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Relative Performance Incentives and Price Bubbles in Experimental Asset Markets

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RELATIVE PERFORMANCE INCENTIVES AND PRICE BUBBLES IN EXPERIMENTAL ASSET MARKETS*

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Abstract:

We study experimental markets in which participants face incentives modeled upon those prevailing in markets for managed funds. Each participant's portfolio is periodically evaluated at market value and ranked by their relative performance as measured by short-term paper returns. Those who rank highly attract a larger share of new fund inflows. In an environment in which prices are typically close to intrinsic value, the effect of these incentives is mild. However in an environment in which markets are prone to bubble, mispricing is greatly exacerbated by relative performance incentives, and even becomes more pronounced with experience.

Keywords: relative performance incentives, price bubbles, managed funds markets, asset market experiments

JEL codes: C92, G12, M52

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I. INTRODUCTION

In the aftermath of the global financial crisis, the incentives of participants in financial markets have come under intense scrutiny. Of particular interest is whether these incentives may induce behavior that contributes to the distortion or instability of markets. One channel through which this might occur has been canvassed in research on managed funds. According to this hypothesis, "returns-chasing" retail investors respond to relative performance rankings of funds, such that funds that place highly in rankings attract the lion's share of new inflows. Since managers are typically remunerated as a function of funds under management, their incentives thus have tournament characteristics. They may therefore be tempted to pursue short-term strategies aimed at improving a fund's position in the rankings table, potentially to the detriment of the long-term interests of existing investors (Brown, Harlow and Starks 1996; Chevalier and Ellison 1997).

Information on managed fund rankings is readily accessible to investors, and commonly features in the advertising of funds themselves. The empirical relationship between past performance and new fund inflows has been extensively documented,[1] and the extent to which funds respond to the resulting tournament incentives has been the subject of a lively empirical debate.[2] However, while this literature considers the effect of incentives on the strategies of individual funds, it is silent on the aggregate implications for the performance of the market as a whole. Further, it is critical to recognize that the relative performance that drives fund inflow is necessarily assessed on the basis of paper returns evaluated at market prices. These market valuations need not coincide with a fund manager's own judgment of the "true" intrinsic value of a fund's assets.

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[1] See, for example, Ippolito (1992); Patel, Zeckhauser and Hendricks (1994); Goetzmann and Peles (1997); Sirri and Tufano (1998); Del Guercio and Tkac (2002); and Ivković and Weisbenner (2009). Del Guercio and Tkac (2008) provide direct evidence on the effect of Morningstar ratings.

[2] See, for example, Brown, Harlow and Starks (1996); Chevalier and Ellison (1997); Koski and Pontiff (1999); Busse (2001); Goriaev, Nijman and Werker (2005); and Chen and Pennachi (2009).

When there are strong forces that keep market prices close to intrinsic value, there is little a fund can do to improve its relative performance other than to trade on "fundamentals" – in effect seeking to arbitrage price deviations from intrinsic value more effectively than its competitors. However this is no longer the case when the market is in a bubble. Since it is performance evaluated at market prices that drives new inflows, a manager's short-term incentive to place highly in a rankings table of paper returns may overwhelm longer-term considerations of intrinsic value.

A fund may then attempt to "ride the bubble" by betting that prices it considers overvalued will nonetheless continue to rise. It does this because the manager fears that if the fund sells out of the bubble prematurely then it will lag the performance of its competitors in the short term, and thereby suffer reduced inflows. This is reflected in the observation by fund manager Jeremy Grantham, commenting at a time when he regarded stocks as overvalued, that "fund managers are simply not prepared to take the career risk of being wrong for a little while and losing business" (quoted in Authers 2009). This motive for participating in a bubble is in addition to the standard speculative motive that arises even in the absence of tournament incentives.

Thus we do not suggest that relative performance incentives, in and of themselves, are responsible for igniting price bubbles. Rather, by linking fund managers' short-term incentives to potentially-overvalued market prices, they reinforce the pressure to participate in a bubble, and conversely weaken the corrective forces that might otherwise bring prices back into line with intrinsic values. If this is the case, we would expect such incentives to have greater distortionary potential when the market environment is itself inherently more prone to mispricing.

In this paper, we study the effect of relative performance incentives on price bubbles in a laboratory experiment, in which both intrinsic value and incentives are known and under the control of the researcher. Since we conjecture that the effect of incentives may interact with a market's inherent susceptibility to mispricing, we build on previous experiments which show how this depends upon the parameterization of intrinsic value. Specifically, in markets with declining intrinsic value, price bubbles are pervasive but diminish with experience (Smith, Suchanek and Williams 1988, hereinafter SSW). On the other hand, when intrinsic value is constant, mispricing is not as severe (Noussair, Robin and Ruffieux 2001, hereinafter NRR). We thus expect the effect of incentives to be more pronounced in the former environment.[3]

In declining-value markets without tournament incentives, we replicate previous findings of substantial price deviations above intrinsic value, which moderate with experience in repeated markets. In such an environment, there is potential for incentives to have a distortionary effect. Consistent with this, we find that mispricing is not only significantly greater in the presence of relative performance incentives, it is even significantly *exacerbated* with experience.

In constant-value markets without tournament incentives, we again replicate previous findings of mild overpricing in inexperienced markets, while prices in experienced markets track intrinsic value almost perfectly. In this setting, since the tension between market and intrinsic values is less pronounced, there is less scope to improve relative position by deviating from the pursuit of intrinsic value. We nonetheless observe a modest but significant effect of incentives, which persists with experience. However this is much milder than in the declining-value environment, manifesting itself in the form of sustained overpricing of around five percent.

[3] The SSW design in particular has been extensively adopted as a platform for experimental research to investigate the effects of a wide range of characteristics of both traders and market institutions. See, for example, King et al (1993), Porter and Smith (1995), Ackert et al (2006), Haruvy and Noussair (2006), Fiedler (2011), Cheung, Hedegaard and Palan (2012), and Cheung and Palan (2012).

II. RELATED LITERATURE

James and Isaac (2000) and Isaac and James (2003) study experimental markets in which above-average performers are paid as a function of the extent to which they "beat the market", while those who perform below average are simply paid a flat fee. However under their incentives, the earnings of those who underperform the market are *completely unhinged from intrinsic value*. This can explain why a trader who trails the market as the reporting date approaches may be willing to bid in excess of intrinsic value: they may gamble on the possibility (however slight) that favorable dividend realizations might push their performance above the market average, knowing there is no downside to this because of the flat fee for below-average performers. Further, under the James and Isaac incentives, a participant's relative performance is evaluated solely on their final position at the conclusion of fifteen trading periods. As a result, those who make poor decisions early in the market may find that they are so far out of the reckoning as to simply "give up" and cease to compete in the tournament.[4]

Our tournament design addresses each of these concerns. To ensure that participants' earnings are linked to intrinsic value, we pay out the final value of their portfolios at the conclusion of the experiment. To avoid the possibility that some participants become discouraged from competing in the tournament, we offer several equal-sized bonuses, at evenly-timed intervals over the life of the market. We design these bonuses such that no-one is ever out of contention for a bonus in the current "market year" on account of poor performance in previous years. We also base our analysis of incentives on a between-groups comparison, whereas James and Isaac report within-group comparisons that may be confounded by experience and treatment order.

[4] In the limit, a trader who believes that they are doomed to receiving the flat fee will no longer have any regard for intrinsic value, and may thus be willing to "throw away money" on seemingly "irrational" bids. James and Isaac (2000, p. 1002) acknowledge that this may account for a number of "frustration trades" that they observe.

Robin, Strážnická and Villeval (2012) study the effect of the frequency with which bonuses are paid to the top performers in a market. In the long-term bonus treatment, bonuses are paid only once, upon conclusion of fifteen periods of trade. In this treatment, performance is evaluated as the overall change in a trader's *cash position* over the life of the market. In the short-term bonus treatment, bonuses are awarded after every trading period. In this treatment, performance is assessed as the change in the *paper value* of a trader's portfolio over the preceding period.

Thus in the long-term condition, traders' final share holdings at the end of the experiment are correctly ascribed their terminal intrinsic value of zero. On the other hand, in the short-term condition, traders' interim share holdings are valued at market prices. We suspect that this distinction may have a considerable bearing upon the results. Robin, Strážnická and Villeval find that market prices are less distorted under long-term bonuses, but more distorted under short-term bonuses. We interpret this to be consistent with our intuition that the effect of incentives is distortionary specifically when a tension is induced between the pursuit of market and intrinsic values. However, the magnitude of the effects are modest, and the authors do not consider the effect of experience. By contrast, our central finding concerns the interaction of incentives with experience, as we show that the effect of incentives is exacerbated with experience.

In the studies by James and Isaac (2000), Isaac and James (2003), and Robin, Strážnická and Villeval (2012), as well as our own work, all participants in the experiment are placed in the role of "managers" and presented with an incentive structure that is exogenously determined by the experimenter. Insofar as the incentives deviate from or augment the simple trading profits from the experiment, they may be thought of as modelling, in a reduced-form manner, the incentives induced by funds flow resulting from the underlying funds allocation decisions of investors. By contrast, Asparouhova et al (2010) report an experiment in which distinct groups of participants are placed in the roles of managers and investors respectively, with investors directly responsible for allocating their funds between managers. In this setup, the rewards to higher-performing managers are determined endogenously through the actions of investors rather than exogenously by the experimenter. This approach is clearly distinct from, but complementary to, our own. The authors find that over time, the share of funds allocated to a handful of successful managers increases, and at the same time there is increasing mispricing relative to a theoretical benchmark.

III. DESIGN

A. Overview and rationale

Our design is based on the canonical studies by SSW and NRR. In addition to incentives, we also examine the effect of experience and the parameterization of intrinsic value (which we refer to as the "market environment"). Our analyses of incentives and the market environment are based upon between-group comparisons, whereas we identify the effect of experience within-groups.

Under our baseline incentives, every market participant receives identical periodic bonuses. These model the inflow of new funds under management, and in the baseline they do not depend upon relative performance. Since a participant's actions cannot influence the value of these short-term bonuses, they are motivated solely to maximize the long-term value of their portfolio, and this is evaluated at intrinsic value at the conclusion of the experiment. In our tournament incentives, we allocate short-term bonuses according to each participant's relative performance, as measured by the recent growth in the paper value of their portfolio. Once again, the final portfolio is evaluated at intrinsic value; however the measure of return that is used to construct the rankings table is based upon market price. In this manner, we induce a potential conflict between the pursuit of long-term and short-term measures of value under the tournament.

The first market environment is due to SSW, and we refer to it as a "Smith market". In it, the intrinsic value of shares declines over time. This environment has a known tendency to bubble and crash when participants are inexperienced which, for our purposes, is a double-edged sword. On one hand, this creates the disconnect between market and intrinsic values which we argue to be a precondition for relative performance incentive effects. On the other hand, it obliges us to disentangle the distortion due to incentives from that which is inherent in the environment.

We therefore introduce the dimension of experience, which is known to moderate the tendency for Smith markets to bubble.[5] By considering both inexperienced and experienced markets we are able, firstly, to examine whether the effect of incentives is itself attenuated or exacerbated with experience, and secondly, to compare markets under tournament incentives to a baseline in which the tendency of the environment to bubble has been moderated by experience. In effect, then, we identify incentive effects in Smith markets through their interaction with experience.

We also examine the effect of incentives in a second market environment due to NRR, which we refer to as a "Noussair market". In this design, the intrinsic value of shares remains constant over time.[6] This market has been found to be less bubble prone, although it is not considered entirely bubble-free.[7] Accordingly, the tension between market and intrinsic values is less pronounced, and thus the effects of relative performance incentives may be milder in this environment.

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5 See, for example, SSW; van Boening, Williams and LaMaster (1993); Dufwenberg, Lindqvist and Moore (2005); and Hussam, Porter and Smith (2008).

6 Smith, van Boening and Wellford (2000) examine a related environment ("Asset A1") in which intrinsic value is also constant. However in that design the asset only pays a single dividend after the final trading period, whereas in the Noussair design there are dividends (which may be negative) after each period.

7 See, for example, NRR; and Kirchler, Huber and Stöckl (2012).

B. Parameters common to all treatments

Our unit of observation is a market, with each market composed of nine traders. Each repetition of a market operates for sixteen trading periods. At the start of a repetition, all traders are given identical initial endowments of experimental money and shares. This eliminates any possibility that the composition of a trader's initial endowment might influence their position in a tournament. In each period, the market opens for three minutes during which traders can buy and sell shares in a computerized continuous double auction. At the end of each period, each share pays a stochastic dividend which is the same for all shares in any given period, and which is added to the current owner's money balance.[8] A trader's holdings of money and shares carry over from one trading period to the next within a given market repetition.

In all treatments, the instructions[9] include an "average holding value table" which summarizes, for each period, the sum of the expected dividends that a trader would receive on average from holding a share from the current period through to the end of the sixteenth period. Since this information is provided to every trader, the intrinsic value of shares is common knowledge.

We frame each period as a "market quarter" and four periods as a "market year". Each market repetition thus constitutes four market years. At the conclusion of the first ("inexperienced") repetition, all money and share balances are reinitialized, and a second ("experienced") repetition is conducted. Participants are paid for their decisions in both repetitions, according to their closing money balance after all shares have been exchanged for their final redemption value.[10]

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8 In a Noussair market it is possible for the dividend to be negative. In this case, it is framed as a "holding cost", and subtracted from the owner's money balance at the end of the period.

9 The full text of the instructions for the Smith tournament treatment is contained in the Online Appendix.

10 In a Smith market, this final redemption value is zero.

C. Market environment parameters

In the Smith environment, the dividend takes values of 0, 8, 28 or 60 experimental currency units (ECU), each with equal probability, such that the expected dividend in each period is 24. At the end of the sixteenth period, all shares expire with no remaining value. The (risk-neutral) intrinsic value of a share in any given period is thus 24 times the number of outstanding dividends. In particular, it is 384 in the first period, and declines by 24 after each dividend realization.

Each trader's initial endowment consists of 2,496 ECU and eight shares. In fixing the cash component of the endowment, we take care to ensure that the initial ratio of cash to the intrinsic value of stock is the same as in SSW.[11] This ratio increases over time, as new dividend flows inject cash into the market at the same time as the intrinsic value of shares declines.

In the Noussair environment the dividend process is specified such that its expected value is zero in each period. In particular, dividends take values of −24, −16, 4 or 36 with equal probability, where these represent the corresponding values in the Smith design shifted downward by their expected value of 24. Negative dividends are framed as "holding costs". To bestow shares with positive intrinsic value, each share pays a final redemption value of 400 after the sixteenth period. The (risk-neutral) intrinsic value of a share is thus constant and equal to 400.

The ratio of cash to the intrinsic value of stock is on average constant over the life of a Noussair market. We set the initial ratio to 2:1, making it comparable to the middle periods of a Smith market.[12] We thus endow each trader in our Noussair markets with 6,400 ECU and eight shares.

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[11] That is, 2,496 / (384×8) = 0.8125. For the median trader in SSW, the ratio is 585 / (360×2) = 0.8125.

[12] In period seven of a standard fifteen-period SSW market, the corresponding ratio is on average 2.0208.

D. Incentive parameters

In our baseline markets, every trader receives the same inflow of new money and shares at the end of each market year. Valued at intrinsic value, each bonus is equivalent to one-quarter of the initial endowment. The reason we infuse shares as well as money is to avoid distorting the ratio of cash to stock in the market. If we were to infuse only cash, this could have an inflationary effect for reasons of excess liquidity alone (Caginalp, Porter and Smith 2001). This would intensify any inherent tendency for the market to bubble, potentially confounding the effect of incentives with that of excess liquidity. In a Noussair market, the bonus that each trader receives in the baseline is simply 1,600 ECU plus two shares at the end of each year. In a Smith market, each inflow consists of two shares plus an amount of cash that increases in each successive year, to compensate for the diminishing expected dividend value remaining on each share.[13]

In our tournament condition, the paper value of each trader's holdings of money and shares is computed at the end of each market year. We assess the paper value of shares using the median transaction price in the previous quarter, since this price is more difficult to manipulate than other measures of market value such as the mean or closing price. Each trader is then ranked from one to nine on the basis of the year-on-year growth in the paper value of their portfolio.[14]

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[13] Notice firstly that one-quarter of our Smith endowment is 624 ECU and two shares. By the end of the first year, each share has paid out four dividends. To bring the value of the first inflow back up to one-quarter of the initial endowment, it is thus necessary to add back the expected dividends that would have accrued on these shares ($24 \times 4 \times 2 = 192$ ECU) had they been held since the start of the market. Thus each trader receives two shares and 816 ECU at the end of the first year, with the cash component increasing to 1,008, 1,200 and 1,392 ECU after each successive year. Since the extra cash simply compensates for the dividends that would have been paid had the shares been in circulation since the beginning of the market, the aggregate expected ratio of cash to the intrinsic value of stock is always the same as that which would have prevailed in the absence of any infusions.

[14] In the first market year, we assess the initial value at intrinsic value. However this has no effect upon the outcome of the ranking, since all traders start out with an identical endowment.

There are several reasons why we choose to evaluate performance on a yearly basis. First, we seek to create the possibility of a conflict between tournament competition over bonuses that depend upon short-term market returns and the long-term pursuit of intrinsic value. Second, the comparison of relatively short-term returns would appear to be most salient to the returns-chasing behavior of retail investors in the managed funds markets that motivate our experiment. Finally, we wish to ensure that no participant is out of contention for a bonus in the current year, and therefore discouraged from competing, on account of their poor performance in the past.

At the end of each year, we allocate bonuses on the basis of each trader's rank over the past year. The three top-ranked traders in the market receive new money and shares amounting to double what they would have received in the corresponding baseline. The three middle-ranked traders receive the same inflow as under the baseline, while the three bottom-ranked traders receive nothing. As a result, the aggregate infusion of new money and shares into the market as a whole is the same at the end of each year as in the corresponding baseline.

E. Details of sessions

We conducted our experiments at an Australian research university between August 2009 and May 2010. We over-recruited participants to ensure exactly nine traders in every market. In some sessions we conducted two simultaneous but independent markets on separate sides of the lab, with the instructions explaining clearly that there were exactly nine traders in each market. All participants were currently enrolled students of the university, and none had participated in any previous asset market experiment. We managed the recruitment of participants using ORSEE (Greiner 2004) and the experiment was programmed in z-Tree (Fischbacher 2007).

We conducted a total of six markets in each of the Smith baseline and tournament conditions, and four markets in each of the Noussair baseline and tournament conditions. Each market yields one inexperienced observation and one experienced observation. Sessions ran for approximately 2.5 hours, and the average payment was AUD 46 (USD 39). Table 1 summarizes our design.

[Table 1 about here.]

IV. BUBBLE MEASURES

Since individual transaction prices – as well as the behavior of participants within a given market – are interdependent in complex ways, we focus on the market itself as the unit of independent observation and conduct our analysis in terms of market-level measures of performance. Thus we focus on the effect of incentives on the severity of mispricing at a market level, as opposed to their intermediating effects upon individual behavior.

We follow the experimental literature in computing a range of summary measures of market performance. For those measures defined in terms of period-wise aggregates of price, we take the median transaction price as our summary measure of price in each period. We define the "bubble measures" that we consider in Table 2, and briefly discuss their interpretation below.[15]

[Table 2 about here.]

Amplitude (*AMP*) is a measure of the overall peak-to-trough deviation in period-wise transaction prices from intrinsic value. A large value of this measure indicates large price swings relative to

[15] With the exception of *RD*, each of these measures is bounded below by zero, with larger values indicating more pronounced deviations from intrinsic value. (For *RD*, larger negative values indicate sustained mispricing *below* intrinsic value.) We also analyzed measures of trading volume (*Share Turnover*, King 1991) and price volatility (*Dispersion Ratio*, Palan 2009). However we found no effects of our treatments upon these measures, with one exception: *Share Turnover* was marginally higher in Noussair tournament compared to Noussair baseline.

intrinsic value. ***Duration*** (*DUR*) is the length of the longest sequence of periods over which the deviation of price from intrinsic value increases from one period to the next.

Relative Deviation (*RD*) is a measure of the average strength and direction of deviations in price from intrinsic value. An *RD* value of 0.1 indicates that prices are on average overvalued by 10 percent. ***Relative Absolute Deviation*** (*RAD*) measures the average *absolute* deviation in price from intrinsic value. It differs from *RD* in that it penalizes both positive and negative deviations, where these potentially cancel out in the definition of *RD*. An *RAD* value of 0.1 indicates that prices deviate from intrinsic value on average by 10 percent, without regard for sign.

Finally, ***Relative Efficiency Loss*** (*REL*) combines volume and price information into a single measure that penalizes high turnover at prices that deviate substantially from intrinsic value. An *REL* of 0.5 indicates that the aggregate absolute mispricing of share transactions amounts to 50 percent of the total intrinsic value of all shares, averaged over the life of the market.

V. RESULTS

Table 3 reports bubble measures for each of our Smith markets, along with averages for each combination of incentives and experience. For example, in inexperienced markets with baseline incentives, the mean *RAD* indicates that prices deviate from intrinsic value on average by 38 percent, while the mean *REL* indicates that the aggregate mispricing amounts to 221 percent of the intrinsic value of all shares. Table 4 reports corresponding measures for Noussair markets.[16]

[Tables 3 and 4 about here.]

[16] Appendix Table A1 reports the volume of transactions in each individual market in every period.

Before turning to an analysis of incentives, we first confirm the effect of the market environment in the absence of incentives. In Table 5, we report one-sided *p*-values for the Fisher-Pitman permutation test for independent samples[17] for each of the bubble measures, comparing Smith and Noussair markets under baseline incentives. The one-sided null, motivated by the existing literature, is that the respective measure is no greater in the Smith environment. Contrary to the null, we find that Smith markets are characterized by larger values of each of the measures, with at least marginal significance, with the exception only of the *RD* measure in experienced markets. This confirms that the Smith markets indeed exhibit greater baseline mispricing.

[Table 5 about here.]

We now turn to the results of our Smith markets. We first establish that there is a small effect of incentives in inexperienced markets, and a much larger one in experienced markets. We then show that this occurs both because prices track intrinsic value more closely with experience under baseline incentives, while they deviate further from it with experience in the tournament.

A. Incentive effects in Smith markets

The effect of incentives in inexperienced Smith markets is depicted in the left-hand panel of Figure 1. The lower stepped line shows the time path of intrinsic value, while the upper stepped line represents the *maximum* holding value of a share, in the event that it realizes a dividend of 60 in every remaining period. The long-dashed line depicts the average price path in the six baseline markets, while the short-dashed line represents the six tournament markets.[18] While prices are consistently higher in tournament markets, the two series diverge from around period

[17] This is a more powerful, computationally-demanding alternative to the Wilcoxon rank-sum test (Kaiser 2007).

[18] We compute the median price in each period for each market, and plot the average for each incentive condition.

twelve onward. The background shading depicts the significance of the differences in one-sided permutation tests, using period median prices in each market as independent observations.[19] It shows that the differences are at least marginally significant from period thirteen onward.[20]

[Figure 1 about here.]

In the left-hand panel of Table 6, we report one-sided *p*-values of permutation tests for each of the bubble measures in inexperienced Smith markets. The one-sided null is that the respective measure is no larger under tournament incentives. Contrary to this, we find that the tournament condition is associated with significantly larger *AMP* and *DUR*. On the other hand, the lack of any significant effect for *RD*, *RAD* and *REL* indicates that, over the full sixteen-period life of the inexperienced markets, prices are not significantly more distorted under tournament incentives.

[Table 6 about here.]

Turning to experienced Smith markets, the right-hand panel of Figure 1 shows that from period three onward, overpricing under tournament incentives is always significantly greater than in baseline markets, at a significance level of at least 5% in one-sided permutation tests.[21] The results of the corresponding tests for our summary bubble measures are reported in the right-hand panel of Table 6. For three of the five measures, a significance level of 1% is attained,

[19] The one-sided null is that the median price in period *t* is no greater under the tournament. Since we perform the test separately for each period, each market contributes only a single independent observation to each test.

[20] Price paths in individual markets are shown in Appendix Figures A1 and A2 for Smith baseline and tournament markets respectively. Prices in baseline markets typically crash back toward intrinsic value as shares approach the end of their life. However this is not the case in tournament markets. Indeed, in five of the six markets, prices remain above the *maximum* holding value over the final three trading periods.

[21] The price paths for individual markets in Appendix Figure A2 show that pronounced bubbles occur in all six experienced tournament markets, and four do not end in a crash. In two markets, prices rise above maximum holding value from as early as period eight, and remain at those levels for the remainder of the market.

notwithstanding that there are only six observations in each incentive condition. We summarize the effect of relative performance incentives in the Smith environment in the following result:

RESULT 1: *In inexperienced Smith markets, the Amplitude and Duration of price bubbles are significantly greater under relative performance incentives. This occurs primarily because these markets typically do not crash back to intrinsic value in the final periods. In experienced Smith markets, prices are significantly more distorted under relative performance incentives. This is the case in all but the very first periods, and is reflected in all of the bubble measures.*

We next show that these effects are observed for two reasons. Firstly, consistent with previous research on Smith markets, prices track intrinsic value more closely with experience in baseline markets. Secondly, in tournament markets, prices in fact become more distorted with experience.

B. Experience effects in Smith markets

The left-hand panel of Figure 2 compares average price paths in inexperienced (long-dashed) and experienced (short-dashed) Smith markets under baseline incentives. Whereas inexperienced markets tend to bubble through the middle periods, experienced markets on average track only slightly above intrinsic value. We compute one-sided *p*-values for the Fisher-Pitman permutation test for paired replicates,[22] and use the background shading to illustrate the significance of the differences according to these tests. The results indicate that experienced baseline markets track closer to intrinsic value with at least marginal significance in periods seven through to thirteen.

[Figure 2 about here.]

[22] This is the single-sample analogue to the test that we use in our market environment and incentive comparisons, and provides a more powerful alternative to the Wilcoxon signed-ranks test. The one-sided null hypothesis is that prices are no higher in the inexperienced repetition.

The left-hand panel of Table 7 reports corresponding tests for our bubble measures. They confirm that bubbles are significantly diminished with experience in Smith markets under baseline incentives. This is the case for all of the measures, with the exception of *Duration*.

[Table 7 about here.]

The right-hand panel of Figure 2 compares average price paths in inexperienced and experienced Smith tournament markets. Prices are generally above intrinsic value in both repetitions, but they are further from it in the *experienced* repetition for all sixteen periods. The background shading represents the significance of these differences, this time under the one-sided null that prices are no higher in the experienced repetition. The differences are at least marginally significant from period two to ten – indicating that a bubble "takes off" earlier in the experienced tournament – and again in periods fourteen and fifteen. The corresponding tests for our bubble measures are reported in the right-hand panel of Table 7. They show that in Smith tournament markets, the experienced repetition is characterized by marginally significant increases in *AMP*, *RD* and *RAD*.

Thus in the Smith environment, the distortionary effect of relative performance incentives is powerful enough that it not only overturns the usual tendency for price bubbles to diminish with experience, if anything it makes them even worse. We summarize the effect of experience in the Smith environment in the following result:

RESULT 2: *In Smith markets with baseline incentives, the effect of experience is to cause prices to track significantly closer to intrinsic value through the middle periods of the market, as reflected in AMP, RD, RAD and RAD. In Smith markets with relative performance incentives, prices deviate further from intrinsic value with experience, as reflected by AMP, RD and RAD.*

We believe that ours is the first result in the literature to identify a treatment that increases price distortion with experience, without changing market parameters between repetitions.[23] Because of this, it is important to consider why this might have occurred. As a starting point, note that mispricing increases with experience in five of our six Smith tournament markets, as measured by both *RD* and *RAD* in Table 3. Appendix Figure A2 reveals that in each of those markets, *the inexperienced repetition does not end in a crash* – in these markets, the median transaction price remains above maximum holding value throughout the last three periods of the inexperienced repetition. By contrast, in the sixth market there is a crash in period fourteen; when this market is repeated, the crash occurs earlier: in period twelve of the experienced repetition.

In the context of SSW markets without tournament incentives, a leading explanation for why mispricing diminishes with experience proposes that traders best respond to their expectations, where these expectations appear to form adaptively by extrapolation from past trends. Haruvy, Lahav and Noussair (2007) elicit traders' expectations of the entire price trajectory in repeated SSW markets. They find that these expectations anticipate the continuation of trends observed in previous repetitions. If traders best respond to such expectations, they will bid up the price in advance of an anticipated boom, before attempting to sell out in advance of the anticipated crash. As a result, the market peak and crash occurs sooner with each repetition. This is precisely what we observe in the one tournament market to exhibit a crash in the inexperienced repetition.

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[23] James and Isaac (2000) showed the effect of incentives in a within-group comparison in which subjects who were experienced with baseline incentives were exposed to tournament incentives. More generally, Hussam, Porter and Smith (2008) found that price bubbles can be "rekindled" among experienced subjects through a combination of increased liquidity and dividend uncertainty. In these results, experienced subjects exhibited increased mispricing when exposed to a new set of parameters, illustrating that "experience is not guaranteed to readily translate between similar but nonetheless different SSW designs" (Palan 2013, p. 573). By contrast, in our Smith tournament we observe mispricing that increases with repetition of a stable set of parameters.

By contrast, if traders' adaptive expectations derived from the inexperienced repetition are for prices to remain at a high level without any ensuing crash – as is likely to be the case in the majority of our tournament markets – then there is nothing that would give them pause to moderate their strategies in the experienced repetition. In short, it appears that the experience of a crash may be pivotal to the salutary effect of market experience. Moreover, it may be the fact that the lure of incentives is strong enough to forestall a crash in the *inexperienced* repetition that accounts for our results in the experienced repetition.[24]

C. Incentive effects in Noussair markets

Because we collected only four observations in each of the Noussair baseline and tournament conditions, we limit our analysis to a between-groups comparison of incentive effects – we lack sufficient observations for anything more than marginal significance in within-group experience comparisons. Figure 3 summarizes average price paths for the Noussair baseline and tournament conditions. Once again, the background shading represents the significance of the difference between incentive conditions in a period, in independent-samples permutation tests. It shows that the differences are at least marginally significant in almost every period across both repetitions.[25]

[Figure 3 about here.]

24 Consistent with this conjecture, note that there is also one baseline Smith market in which the inexperienced repetition does not end in a crash. In this market, the experienced repetition again does not end in a crash.

25 Price paths in individual markets are shown in Appendix Figures A3 and A4. After some initial volatility, prices in each baseline market settle at intrinsic value by around period ten of the first repetition, and remain there throughout the second repetition. In contrast, prices take longer to settle in tournament markets, and only one market settles at intrinsic value. Each of the tournament markets nonetheless reaches an "equilibrium" price by around period fourteen of the first repetition, and remains there throughout the second repetition. However in three of the markets this "equilibrium" occurs at a price somewhat above intrinsic value.

Table 8 reports the analysis of bubble measures. In both the inexperienced and experienced repetitions, *RD*, *RAD* and *REL* are greater with at least marginal significance under tournament incentives. In addition, there is a marginally significant effect for *AMP* in inexperienced markets. The effect of relative performance incentives is clearly smaller than in the Smith environment, amounting to overpricing of around five percent in experienced markets, but it nonetheless persists even in a setting in which experienced baseline markets price with near perfect accuracy.

[Table 8 about here.]

RESULT 3: *In Noussair markets, prices are significantly further from intrinsic value under relative performance incentives, across both market repetitions. In particular, prices in experienced baseline markets settle almost precisely at intrinsic value. By contrast, experienced tournament markets remain persistently above intrinsic value.*

VI. CONCLUSION

In a laboratory experiment, we find that asset prices can become very significantly inflated when traders compete to attract new fund inflows, where the size of these flows is determined by their relative performance as measured by short-term paper returns. A recent body of literature argues that this describes the incentives facing professional fund managers. We find that the effect of incentives is more severe when the environment is such that the tension between the pursuit of short-run market value and long-run intrinsic value is greater.

We observe our most pronounced effects in the Smith environment. This is sometimes criticized on the grounds that its declining-value feature is not a fair representation of real-world financial markets (Kirchler, Huber and Stöckl 2009). On the contrary, we consider the Smith environment to be a reasonable model of market conditions during a period of market turbulence – that is, when investors are reassessing expected future stock earnings in a downward direction – pointing, in the limit, to the possibility of a firm's bankruptcy. In our Smith baseline condition we confirm that, with experience, market participants learn to incorporate such expectations into the price; however, such judgments appear to be overruled in the presence of relative performance incentives. We consider these to be our primary results.

By contrast, we interpret the Noussair environment as modeling a situation in which market fundamentals are stable, and there exists a widely-accepted benchmark of value. This has previously been shown to be a setting in which mispricing is less likely to occur. We find that the effect of incentives is powerful enough to exert a small, but nonetheless discernable effect even in this setting in which the intrinsic value ought to be transparently clear.

Our findings are significant because of the prevalence of relative performance style incentives (explicit or implicit) throughout the economy, because of the influence that fund managers exert in financial markets, and the importance of managed investments to the savings and retirement decisions of retail investors. Notwithstanding the difficulty posed by the unobservability of intrinsic value in real-world markets, our results also challenge regulators to develop more reliable means to inform investors' fund allocation decisions – as opposed to relying upon the dissemination of returns information derived from potentially misleading accounting measures.

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TABLE 1: SUMMARY OF DESIGN

	Smith Environment	Noussair Environment
Number of baseline markets	6	4
Number of tournament markets	6	4
Number of repetitions per market	2	2
Traders per market	9	9
Number of trading periods	16	16
Dividend realizations	0, 8, 28, 60	−24, −16, 4, 36
Expected dividend per period	24	0
Redemption value per share	0	400
Intrinsic value in period 1	384	400
Initial endowment	2,496 ECU / 8 shares	6,400 ECU / 8 shares
Intrinsic value of endowment	5,568	9,600
Initial cash to stock ratio	0.8125	2
Baseline inflow period 4	816 ECU / 2 shares	1,600 ECU / 2 shares
Baseline inflow period 8	1,008 ECU / 2 shares	1,600 ECU / 2 shares
Baseline inflow period 12	1,200 ECU / 2 shares	1,600 ECU / 2 shares
Baseline inflow period 16	1,392 ECU / 2 shares	1,600 ECU / 2 shares
Tournament inflow top 3	Double baseline	Double baseline
Tournament inflow middle 3	Same as baseline	Same as baseline
Tournament inflow bottom 3	Nil	Nil
Exchange rate	500 ECU / AUD	800 ECU / AUD
Average earnings per trader	AUD 45.6	AUD 47.4

TABLE 2: BUBBLE MEASURE DEFINITIONS

Measure and Source	Definition
Amplitude (Haruvy and Noussair 2006)	$AMP = \max_t \left[\left(P_t - f_t \right) / f_t \right] - \min_t \left[\left(P_t - f_t \right) / f_t \right]$
Duration (Porter and Smith 1995)	$DUR = \max_{t,m} \left(m : P_t - f_t < P_{t+1} - f_{t+1} < \ldots < P_{t+m} - f_{t+m} \right)$
Relative Deviation (Stöckl et al 2010)	$RD = \frac{1}{T} \sum_{t=1}^{T} \left(P_t - f_t \right) \big/ \overline{f}$
Relative Absolute Deviation (Stöckl et al 2010)	$RAD = \frac{1}{T} \sum_{t=1}^{T} \left\| P_t - f_t \right\| \big/ \overline{f}$
Relative Efficiency Loss (adapted from King et al 1993 measure of *NAPD*)	$REL = \frac{1}{\overline{f}} \sum_{t=1}^{T} \left\{ \sum_{i=1}^{q_t} \left\| P_{it} - f_t \right\| \big/ TSU_t \right\}$

Notes: P_t denotes the (median) transaction price in period *t*; f_t is intrinsic value in period *t*; *T* is the total number of trading periods; $\overline{f}$ is the mean level of intrinsic value; q_t is the number of shares transacted in period *t*; P_{it} is the price of the *i*-th share transacted in period *t*; and TSU_t ("total stock of units") is the total number of shares on issue in period *t*.

TABLE 3: BUBBLE MEASURES IN SMITH MARKETS

	Amplitude	*Duration*	*Relative Deviation*	*Relative Absolute Deviation*	*Relative Efficiency Loss*
Baseline Inexperienced					
Market 101	1.656	9	0.161	0.342	1.039
Market 102	3.501	12	0.170	0.542	2.627
Market 103	2.458	11	0.449	0.472	3.268
Market 104	8.979	3	0.577	0.755	5.574
Market 105	0.573	1	0.015	0.060	0.345
Market 106	0.326	4	−0.089	0.094	0.407
Average	**2.916**	**6.667**	**0.214**	**0.377**	**2.210**
Tournament Inexperienced					
Market 111	9.063	15	0.123	0.480	2.638
Market 112	4.201	10	0.235	0.235	0.681
Market 113	14.411	15	0.785	0.785	1.966
Market 114	7.372	9	0.280	0.288	1.067
Market 115	4.570	8	0.325	0.396	1.194
Market 116	3.047	11	0.685	0.712	3.543
Average	**7.111**	**11.333**	**0.406**	**0.483**	**1.848**
Baseline Experienced					
Market 101	0.333	6	−0.201	0.201	0.585
Market 102	0.923	6	0.085	0.202	0.689
Market 103	1.545	10	0.419	0.421	2.757
Market 104	8.802	14	0.354	0.477	2.875
Market 105	0.550	1	−0.017	0.018	0.121
Market 106	0.458	4	−0.239	0.239	0.799
Average	**2.102**	**6.833**	**0.067**	**0.260**	**1.304**
Tournament Experienced					
Market 111	47.241	15	2.074	2.199	9.831
Market 112	13.685	14	0.847	0.871	2.899
Market 113	10.828	12	1.508	1.508	4.409
Market 114	11.595	8	0.431	0.431	1.004
Market 115	9.339	11	0.373	0.400	0.842
Market 116	1.659	9	0.486	0.503	2.106
Average	**15.724**	**11.500**	**0.953**	**0.985**	**3.515**

TABLE 4: BUBBLE MEASURES IN NOUSSAIR MARKETS

	Amplitude	*Duration*	*Relative Deviation*	*Relative Absolute Deviation*	*Relative Efficiency Loss*
			Baseline Inexperienced		
Market 201	0.298	2	−0.033	0.049	0.997
Market 202	0.100	1	0.001	0.011	0.303
Market 203	0.128	2	−0.013	0.013	0.215
Market 204	0.138	2	−0.022	0.024	0.466
Average	**0.166**	**1.750**	**−0.017**	**0.024**	**0.495**
			Tournament Inexperienced		
Market 211	0.270	1	0.018	0.020	0.599
Market 212	0.311	1	0.240	0.240	1.639
Market 213	0.596	1	0.021	0.078	0.483
Market 214	0.138	3	0.067	0.067	1.090
Average	**0.329**	**1.500**	**0.086**	**0.101**	**0.953**
			Baseline Experienced		
Market 201	0.005	1	0.002	0.002	0.042
Market 202	0.015	1	−0.001	0.002	0.005
Market 203	0.005	1	0.000	0.001	0.088
Market 204	0.030	1	−0.003	0.004	0.011
Average	**0.014**	**1.000**	**−0.001**	**0.002**	**0.037**
			Tournament Experienced		
Market 211	0.005	3	0.001	0.001	0.021
Market 212	0.010	1	0.097	0.097	0.411
Market 213	0.023	1	0.043	0.043	0.213
Market 214	0.065	2	0.048	0.048	0.807
Average	**0.026**	**1.750**	**0.047**	**0.047**	**0.363**

TABLE 5: EFFECTS OF MARKET ENVIRONMENT UNDER BASELINE INCENTIVES

	Inexperienced Baseline			Experienced Baseline		
	Smith (Average)	**Noussair (Average)**	**Permutation test (one-sided *p*-value)**	**Smith (Average)**	**Noussair (Average)**	**Permutation test (one-sided *p*-value)**
Amplitude	2.916	0.166	0.005**	2.102	0.014	0.005**
Duration	6.667	1.750	0.038*	6.833	1.000	0.024*
Relative Deviation	0.214	−0.017	0.052^	0.067	−0.001	0.333
Rel. Abs. Deviation	0.377	0.024	0.005**	0.260	0.002	0.005**
Rel. Efficiency Loss	2.210	0.495	0.052^	1.304	0.037	0.005**

^ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$.

TABLE 6: EFECTS OF TOURNAMENT INCENTIVES IN SMITH MARKETS

	Inexperienced Smith			Experienced Smith		
	Baseline (Average)	**Tournament (Average)**	**Permutation test (one-sided *p*-value)**	**Baseline (Average)**	**Tournament (Average)**	**Permutation test (one-sided *p*-value)**
Amplitude	2.916	7.111	0.037*	2.102	15.724	0.002**
Duration	6.667	11.333	0.040*	6.833	11.500	0.035*
Relative Deviation	0.214	0.406	0.114	0.067	0.953	0.002**
Rel. Abs. Deviation	0.377	0.483	0.232	0.260	0.985	0.005**
Rel. Efficiency Loss	2.210	1.848	0.637	1.304	3.515	0.066^

^ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$.

TABLE 7: EFFECTS OF EXPERIENCE IN SMITH MARKETS

	Baseline			Tournament		
	Inexperienced (Average)	**Experienced (Average)**	**Permutation test (one-sided *p*-value)**	**Inexperienced (Average)**	**Experienced (Average)**	**Permutation test (one-sided *p*-value)**
Amplitude	2.916	2.102	0.047*	7.111	15.724	0.094^
Duration	6.667	6.833	0.563	11.333	11.500	0.500
Relative Deviation	0.214	0.067	0.016*	0.406	0.953	0.078^
Rel. Abs. Deviation	0.377	0.260	0.094^	0.483	0.985	0.078^
Rel. Efficiency Loss	2.210	1.304	0.047**	1.848	3.515	0.125

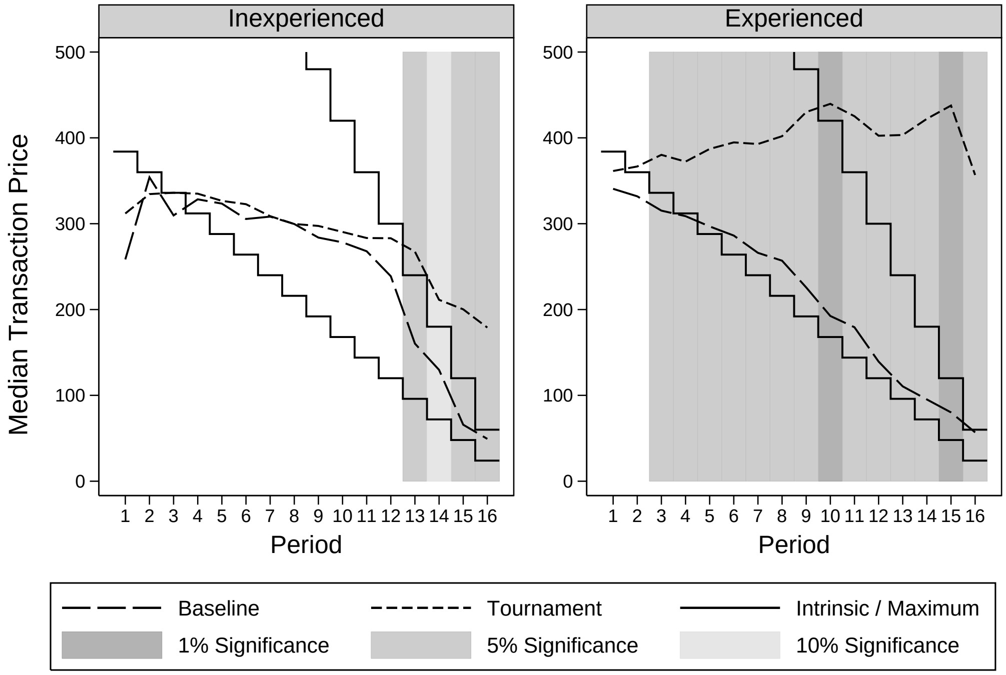
^ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$.

TABLE 8: EFECTS OF TOURNAMENT INCENTIVES IN NOUSSAIR MARKETS

	Inexperienced Noussair			Experienced Noussair		
	Baseline (Average)	**Tournament (Average)**	**Permutation test (one-sided *p*-value)**	**Baseline (Average)**	**Tournament (Average)**	**Permutation test (one-sided *p*-value)**
Amplitude	0.166	0.329	0.086^	0.014	0.026	0.314
Duration	1.750	1.500	0.814	1.000	1.750	0.214
Relative Deviation	−0.017	0.086	0.014*	−0.001	0.047	0.029*
Rel. Abs. Deviation	0.024	0.101	0.043*	0.002	0.047	0.057^
Rel. Efficiency Loss	0.495	0.953	0.086^	0.037	0.363	0.043*

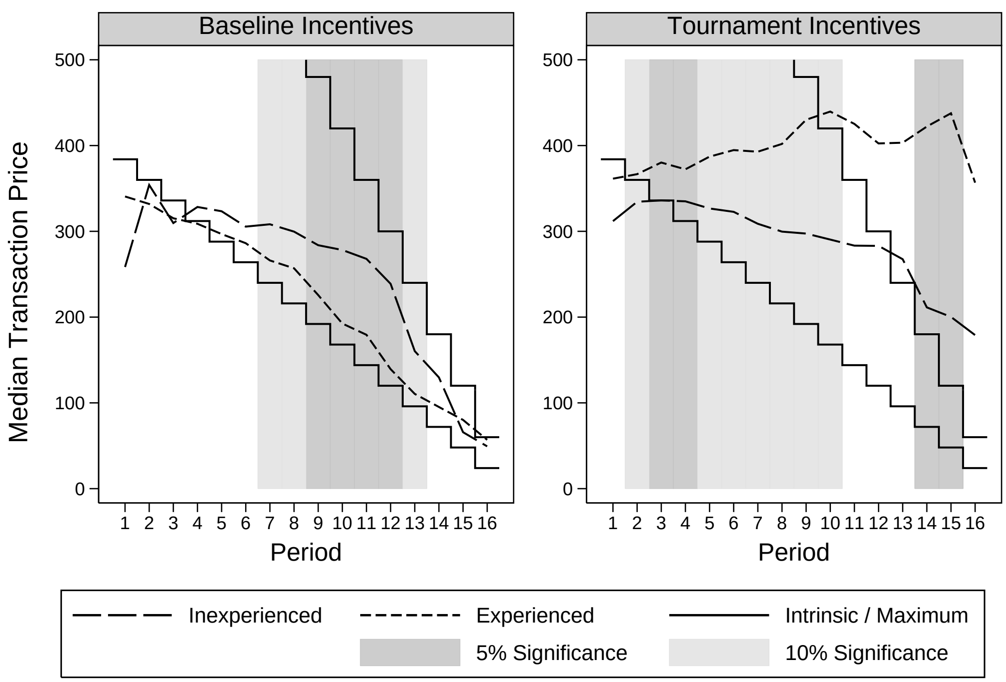
^ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$.

FIGURE 1: INCENTIVE EFFECTS IN SMITH MARKETS



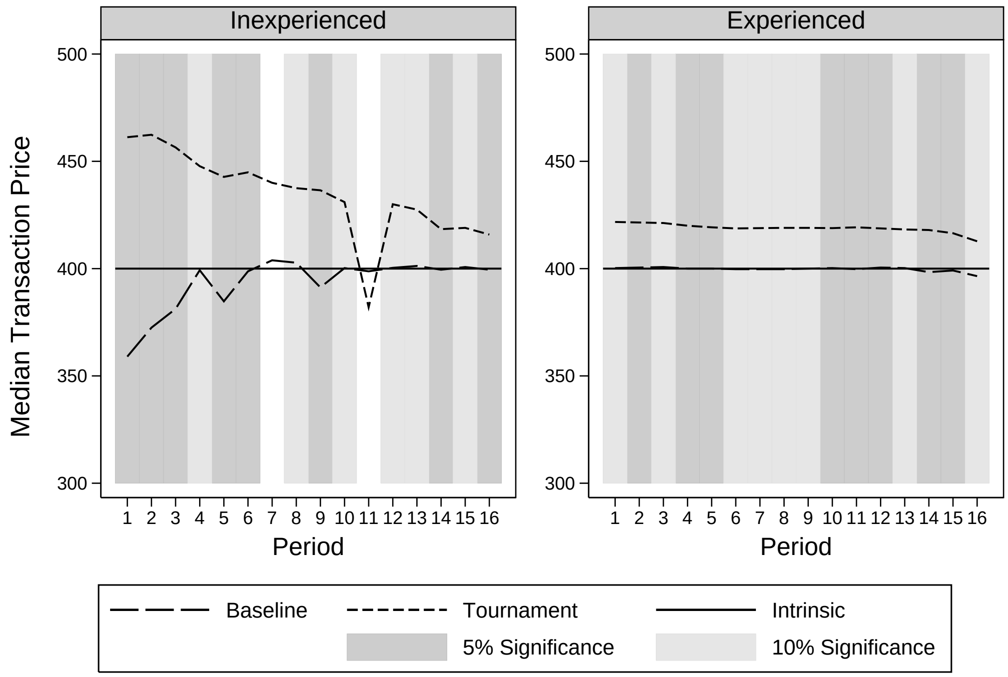
Note: Significance levels refer to comparisons between Baseline and Tournament incentives.

FIGURE 2: EXPERIENCE EFFECTS IN SMITH MARKETS



Note: Significance levels refer to comparisons between Inexperienced and Experienced repetitions.

FIGURE 3: INCENTIVE EFFECTS IN NOUSSAIR MARKETS



Note: Significance levels refer to comparisons between Baseline and Tournament incentives.

APPENDICES – FOR ONLINE PUBLICATION ONLY

TABLE A1: VOLUME OF TRANSACTIONS IN INDIVIDUAL MARKETS, BY PERIOD

	Inexperienced																Experienced															
Period	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Shares on Issue	72				90				108				126				72				90				108				126			
Smith Baseline																																
Market 101	21	23	22	17	11	10	9	13	12	9	20	29	20	17	23	28	22	14	10	20	18	15	16	10	14	12	10	17	27	18	20	10
Market 102	20	28	28	36	40	38	26	28	27	38	43	26	30	18	27	43	25	14	16	19	17	15	27	15	15	22	10	8	17	22	14	27
Market 103	47	28	18	26	24	23	33	22	43	50	41	36	43	29	30	39	49	49	29	36	43	34	28	29	42	42	31	20	78	24	13	27
Market 104	23	46	28	37	33	40	28	41	59	45	25	25	38	36	46	36	37	34	25	25	36	30	29	30	29	47	37	36	33	52	55	42
Market 105	23	21	20	34	31	27	35	26	29	34	41	39	53	39	24	24	27	26	24	22	25	27	20	8	32	15	12	39	16	36	26	43
Market 106	12	16	22	12	21	16	13	16	14	12	13	16	20	22	14	22	17	13	15	24	23	19	21	21	20	16	20	17	23	12	21	12
Smith Tournament																																
Market 111	33	46	40	18	39	19	17	21	15	37	37	34	40	33	25	33	44	33	34	27	26	16	20	21	25	25	34	31	38	43	44	20
Market 112	14	19	11	19	18	12	9	17	15	24	15	12	7	10	16	35	24	12	11	9	11	21	18	19	19	25	31	7	47	28	22	20
Market 113	15	10	8	9	18	26	11	3	16	14	25	14	32	8	10	19	28	15	11	16	26	17	19	19	24	19	14	16	30	28	7	28
Market 114	23	30	31	49	57	28	37	62	20	24	24	22	26	19	15	13	24	16	13	19	20	6	11	9	16	9	13	38	25	21	14	6
Market 115	10	19	19	17	22	22	19	18	14	15	13	10	13	15	16	16	32	21	18	24	22	15	15	16	14	13	13	14	12	8	8	16
Market 116	43	54	31	38	42	22	33	12	16	22	40	22	31	33	11	14	24	14	28	15	15	17	18	20	17	29	13	21	35	33	32	19
Noussair Baseline																																
Market 201	29	50	54	18	33	21	27	21	49	12	13	28	58	67	42	70	65	34	36	40	46	52	26	27	52	10	57	30	68	30	22	17
Market 202	29	36	25	24	15	18	18	15	27	29	15	34	21	37	51	10	43	7	17	8	26	2	11	24	21	2	12	18	26	17	4	24
Market 203	22	35	28	36	33	22	8	12	15	21	15	11	18	17	17	41	24	20	10	20	17	11	13	18	23	20	19	11	4	36	29	52
Market 204	26	36	28	11	17	14	11	21	24	19	6	15	7	12	11	14	7	17	12	11	7	13	9	11	23	23	2	5	16	25	7	11
Noussair Tournament																																
Market 211	27	47	24	19	13	22	19	35	36	50	34	22	33	25	20	22	30	37	47	33	27	46	13	26	37	8	54	24	18	14	41	27
Market 212	16	30	35	74	63	47	37	30	37	28	25	22	24	21	13	22	31	19	11	31	38	34	32	22	19	29	28	25	28	15	17	11
Market 213	19	32	30	24	36	22	19	23	38	29	32	32	44	26	36	23	19	27	19	21	35	38	25	40	22	17	20	37	59	30	14	49
Market 214	36	47	76	73	77	84	93	102	91	81	87	72	82	78	60	71	97	85	104	84	72	85	86	75	67	78	59	68	38	52	32	38

FIGURE A1: PRICE PATHS IN SMITH BASELINE MARKETS

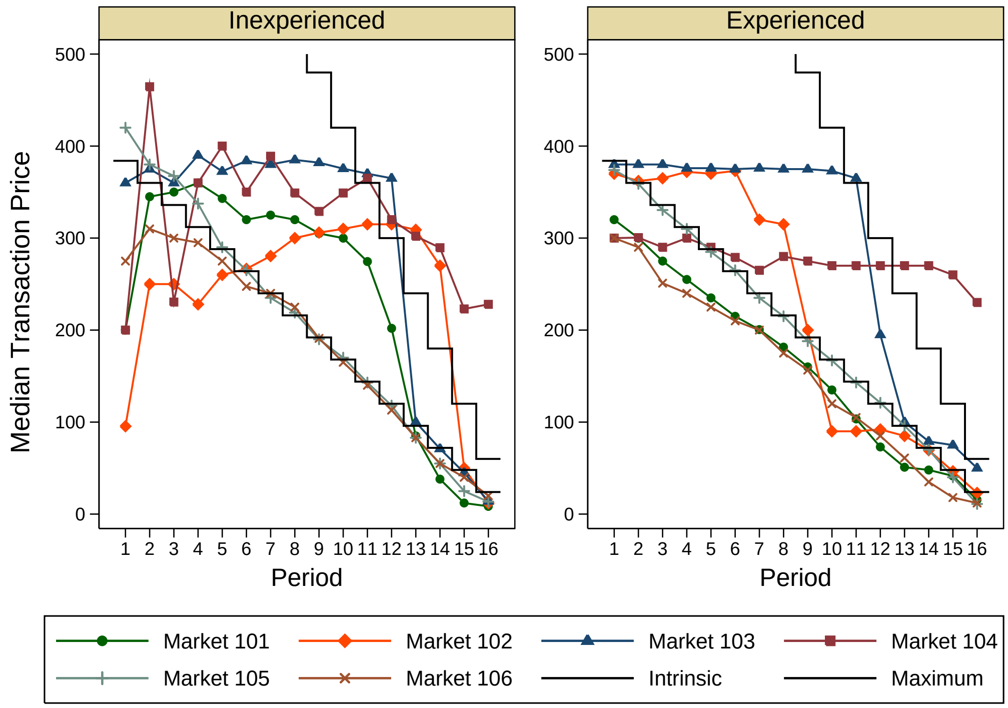


FIGURE A2: PRICE PATHS IN SMITH TOURNAMENT MARKETS

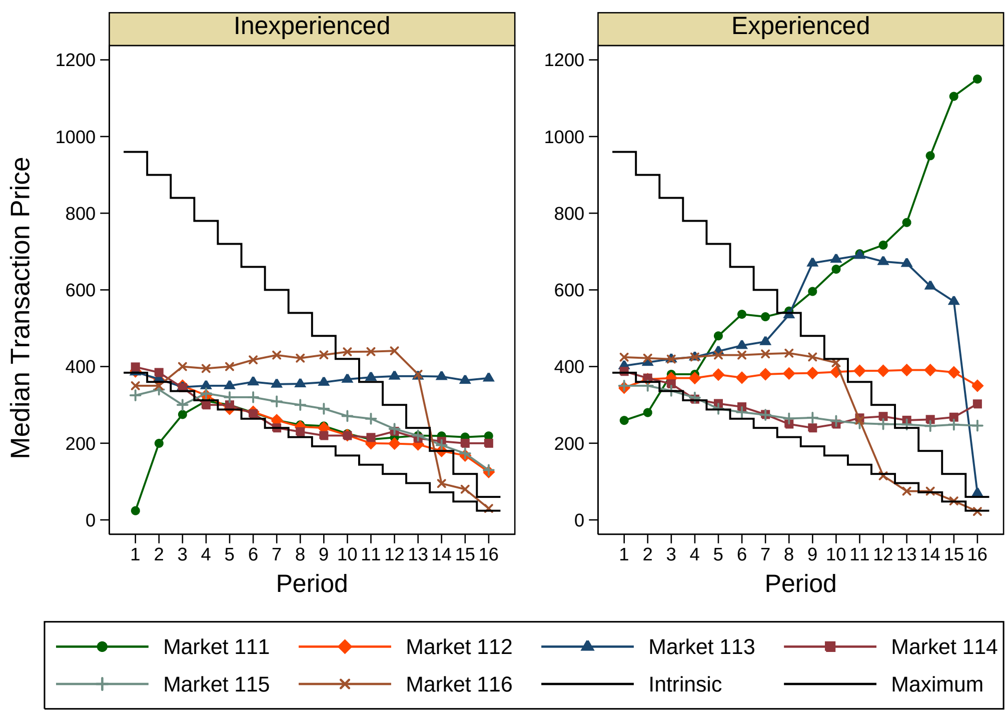


FIGURE A3: PRICE PATHS IN NOUSSAIR BASELINE MARKETS

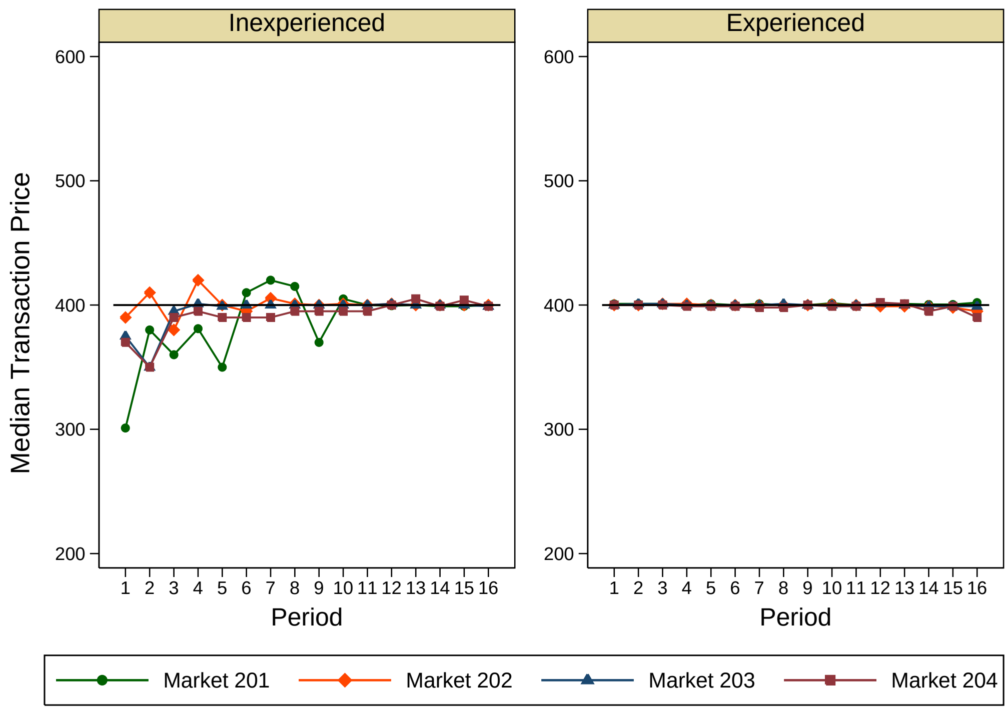
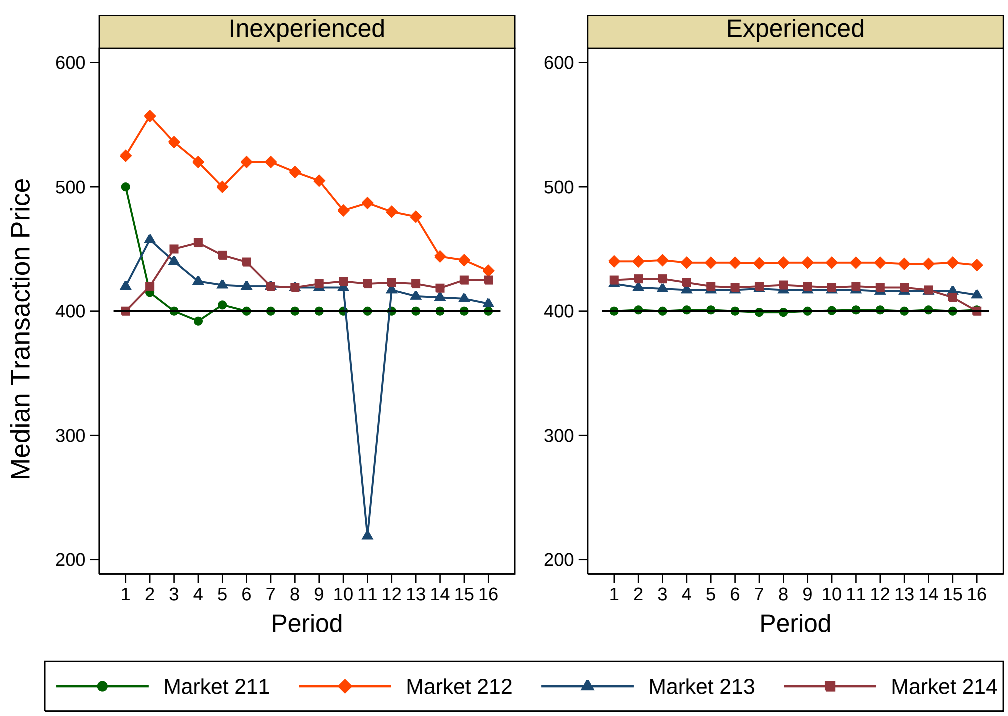


FIGURE A4: PRICE PATHS IN NOUSSAIR TOURNAMENT MARKETS



APPENDICES – FOR ONLINE PUBLICATION ONLY

INSTRUCTIONS FOR THE SMITH TOURNAMENT TREATMENT ‡

General Instructions

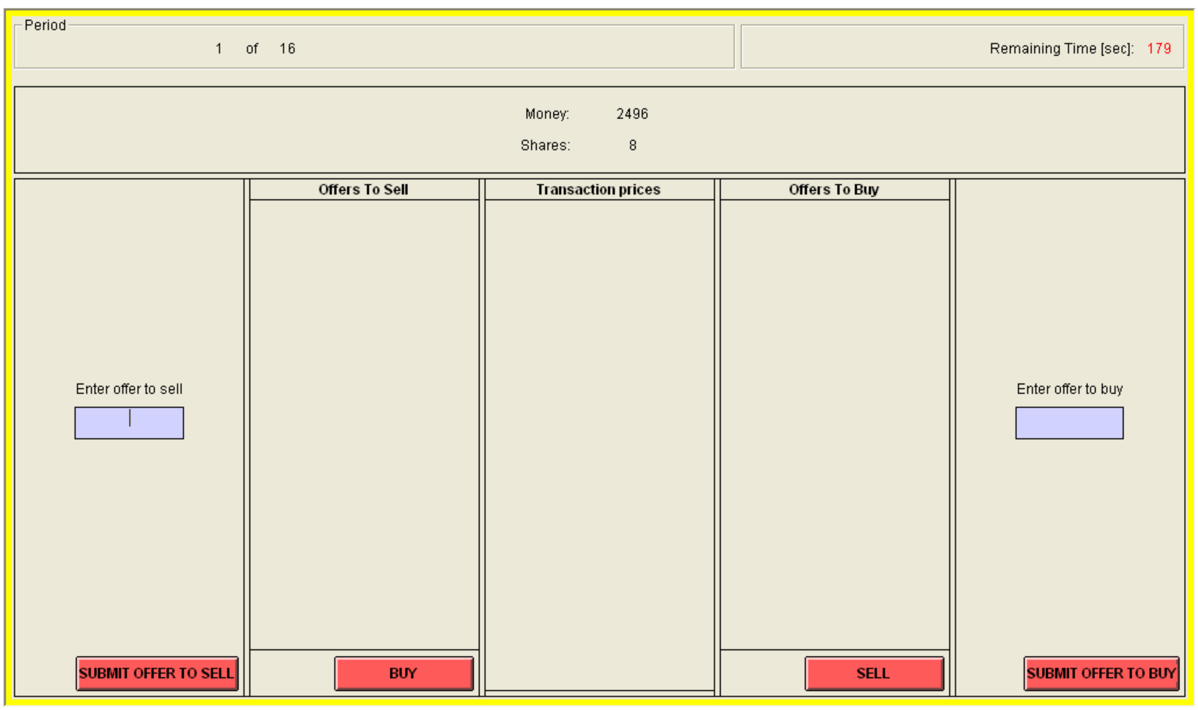
This is an experiment in the economics of decision making in a market. The instructions are simple and if you follow them carefully and make good decisions you may earn a considerable amount of money which will be paid to you in cash at the end of the experiment.

It is imperative that you do not communicate with any other participant while the experiment is in progress. If you communicate with another participant, the data will lose its scientific value and we will not be able to pay any of the participants. It is therefore in your common interest to follow this strict ban on communication. If you have any questions please raise your hand, and an experimenter will come to you and answer your questions in private.

The main part of the experiment will consist of two rounds of trading periods in which you have the opportunity to buy and sell shares in a market. The currency used in this market is "Experimental Currency Units" (ECU). All trading will be in terms of ECU. The cash payment to you at the end of the experiment will be in Australian Dollars. The conversion rate is **500 ECU to 1 Australian Dollar**.

How to use the Computerised Market

In the top right hand corner of the screen you see how much time is left in the current trading period. The items you can buy and sell in the market are called shares. In the centre of your screen you see the number of shares you currently have and the amount of money you have available to buy shares.



You can use the trading screen to participate in the market in one of four ways.

‡ Horizontal rules denote the positions of the page breaks in the original instructions. Instructions for the remaining treatments are available upon request.

Making an offer to sell a share, by entering the price at which you would like to sell

To offer to sell a share, enter the price at which you would like to sell in the box labelled "Enter offer to sell" on the left of the screen, then click on the button "Submit offer to sell".

The second column from left will show a list of offers to sell, each submitted by a different participant. Your own offer will appear in blue. Submitting a new offer will replace your previous one.

Making an offer to buy a share, by entering the price at which you would like to buy

To offer to buy a share, enter the price at which you would like to buy in the box labelled "Enter offer to buy" on the right of the screen, then click on the button "Submit offer to buy".

The second column from right will show a list of offers to buy, each submitted by a different participant. Your own offer will appear in blue. Submitting a new offer will replace your previous one.

Buying a share, by accepting an offer to sell

You can select an offer to sell in the second column from left by clicking on it. If you click the "Buy" button at the bottom of this column, you will buy one share at the selected offer-to-sell price.

Selling a Share, by accepting an offer to buy

You can select an offer to buy in the second column from right by clicking on it. If you click the "Sell" button at the bottom of this column, you will sell one share at the selected offer-to-buy price.

Transaction prices

When you buy a share your money decreases by the price of the purchase. When you sell a share your money increases by the price of the sale. In the middle column, labelled "Transaction prices", you can see a list of the prices at which shares have been bought and sold in the current trading period.

Instructions for the Experiment

Each market will have nine participants in it. *Even though there may be more than nine participants in the room today, you will always participate in a market of nine, consisting of yourself and eight others.*

The experiment consists of two rounds and you will be paid your earnings from both rounds. At the start of each round, every participant will have a starting balance of **2,496 ECU and 8 shares**.

Each round consists of 16 trading periods. In each period the market will open for three minutes during which you can buy and sell shares in exchange for ECU.

Every share you buy or sell will change your holdings of money and shares. Your holdings will carry over from one trading period to the next within the current round. At the start of the second round, your holdings will be reset to the starting values explained above.

Each trading period represents one market quarter, and thus every four periods represents one market year. Since each round runs for 16 periods, this represents four market years.

Dividends

Shares are assets with a life of 16 periods. Each share will pay dividends to its current owner at the end of each trading period. This dividend will be randomly determined by the computer, and will be the same for all shares. In particular, each share that you own at the end of a period:

- pays a dividend of 0 ECU with probability 1/4;
- pays a dividend of 8 ECU with probability 1/4;
- pays a dividend of 28 ECU with probability 1/4; and
- pays a dividend of 60 ECU with probability 1/4.

Since each of these outcomes is equally likely, the average dividend is 24 ECU in every period. After the final dividend has been paid, all shares will expire and there will be no further earnings possible from them.

Rank and portfolio value

Your rank out of nine participants in your market will be calculated at the end of every market year (four periods). This is based on your percentage return over the past year. A rank of 1 indicates the highest return over the past year. A rank of 2 indicates the second highest return, and so on. Note that your rank is based only upon your return over the last year, and not in any previous years.

The return used to generate your rank will be calculated as follows:

Return = (Value of Portfolio at end of year) / (Value of Portfolio at start of year)

The value of your portfolio is calculated as your cash holdings plus the value of your share holdings valued at the median traded share price over the last period.

Inflows of new money and shares

After every four periods you will receive an inflow of new money and shares. This will depend upon your rank. At the end of period 4, the new inflow will consist of:

1,632 ECU and 4 Shares	if your rank is between 1 and 3
816 ECU and 2 Shares	if your rank is between 4 and 6
0 ECU and 0 Shares	if your rank is between 7 and 9

At the end of period 8, it will consist of:

2,016 ECU and 4 Shares	if your rank is between 1 and 3
1,008 ECU and 2 Shares	if your rank is between 4 and 6
0 ECU and 0 Shares	if your rank is between 7 and 9

At the end of period 12, you will receive:

2,400 ECU and 4 Shares	if your rank is between 1 and 3
1,200 ECU and 2 Shares	if your rank is between 4 and 6
0 ECU and 0 Shares	if your rank is between 7 and 9

At the end of period 16, you will receive:

2,784 ECU and 4 Shares	if your rank is between 1 and 3
1,392 ECU and 2 Shares	if your rank is between 4 and 6
0 ECU and 0 Shares	if your rank is between 7 and 9

The new money and shares are added to your balance after the dividends have accrued for the period just completed. That is, you will not receive any dividends on the new shares until the end of the next period.

APPENDICES – FOR ONLINE PUBLICATION ONLY

Summary screen

At the end of each trading period you will see a summary screen. This will provide information about your closing balance of money and shares, as well as the dividend for the period, and the effect of any new inflow of money and shares on your holdings where applicable.

Your earnings

You will be paid for your decisions in both rounds. Your earnings in each round are determined by the money you have at the end of the 16th period – after the final dividend, and after the final inflow of new money and shares. This amount is:

The money you had at the beginning of period one
+ Money you received from sales of shares − Money you spent on purchases of shares
+ Dividends you received + Money you received in new inflows.

At the end of the experiment, this amount will be converted into Australian dollars at the rate specified on page 1 of the instructions.

Average holding value table

You can use your AVERAGE HOLDING VALUE TABLE to help you make decisions.

The first column indicates the Ending Period of the current round. The second column indicates the Current Period for which the average holding value is being calculated. The third column gives the Number of Holding Periods from the Current Period until the Ending Period. The fourth column gives the Average Dividend per Period for each share that you hold. The fifth column gives the Average Holding Value per Share that you hold from now until the end of the current round.

That is, for each share that you hold for the remainder of the current round, you will earn on average the amount listed in column five.

AVERAGE HOLDING VALUE TABLE

Ending Period	Current Period	Number of Holding Periods	×	Average Dividend per Period	=	Average Holding Value per Share
16	1	16		24		384
16	2	15		24		360
16	3	14		24		336
16	4	13		24		312
16	5	12		24		288
16	6	11		24		264
16	7	10		24		240
16	8	9		24		216
16	9	8		24		192
16	10	7		24		168
16	11	6		24		144
16	12	5		24		120
16	13	4		24		96
16	14	3		24		72
16	15	2		24		48
16	16	1		24		24