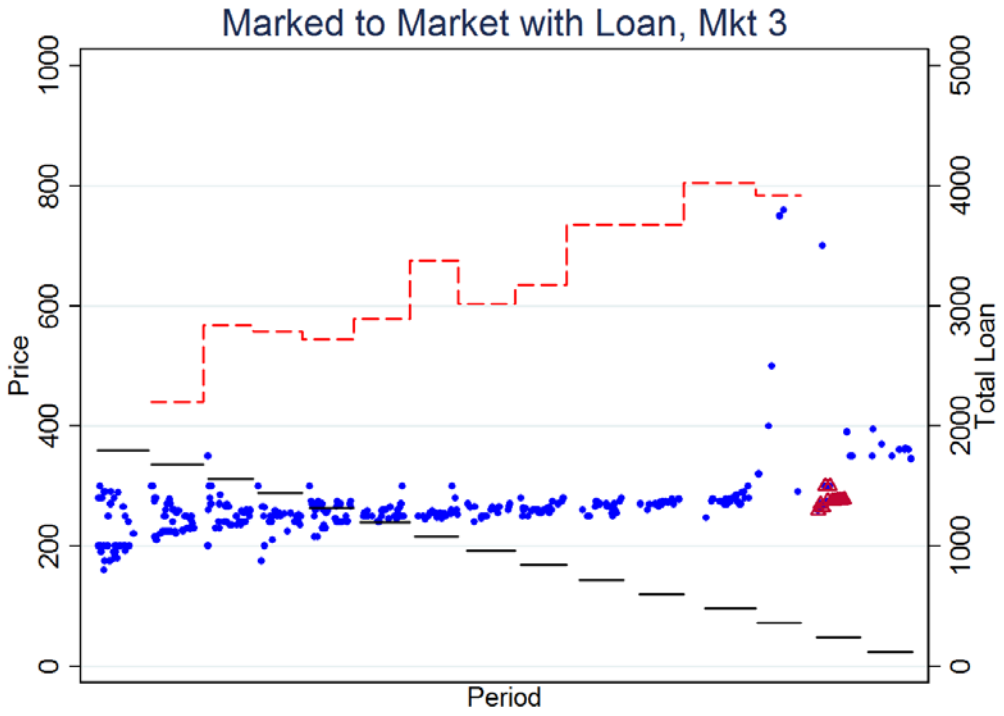
Recall that all loans are due in period 13. A default occurs when a trader's cash holdings fall short of the loan termination amounts. When a default occurs, the defaulter's shares are taken into custody and sold to the current highest market bid at 10 seconds intervals. Once the raised capital from liquidation is sufficient to cover the payback short fall, the defaulter's remaining shares are returned and the trading restriction is removed.

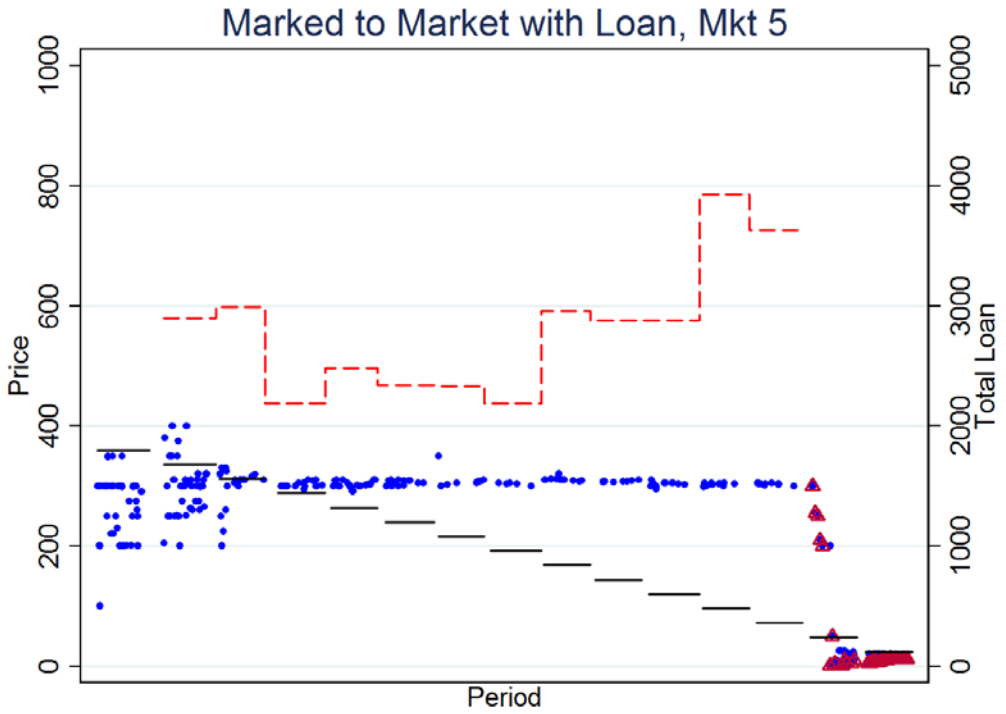
No default was observed in any of the M2F markets, while a third of the HC markets and half of the M2M markets experienced default. In each of those markets, the default event was limited to a single trader. Figure 5 plots the trading prices (including the liquidating trades indicated with a red **Δ**), together with the Total Debt (the dashed line) in each trading period. All the defaults involved a high level of debt except the default in Market 4 of the HC treatment where the default involved the liquidation of just one share.

Figure 5 Markets with Defaults




Historic Cost with Loan, Mkt 4
Price
0
200
400
600
800
1000
Total Loan
0
1000
2000
3000
4000
5000
Period


Marked to Market with Loan, Mkt 3
Price
0
200
400
600
800
1000
Total Loan
0
1000
2000
3000
4000
5000
Period


Marked to Market with Loan, Mkt 5
Price
0
200
400
600
800
1000
Total Loan
0
1000
2000
3000
4000
5000
Period

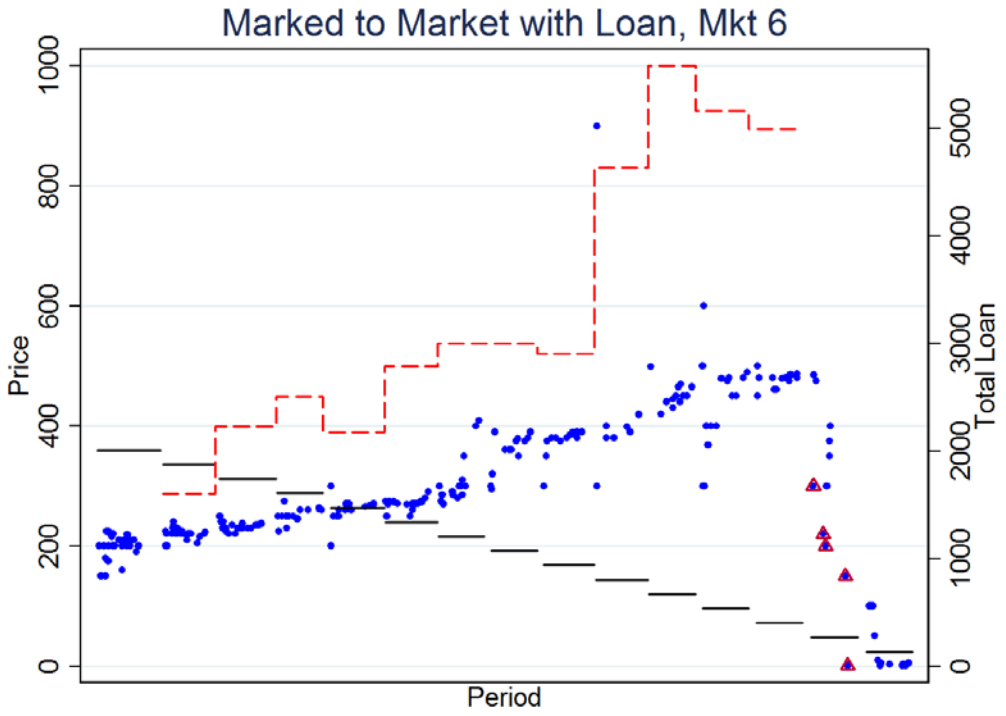

Marked to Market with Loan, Mkt 6
Price
0
200
400
600
800
1000
Total Loan
0
1000
2000
3000
4000
5000
Period

Table VI provides the details of the five defaults. What stands out is the size of the price crash following the default. The average price fall in the two HC markets is 42.7 cents while in the three M2M markets the average crash in price is 194.8.

Table VI. Default Details and Market Crash

Session Name	Shares Liquidated	Defaulter's Cash Shortage in Period 13	Average Liquidating Price in Period 14	Average Trading Price in Period 13	Average Trading Price in Period 14	Price Crash from Period 13 to 14
HC –Mkt1	17	1428	6.8	55.7	5.9	-49.8
HC –Mkt4	1	12	135.0	158.0	122.5	-35.5
M2M – Mkt3	12	3160	277.4	503.3	319.9	**-183.4**
M2M – Mkt5	30	2820	100.2	303.3	83.3	**-220.0**
M2M – Mkt6	5	1033	174.2	477.0	296.0	**-181.0**

3.5 Financial Leverage

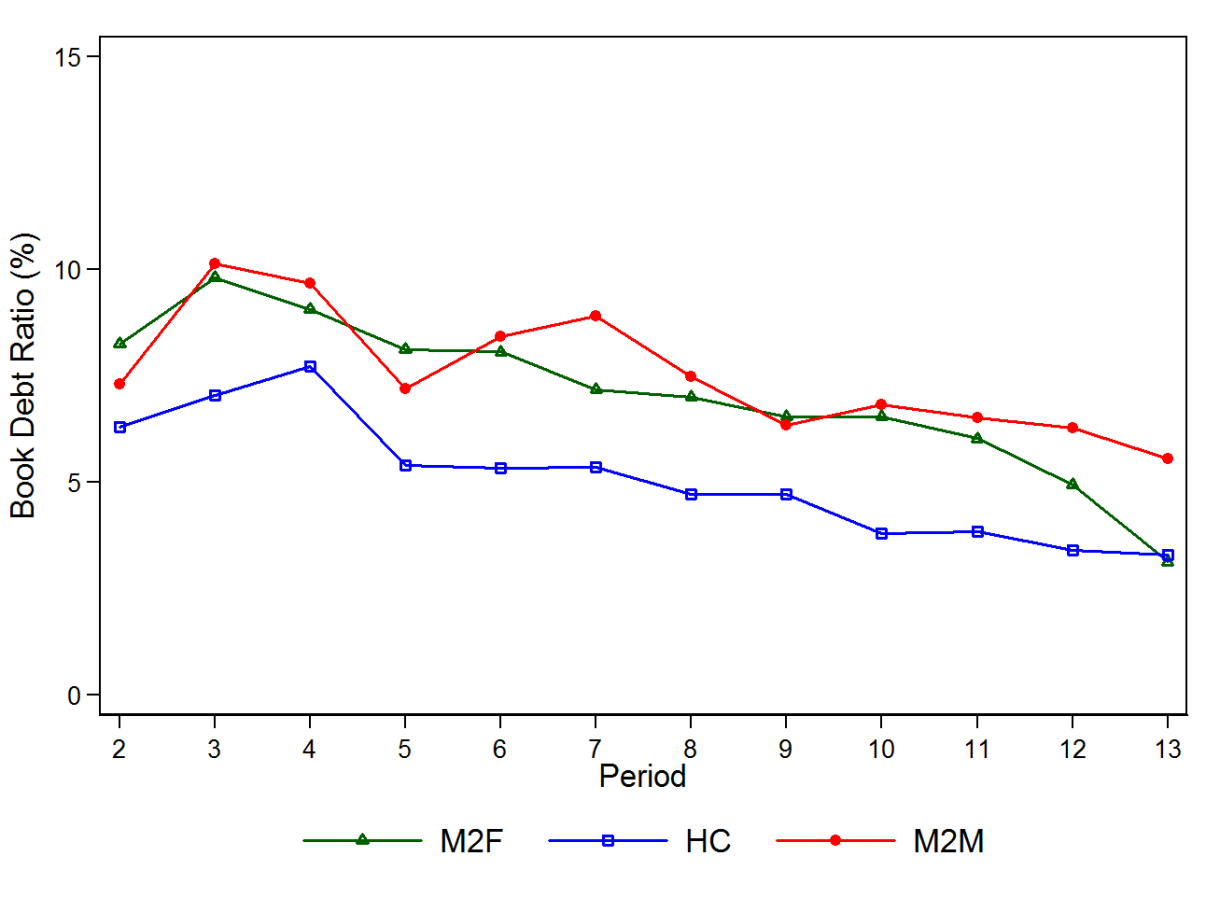
Financial leverage is typically measured as the ratio of total debt to total assets. We employ two definitions of this ratio – a book debt ratio based on reported accounting numbers and a debt ratio based on fundamental value. The book debt ratio is defined as follows:

$$Book\ Debt\ \ Ratio = \frac{Liabilities}{Total\ \ Assets\ on\ Book} = \frac{Loans}{Cash + Share\ \ Accounting\ \ Value}$$

In Figure 6 we chart the average book debt ratio for each period and treatment. Each treatment results in a slight downward trend in this ratio. However, this downward trend is somewhat misleading. As the experiment progresses, dividends are paid, so the overall cash balance increases as the fundamental value (expected remaining dividend) decreases. Fundamental value accounting creates an automatic deleveraging effect as traders are forced to maintain a loan balance at less than or equal to 50% of the reported share value. Hence, the numerator in the ratio declines while the denominator in the ratio remains relatively constant. The decreasing ratio reflects the declining amount of outstanding loans.

In contrast, the reported value of the shares does not decrease in the HC markets and increases over time in the M2M markets, even as cash dividends are paid. Under both accounting regimes, the denominator in the book debt ratio increases each period until the bubble bursts, causing the book debt ratio to trend downward even as loan balances are increasing.

Figure 6. Book Debt Ratio over Time for Three Accounting Treatments



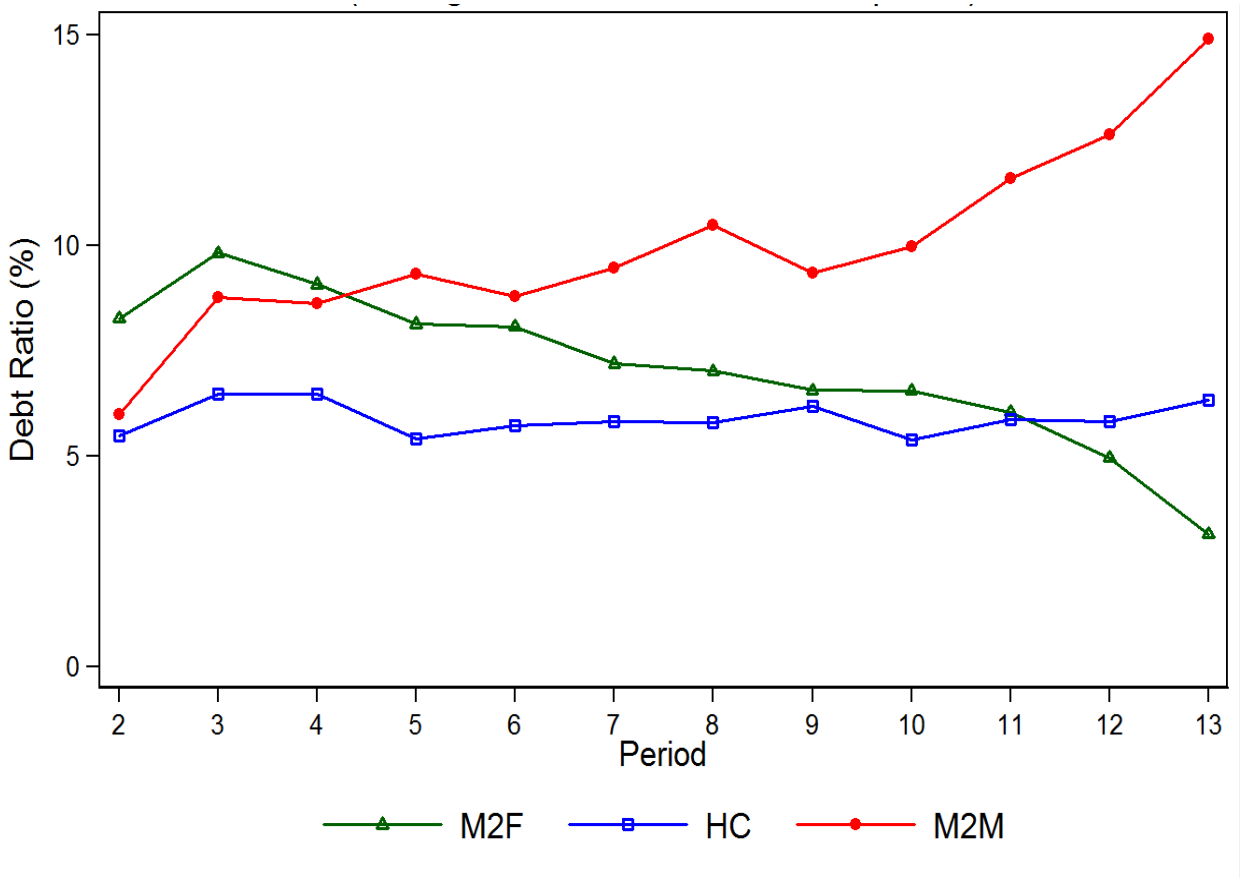
A different perspective on leverage is provided by the debt ratio. The debt ratio differs from the book debt ratio only in the denominator value of the shares held. Instead of using shares' book values reported under each accounting alternative, we use shares' fundamental values. The book debt ratio can be interpreted as a nominal measure of financial leverage, while actual leverage is measured by the debt ratio.

$$Debt\ \ Ratio = \frac{Liabilities}{Total\ \ Assets} = \frac{Loans}{Cash + Share\ \ Fundamental\ \ Value}$$

Figure 7 plots the mean debt ratio among the individual traders in each period for each treatment. For the M2F treatment, the debt ratio is the same as the book debt ratio, by definition. As can be seen, the mean debt ratio for M2F traders tends to decline over time. In contrast, the mean debt ratio for HC traders stays about the same over time, and the mean debt ratio for M2M increases over time and hits its highest value in period 13.

In period 13, the M2M traders have the highest average debt ratio while M2F subjects have the lowest. M2F accounting tracks the fundamental value. The level of individual indebtedness explains why M2M is most prone to defaults and M2F is immune to defaults.

Figure 7. Debt Ratio over Time for Three Accounting Treatments



The book debt ratio gives the impression that financial leverage is decreasing over time. This is true in the M2F markets, where the declining fundamental value forces traders to de-leverage as the experiment progresses. However, in the HC markets, actual financial leverage remains relatively constant while in the M2M markets, actual leverage is increasing. The inflated reported value of the shares in the HC and M2M markets gives the misleading impression that the trader has assets of sufficient value to cover the loan repayment when the loan is due, even as the loan balance is increasing. In fact, when the trader tries to liquidate shares to repay the loan in period 13, the market price crashes to fundamental value and the true level of financial leverage is revealed.

Table VII compares the average debt ratios and book debt ratios in Period 13 for all 18 markets as well as these two ratios for the individual traders who defaulted in each market.

Table VII: Debt Ratio(%), Book Debt Ratio (%) and Defaults at Maturity

					Defaulters	
Treatment	MKT	Debt Ratio	Book Debt Ratio	Anyone Default?	Debt Ratio	Book Debt Ratio
M2F*	1	5.4	5.4	No		
	2	4.8	4.8	No		
	3	1.8	1.8	No		
	4	1.9	1.9	No		
	5	3.8	3.8	No		
	6	7.2	7.2	No		
	mean	4.1	4.1			
HC	**1**	**15.0**	**6.2**	**Yes**	**110.7**	**32.5**
	2	4.7	3.2	No		
	3	0.2	0.2	No		
	4	**4.2**	**2.3**	**Yes**	**38.0**	**21.0**
	5	8.4	4.0	No		
	6	5.5	3.9	No		
	mean	6.3	3.3			
M2M	1	2.1	1.6	No		
	2	8.0	4.8	No		
	3	**17.5**	**5.7**	**Yes**	**144.2**	**40.0**
	4	8.5	6.2	No		
	5	**17.4**	**6.3**	**Yes**	**129.9**	**31.7**
	6	**18.1**	**8.5**	**Yes**	**89.1**	**24.9**
	mean	11.9	5.6			

The ratios are reported for Period 13 when all loans mature. A debt ratio over 100% means that the subject's net equity is negative.

* By definition, the debt ratio is identical to the book debt ratio for M2F markets. These values are included for comparison purposes.

Comparing the debt ratio to the book debt ratio in each market indicates the extent to which financial leverage is understated by the book debt ratio. In all of the M2M markets and all but one of the HC markets, the actual debt ratio is greater than the book debt ratio. In the HC markets, the mean debt ratio is 6.3% compared to an average book debt ratio of 3.3%. In the M2M markets, the difference is more dramatic; the mean debt ratio of 11.9% is more than double the average book debt ratio of 5.6%. Moreover, the markets experiencing defaults have higher debt ratios relative to other markets in the same treatments, while their book debt

ratios are much closer to the average. Table VIII suggests that these defaulters' balance sheets look healthy on paper, while, in fact, they are set up for a difficult deleveraging event.

3.6 Debt and Earnings

Does taking on more debt have an effect on earnings? To answer this question, we regress each subject's earnings against their average loan level across periods:

$$EARNINGS_j = \alpha + \beta \times AVG\_LOAN_j + \varepsilon$$

AVG_LOAN_j measures each subject's average loan holdings from period 2 to period 13. Table VIII reports the OLS regression results in two samples: One includes all subjects; the second excludes those who default.

Table VIII: OLS Regression on Earnings and Loan Level

EARNINGS	All Subjects	Exclude those who default
AVG_LOAN	0.73 (0.27) t=2.74***	1.43 (0.28) t=5.18***
Constant	2010.74 (120.37) t=16.7***	1960.8 (110.75) t=17.7***
	n=162 R2 =0.0447	n=157 R2=0.1475

As can we seen from the table, earnings are positively and significantly related to loan adoption, indicating that financial leverage helps as long as you don't default. Specifically, borrowing early to buy the asset when prices are below fundamental value, riding the price momentum as the bubble grows, and then unwinding the position in a timely fashion, is a strategy that is indeed profitable. Timing is everything.

5. Conclusions

We conduct 27 laboratory markets in which subjects were allowed to trade shares of an asset that paid a cash dividend at the end of each of fifteen trading periods. At the end of each period subjects were presented with a balance sheet detailing their cash position and the value of their shares. The main focus of our study is the effect of alternative accounting methods for valuing assets and their effect on potential asset mispricing.

Our experimental design uses a well-studied environment that reliably produces bubbles and crashes in asset prices. We use this environment to stress test three accounting methods: Mark-to-Market (M2M), Historical Cost (HC), and Mark-to-Fundamental value (M2F). These methods were used to report asset values in a balance sheet to show subjects their net worth position. In addition, a treatment was created to link asset value on individual balance sheets to the ability of subjects to take out loans to increase their cash position. In the treatment when loans are absent, the accounting effects are hardly distinguishable. That is, there seems to be no link between the reporting of balance sheet asset values and the characteristics of the price bubbles. However, in the loan treatments, the bubbles are exacerbated and the characteristics of the bubbles were related to the accounting method used to report asset values.

We examine the leveraging process under each accounting alternative. Overall, M2M and M2F have higher loan presence than HC, and these two have similar loan levels. It is this enhanced liquidity that helps explains the size of bubbles. When asset prices are inflated on the balance sheet, the indebtedness of individual holdings is naturally understated. Both M2M and HC accounting systematically understate the actual debt-to-asset ratios, with their balance sheets appearing healthy on paper. M2M markets experienced the worst market crashes and the most frequent loan defaults. HC markets suffer from the same debt understatement, however, the leverage is limited and thus the deleveraging damage is less severe.

M2M and M2F also differ in leverage levels at different points of time. We find that in M2M markets the debt ratio steadily increases over time which makes M2M markets prone to default at loan maturity. In contrast, debt ratios in the M2F markets gradually decrease as the falling fundamental value provides an automatic built-in deleveraging mechanism. This feature of M2F makes them completely immune to defaults.

Our study demonstrates that the relevance of M2M or HC accounting depends on how well market prices reflect fundamentals (directly or indirectly). When reported asset values depart from fundamental value, markets are vulnerable to costly mistakes and corrections.

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Appendix A: Instructions

Instructions

This is an experiment in market decision making. You will be paid in cash for your participation at the end of the experiment. Different participants may earn different amounts. The amount that you earn will depend on your decisions and on the decisions of others.

The experiment will take place through the computer terminals at which you are seated. If you have any questions during the instruction round, raise your hand and a monitor will come by to answer your question.

If any difficulties arise after the experiment has begun, raise your hand, and someone will assist you.

In this experiment you will be able to sell or buy an item called **Shares**, from one another.

At the start of the experiment, every participant will be given some **Cash** and some **Shares**.

The experiment will last 15 **rounds**. In each round, you are allowed to buy or sell shares in the market.

At the end of EACH round, each share will pay the owner a **dividend**. The dividend per round can be 0, 8, 28 or 60 cents, with equal chances. The dividends will be added to your cash amount.

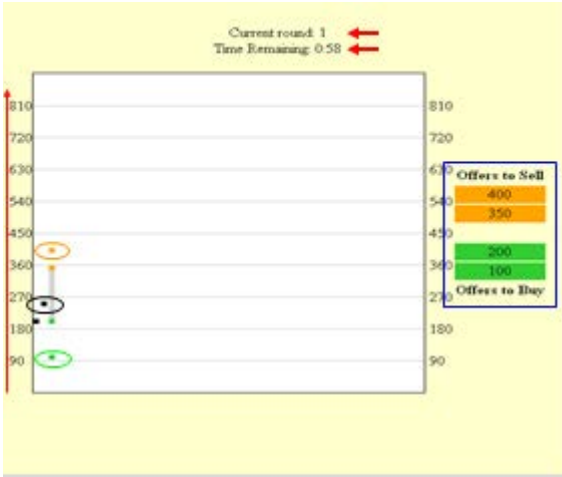
The *average* dividend per share is **24 cents**. That is, over many rounds, the average dividend per round tends to be:
(0 + 8 + 28 + 60) ÷ 4 = 24 cents per share.

If you hold a share from round 1 to round 15, the share will pay you 15 dividends. The total dividend value you receive can be as low as **0 cents** (15 × 0 = 0), if all 15 dividends are **0**; it can be as high as **900 cents** (15 × 60 = 900), if all 15 dividends are **60**.

However, each of the four possible dividend amounts has an equal chance of occurring each round, so it is unlikely that the dividend will be the same amount for all 15 rounds. Because the average dividend in each round is 24, the *average* total value is **360 cents** (15 × 24 = 360).

If you purchase a share in the second round and hold it until the end of the 15th round, the average total dividend value will be **336 cents** (14 × 24 = 336), and could be as low as **0 cents** (14 × 0) and as high as **840 cents** (14 × 60).

At the end of the 15th round, one last dividend will be paid. As in all rounds, that dividend can be either 0, 8, 28, or 60. After that final dividend is paid, the share expires and is worth nothing.



During every round, participants can buy or sell shares from one another by making offers to buy or to sell.

The existing offers are shown on the graph to the left.

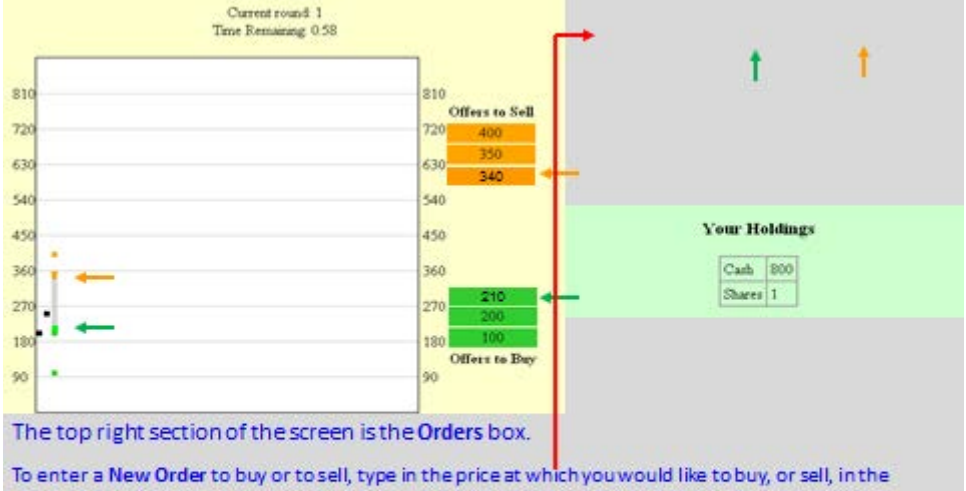
Your Holdings

Cash	800
Shares	1

On top of the graph, the **Trading Round** is shown.
Below that, the **Remaining Time** for the trading round is shown. Each round lasts 4 minutes.
The vertical axis lists the **Price** for the offers.

Every time someone makes an offer to **buy** a share, a **GREEN** dot will appear on the graph to the left.
Every time someone makes an offer to **sell**, an **ORANGE** dot will appear on the graph to the left.
Once a **trade** is actually made, the trade will be shown as a **BLACK** dot in the graph.

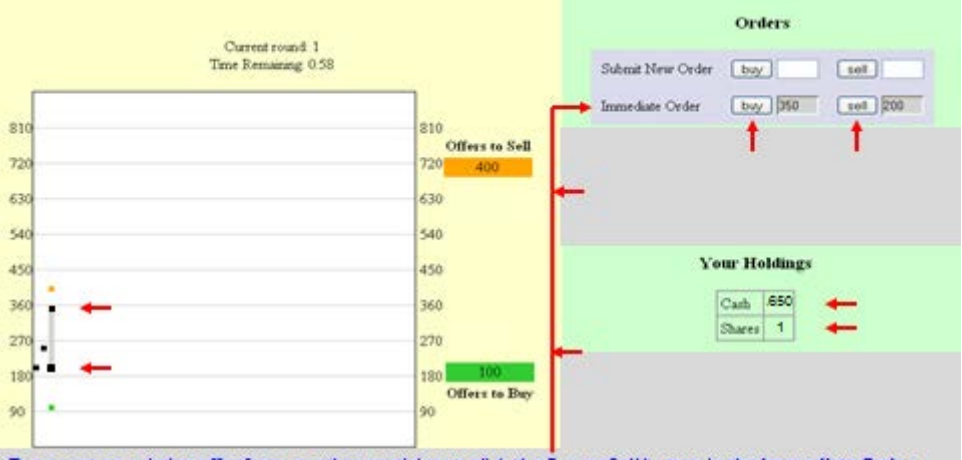
Offers are also listed on the **Market Book** to the right of the graph.



The top right section of the screen is the **Orders** box.

To enter a **New Order** to buy or to sell, type in the price at which you would like to buy, or sell, in the appropriate **Submit New Order** box. Click the **Buy** or **Sell** button to submit your order.
Once the order is entered, the offer will be updated on both the **Market Book** and the **Price Scale**.

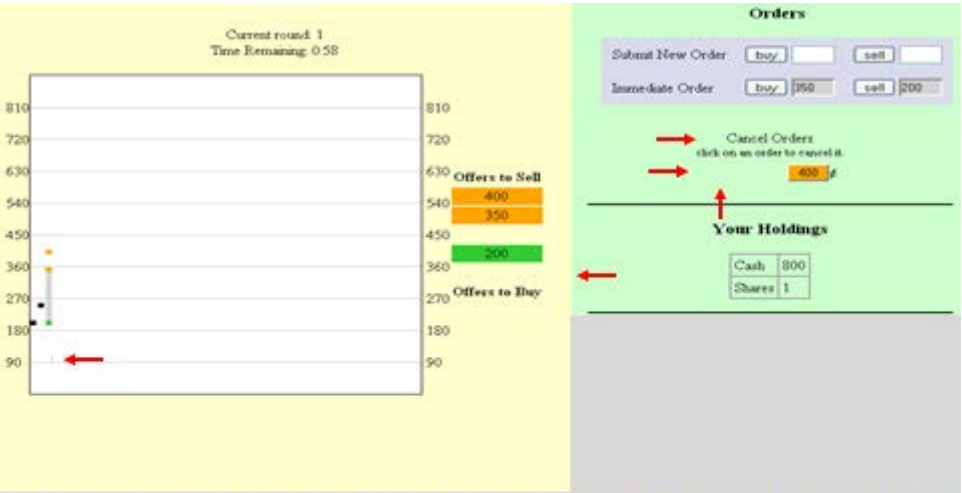
Suppose you want to place an order to buy, it must be higher than the current best offer to buy, which is now 200. Say, you want to buy at 210, you type in 210 and click buy.
Suppose you want to place an order to sell, it must be lower than the current best offer to sell, which is now 350. Say, you want to sell at 340, you type in 340 and click sell.



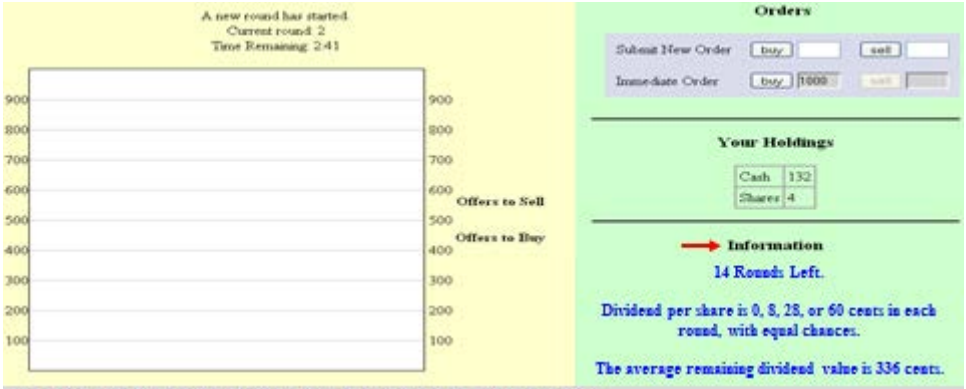
To accept an existing offer from another participant, click the Buy or Sell button in the **Immediate Order** section above. The Immediate Order section shows you the best prices to buy, or sell, that are currently available on the market.

By clicking on the **Buy** button, you **buy** at the listed price.
Say, the current best offer to sell is 350, if you click Buy, you buy a share at the price of 350 immediately.
And your cash holding will drop by 350 and your share number will increase by 1.

By clicking on the **Sell** button, you **sell** at the listed price.
Say, the current best offer to buy is 200, if you click Sell, you sell a share at the price of 200 immediately.
And your cash holding will increase by 200 and your share number will drop by 1.



Whenever you enter new offers to buy, or sell, you will have those offers appear as **Buttons** below the order box.
Your outstanding offers to sell cannot exceed the number of shares you hold in your share holdings; your outstanding offers to buy cannot exceed your cash holding.
Therefore, you may have to delete your offers. To do this, look for "**Cancel Orders**".
By clicking on these buttons, you can take them out of the market.
Suppose you click on the button 100, you will remove it from the market.

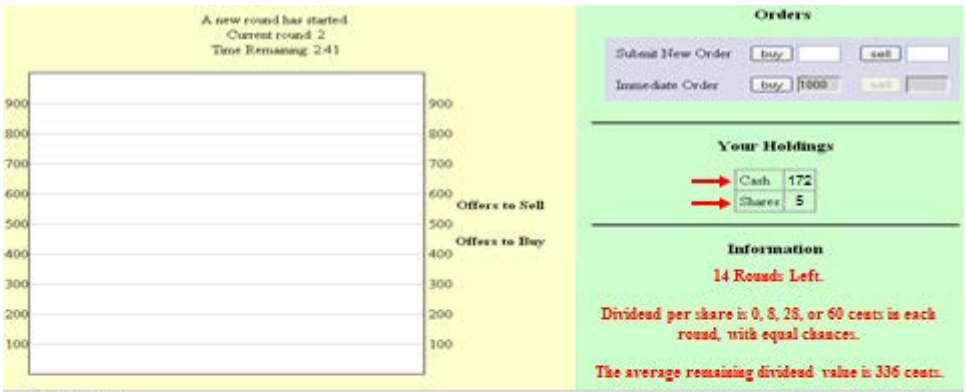


The **Information** section will provide you updates on the following:

- The number of trading rounds remaining;
- The possible dividend results; recall that the result can be 0, 8, 28, or 60, with equal chances;
- The average remaining dividend value, which is the number of periods remaining times the average dividend per round (24 cents). In this case, the remaining dividend value is **336 cents** (14 × 24 = 336).

The earned dividends (for shares) each round will be added to the cash account of the holder. Your cash account will accumulate all your past earnings, and you can use the cash for purchasing shares on the market.

Your shares will also carry over to the next round. The number of your shares will change, only when you buy, or sell, shares.

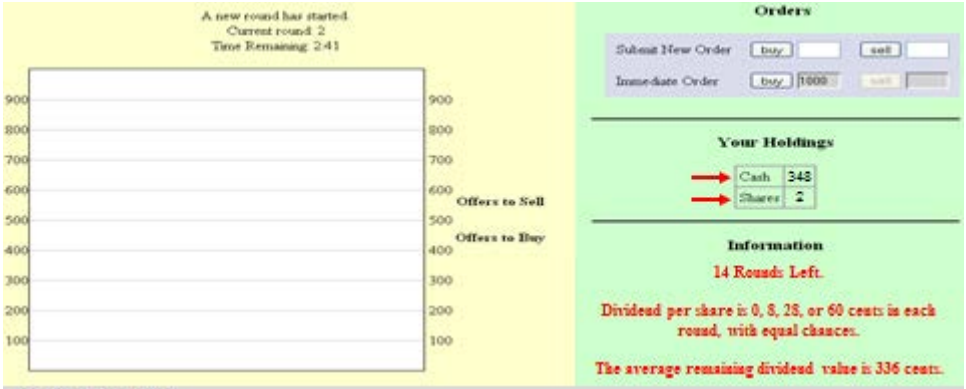


An example:

Suppose you have **4** shares and **132** in Cash at the start of a round,
and you make one transaction during the round purchasing a share for **100** cents during the round,
then: your share holdings will increase from **4** to **5** units ...
and your cash will decrease from **132 cents** to **32 cents**.

If the dividend for the round is 28 cents, then, at the end of the round, your Cash holdings will automatically increase by **140 cents** (28 × 5 = 140).

Your new cash holding will thus be **132 − 100 + 140 = 172** cents.



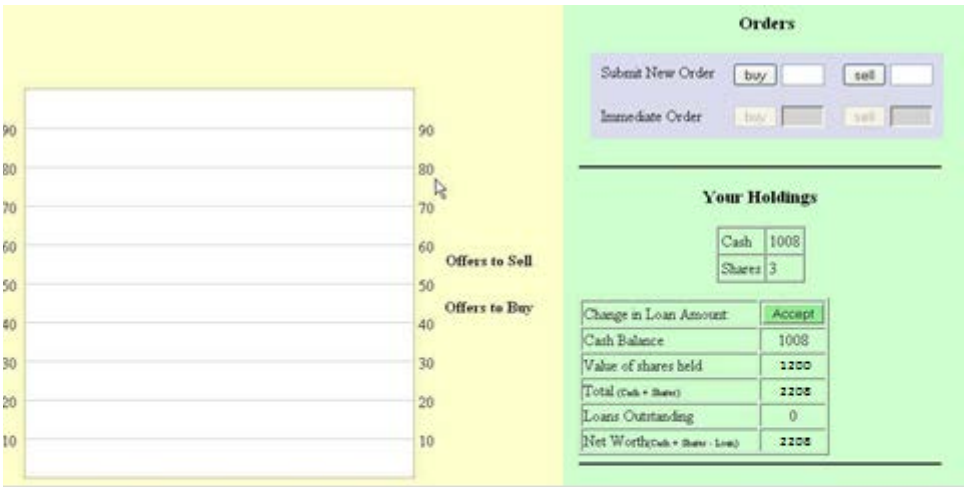
Another example:

Suppose you have **4** shares and **132** in Cash at the start of a round,
and you make **two** transactions during the round selling a share for **110** cents and selling another share for **90** cents.

Your share holdings will decrease from **4** to **2** shares....
and your cash will increase from **132** cents to **332** cents.

If the dividend for the round is 8 cents per share, at the end of the round, your Cash holdings will increase by **16 cents** (8 × 2 = 16).

Your new cash holding will thus be **348 cents** (132 + 110 + 90 + 16 = 348).

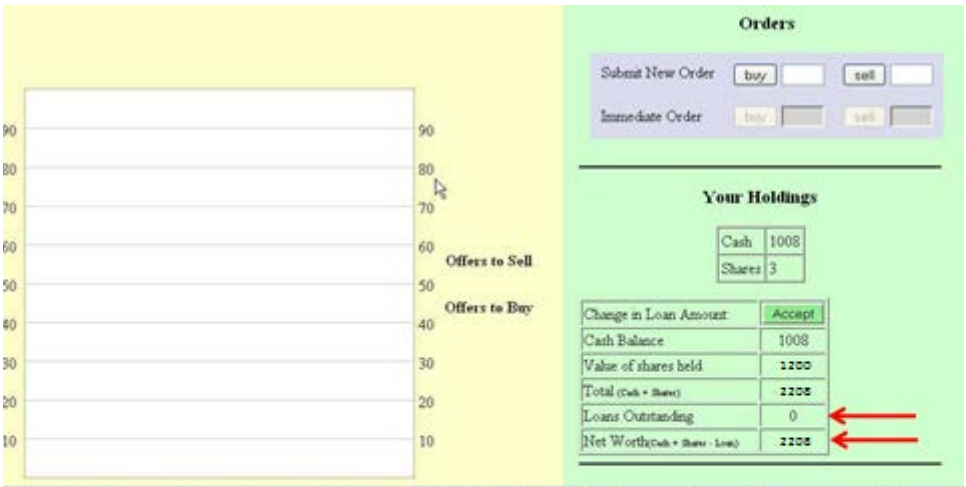


At the end of each trading round, a **financial report** detailing the status and changes in your financial standing will be presented on the screen. You will be given a moment at the end of each round to review this report.

First, the financial report will show the amount of **Cash** you hold. This amount is listed in two places. The cash amount includes any dividends paid on shares at the end of the last round.

Next, the report shows the number of shares held and the **Value** of these shares. This value is equal to the number of shares held times the last price at which a share was traded. In this illustration, the last share traded at 400, so the value of shares held is 1200 (400 x 3).

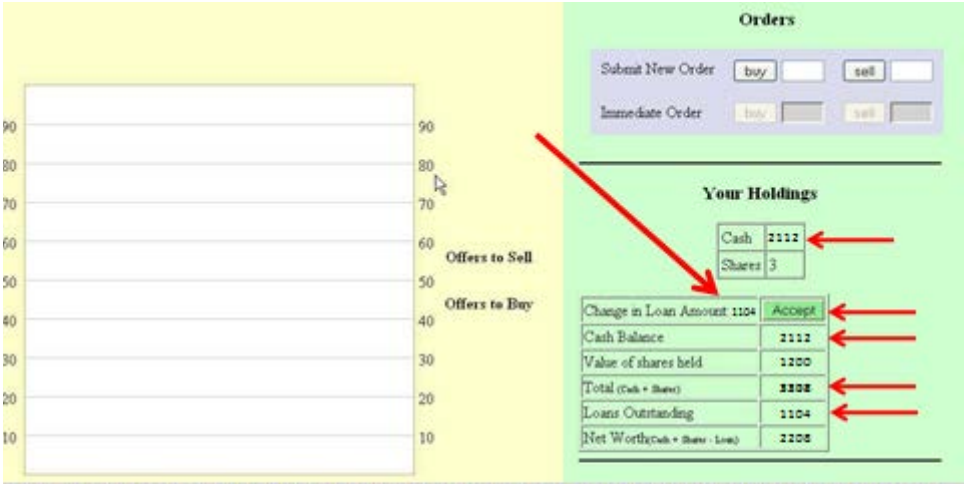
After the value of shares held, the **Total** value of cash and shares is listed.



After each round, you may be given the opportunity to borrow additional cash. This cash may be used to purchase shares in the next round.

Listed immediately below the total value of cash and shares is your amount of **Loans Outstanding**.

After the loans outstanding, your **Net Worth** is listed. This amount is equal to the total value of cash and shares less the loans outstanding.



The amount that you are allowed to borrow at the end of each round will appear at the top of the financial report as the **Change in Loan Amount**.

Next to the Change in loan amount is a button labeled "Accept." If you wish to borrow the amount of money listed as the change in loan amount, click the "accept" button.

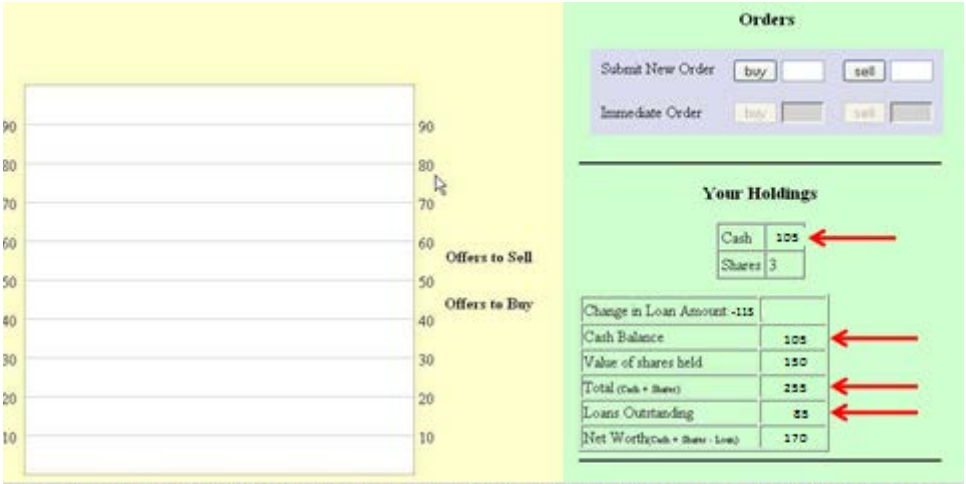
When the loan is accepted, the change in loan amount is added to your cash and to your loans outstanding. Notice that your net worth does not change when you accept a loan.

You may borrow up to 50% of your Net worth at any point in time, but your Loans outstanding may not exceed 50% of your Net worth.

If your Loans outstanding amount is less than 50% of your Net worth, you will be given the opportunity to borrow additional cash up to the 50% limit. The amount of additional loan available to borrow is listed as the Change in loan amount.

If your Loans outstanding exceeds 50% of your Net worth, the excess will be subtracted from your Loans outstanding and your cash automatically.

If your Loans outstanding exceeds 50% of your Net worth and you have insufficient cash to cover the excess loan amount, you will be in default and your shares will be repossessed and sold to pay down the loan.



To illustrate what happens when your loan exceeds 50% of your Net worth, assume that, at the end of a round, you are left with 220 cents in cash and 3 shares. The last share traded for 50 cents, so the shares are worth 150 (3 x 50).

The total cash and shares is 370 (220 + 150). The loan outstanding is 200 and net worth is 170.

Because your loan amount is greater than 50% of your net worth, the loan will be automatically reduced to 85 cents. This is done by subtracting 115 from the loan outstanding and from cash.

As another example, consider this individual who ended a round with cash of 168 and 6 shares. The share price was 1 at the end of the round, so the value of his shares is 6 cents (6 x 1).

The total value of cash and shares is 174 (168 + 6). The loan outstanding is 1997, leaving a net worth of -1823.

This loan is in default. The loan outstanding is greater than 50% of the net worth and the available cash is insufficient to repay the loan. Thus, the cash and shares are repossessed.

Summary

1. You will be given an initial amount of Cash and Shares.
2. Every share generates a dividend of either 0, 8, 28 or 60 cents at the end of each of 15 trading rounds. Each dividend has the same chance of being picked at the end of each round. Thus, the average dividend per round is 24 cents.
3. You can submit offers to BUY shares and offers to SELL shares.
4. You make trades by buying at the current lowest offer to sell or selling at the current highest offer to buy.
5. The market lasts for 15 rounds. At the end of round 15, there will be one last dividend draw. After that, all shares expire and are worth **nothing** to you.
6. A report on your financial status is provided at the end of each trading round. The report details your cash, share value, loans outstanding and net worth.
7. A practice round will be given for participants to become familiar with the program.

A short quiz follows. When you are ready to take the review quiz, please click **Next**.

Appendix A: Quizzes

Questions for both No Loan and Loan Treatments

(1) How many dividend payments would a share pay out in the experiment? (Answer: 15.)

(2) True or False? Your net worth at the end of a round is your cash plus the value of shares you have on hand minus your loan. (Answer: True.)

(3) What is the average dividend payout per round per share? (Answer: 24 cents.)

(4) How much would a share be worth when the market is closed at the end of round 15? (Answer: Zero.)

(5) The value of each share you held reported in the financial statement at the end of a round is determined by? (Answer: Average Remaining Dividends (in M2F) or Purchase Cost (in HC) or the last transaction price of the round (in M2M))

(6) Your earnings from the experiment will be __? (Answer: Your final cash on hand.)

Additional Questions for Loan Treatments

(1) Your loan can never exceed what __% of your net worth? (Answer: 50.)

(2) Suppose at the end of a period your loan outstanding was 600. Your net worth was 2800. How much can your loan be increased by? (Answer: 800.)

(3) Suppose at the end of a period your loan was 600. Your net worth was 1000, how much of the loan must be paid down? (Answer: 100.)

(4) At the end of which round should loans be paid down completely? (Answer: 13.)

(5) True or False? If you do have not have enough cash on hand to cover the required loan reduction, your shares will be taken into custody and auctioned off at whatever prices available in the market. (Answer: True.)