STORIES MATTER: THE EFFECT OF NEWS IN A LABORATORY ASSET MARKET

SUDEEP GHOSH[†] AND TOM VINAIMONT[‡]

ABSTRACT. We investigate the effect of information packaging and information flows on trading behavior in a laboratory asset market. Controlling the packaging and sequence of information to traders, we observe that feeding 'salient' information significantly impacts individual trading decisions, especially when the information is otherwise statistically unreliable. Also, information affecting one particular asset has spill-over effects on trading behavior of another unrelated one. We attribute this spill-over effect to the creation of market sentiment.

KEYWORDS: Experimental Asset Markets, Behavioral Bias, Information Flows

`Preliminary Draft - Comments Welcome`

[†] School of Accounting & Finance, Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong; Tel: +852 2766 7124; email:afsghosh@polyu.edu.hk .

[‡] Department of Economics & Finance, City University of Hong Kong, 83 Tat Chee Avenue, Kowloon, Hong Kong; Tel: +852 2788 7693; email: eftomv@cityu.edu.hk .

1. INTRODUCTION

Investors make investment decisions based on quantitative and qualitative information about macro-economic, industry- and company-specific variables. The impact of such information on investors will obviously depend on its relevance and reliability. However, before information pertinent to a company becomes public and reaches an investor, it travels through the company's communication or public relations managers and often also through an editorial team of a news agency specializing in distributing information. Although the intermediaries' conversion of information to news through packaging and presentation is a major component of the information dissemination process, its role in influencing investors' perception and reaction to information is not well examined and understood. This study explores the role of information packaging and presentation, by examining its influence on trading behavior and market variables through a novel experimental approach.

Our experiment investigates the effect of news flows on individual trading behavior and aggregate market variables in a laboratory asset market. In our approach news has two components: reliability and presentation of information. Reliable news contains statistically reliable, while unreliable news contains statistically unreliable information. Both reliable and unreliable information are presented to the subjects in one of two distinct news forms: unpackaged and packaged. The unpackaged dissemination of information is purely factual, while packaged information is constructed by using language from actual news releases of real-world companies. The informational content remains identical across the two forms of presentation, i.e. unpackaged and packaged news. Our main goal is to analyze the impact of the presentation of information on market prices and individual trading behavior. We find that packaging of information significantly affects trading behavior and market variables. Interestingly, the effect of packaging is stronger when the information embedded in the news is less reliable. We also find strong evidence that the effect of packaging asset-specific information spills over to trading decisions on unrelated assets, which we attribute to market sentiment.

By incorporating the presentation or packaging of information as a determinant of trading behavior in asset markets, we believe we initiate a novel line of inquiry investigating the role of qualitative information in finance and accounting. Some earlier studies have examined whether qualitative information has predictive power on earning and stock returns. For instance, Li (2006) finds that particular negative words in annual reports predict low earnings and returns. Using daily news stories, Tetlock et al. (2008) similarly find that the fraction of negative words in news stories predicts low earnings and document brief underreaction on negative news stories. In an earlier study, Tetlock (2007) measures the interaction between media reports and stock market returns. He finds that his measure for high media pessimism predicts temporary downward pressure on prices. Furthermore, unusually high or low pessimism is linked to high market volume. He argues the results are consistent with theoretical projections about noise and liquidity traders, but contrary to media content revealing new information about fundamental asset values. The implicit claim behind such studies is that in order for qualitative aspects of news to affect stock returns it must have novel information embedded in it regarding cash flows or investors' discount rates (Campbell and Shiller, 1987), which cannot be captured by its quantitative aspects. But this ignores the effect that qualitative aspect of news can have on the perception of investors towards the information embedded in the news. Therefore, contrary to these studies that examine the extent of residual information embedded in the qualitative aspect of news, we are interested in isolating the pure effect of presentation or framing of information on investors' perception and reaction to such information. Archival studies, though more realistic, are unable to control for the reliability of information embedded in the qualitative component of information. An experimental approach allows us to control for the informational content of news by enabling packaging of information without affecting its reliability. Unlike empirical studies this enables us to examine the impact of presentation or framing of information on investor reactions without any confounding effect from the reliability of such information.

The results of our work should also be seen in the broader context of predictability of stock returns on past return patterns, and in particular the occurrence of short-term momentum and long-term reversal effects in stock prices documented in e.g. Jegadeesh and Titman (2001). While traditional asset pricing models fail to explain this major puzzle in finance, one line of enquiry approaches the phenomenon from a behavioral framework. Barberis et al. (1998) argue that the phenomenon can be attributed to a conservatism bias (Edwards, 1968) or a confidence bias (Tversky and Kahneman, 1974; Griffin and Tversky, 1992), while Daniel et al. (1998) point to attribution biases by informed traders. The second approach argues that the phenomenon might just be a compensation for risk or an artefact of more complicated pricing kernels. In support of efficient markets, Conrad and Kaul (1998) amongst others attempt to explain these patterns from cross-sectional variation in expected returns. The few empirical papers which address behavioral effects mainly demonstrate how trading activity and portfolio choice are consistent with potential behavioral biases (eg. Odean, 1998; Benartzi and Thaler, 2001; Hong et al., 2000). Regarding experimental studies in this area, Bloomfield (1996), Nelson et al. (2001) and Andreassen (1990) amongst others, examine over- and underconfidence of investors based on Griffin and Tversky's (1992) theory of differences in confidence judgement depending on the type of information they receive. While such experimental studies are in general more suitable compared to the empirical studies for observing individuals behavior due to the controlled environment, they do not have a market clearing mechanism for determining prices, instead using a coin-flipping exercise or exogenously given price patterns for example.

In our experiment, we introduce aspects of both reliability and presentation of information by controlling the flow of news in our laboratory asset market and observe individual trading behavior and their effect on aggregate market variables. A market clearing mechanism determines prices based on subjects' investment decisions. We vary reliability of information by sometimes revealing highly statistically significant information on actual future cash flows in addition to a continuous flow of statistically unreliable information, sourced from a survey of (almost) all uninformed traders' outlook about future cash flows. We introduce two risky assets and one risk free one (cash). The two risky assets are stock N (with news) and stock X (without news). Our main objective is to investigate whether the packaging and reliability of information and their interaction affect trading behavior. In addition, we also examine the spill-over effect of the news on the unrelated stock X, whose future outcomes are not covered by news.

We observe a strong and significant effect of the packaging or presentation of information on trading decisions and market prices. This result is robust as it holds across more than one variable. We find that the marginal effect of packaging is stronger when there is a lack of reliability in news. Furthermore, we find that the effect of unreliable but packaged news on stock N also affects trading decisions on the unrelated stock X. We attribute this to market sentiment generated by news also influencing behavior on unrelated assets.

The scheme for the rest of the paper is as follows. In the next section we provide the experiment design, including the treatment and session information. Then we provide the regression models and their results. Finally, we conclude.

2. Experiment Design

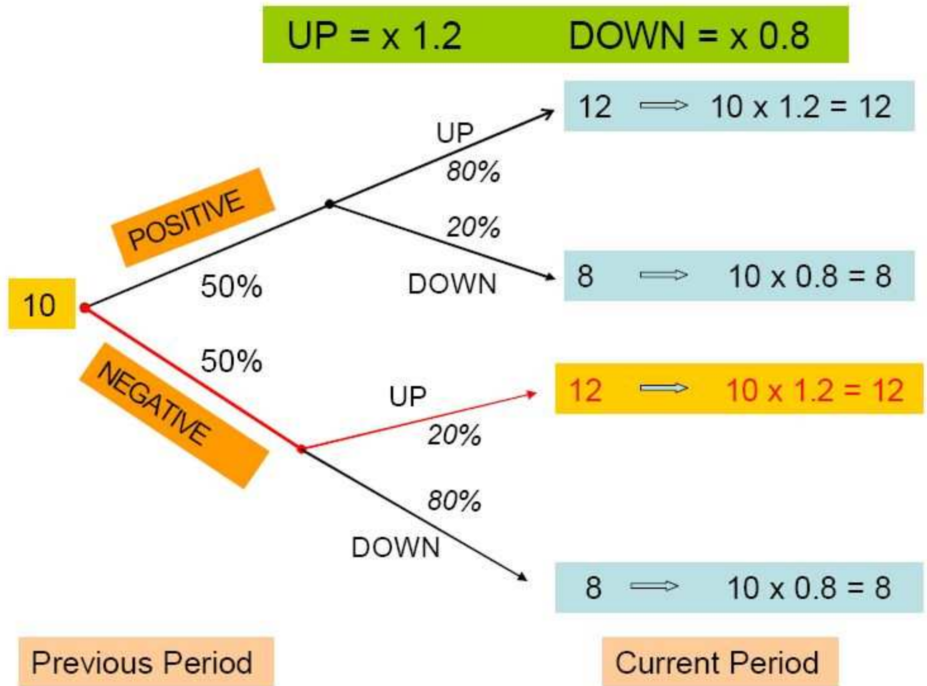
We ran a laboratory based asset market experiment. The subjects in our experiment were drawn voluntarily from the pool of business students, both undergraduate and graduate. They were assigned the role of asset market traders. The subjects were paid in cash an amount depending on their decisions during the experiment and an initial show-up fee. They earned in total around HK$200 (where 1US$ $\approx$ 7.8 HK$) on average for a two to three hour session. Each trader was given an an initial endowment/portfolio of cash (25000 experimental currency units) and 250 shares each of the two stocks N (with news) and X (without news), that could either be bought or sold every period[1]. In our setup both stocks pay a dividend that was random depending on the "state," where the dividend amount and the state determination are independent for the two stocks. Cash not used to purchase shares accrues a known risk-free return (4% in all sessions). Once markets clear, dividends and interest from cash holdings are paid at the end of each trading period. The dividend determination process for both stocks follows a random walk process. The specific parameters of the process can be observed from the figures 1 and 2, for stocks N and X respectively.

The shares of each asset have a redemption value which is determined by the last period dividend. Since our dividend determination process follows a random walk without drift, in any period the future expected dividend is exactly equal to the current period dividend (see figure 3(a)). Therefore the expected redemption value for a stock is the ratio of the current dividend over the risk free rate (4% in our experiments) and incrementally changes in each trading period depending on the realized dividend (see figure 3(b)). The program interface provides the subjects with the expected redemption value for each stock at the end of each trading period.

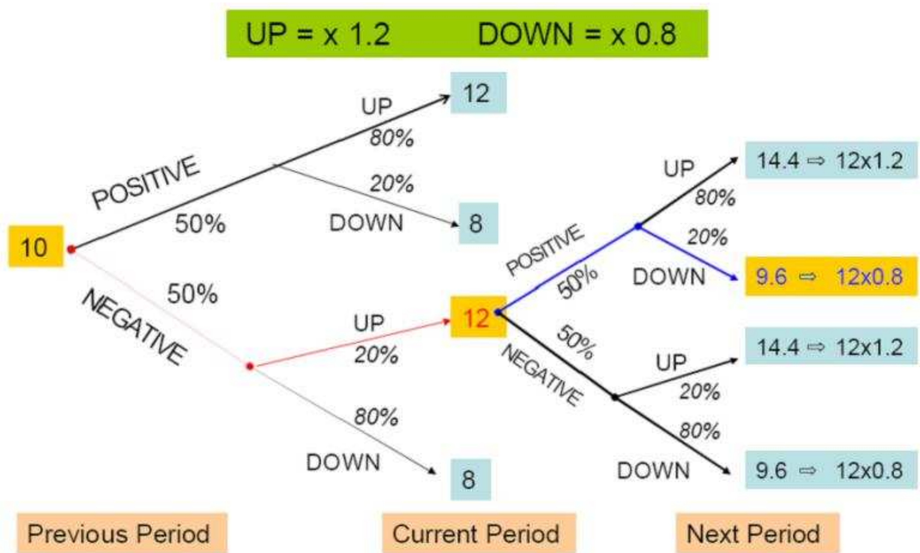
Trades are arranged through a standard limit-order process. At the start of a period, each trader can submit a limit order to buy (bids) and/or sell (asks) shares by specifying the number of shares and the maximum purchase/minimum sale price (see figure 4(a) for the interface). All bids and asks are arrayed into a pseudo demand and supply function respectively, which determines the market clearing price and volume. Once market clearing takes place, subjects are informed about their order execution result, the market price and market trading volume. Subjects are also informed about the realized dividend, their total dividend earnings and their portfolio value based on market prices of the assets (see figure 4(b)).

2.1. **News.** The type and sequence of news flow is the primary treatment variable, where news items with different reliability-presentation combinations were released in different sequences

[1]Subjects were not allowed to short stocks in order to prevent potential default in payments and bankruptcies.



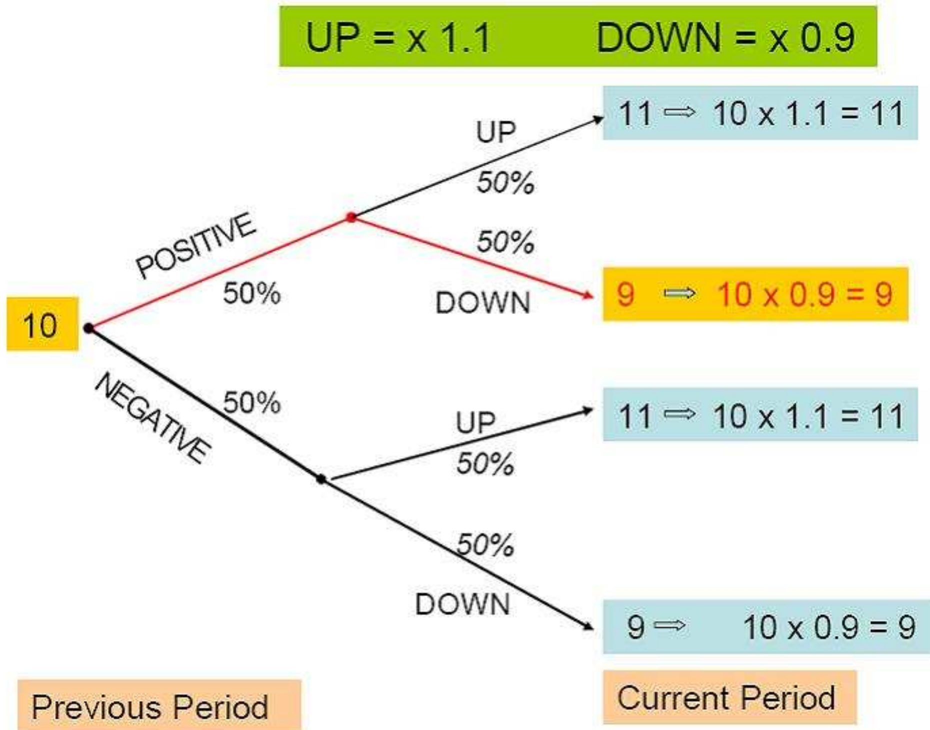
(a) Current Period Dividend



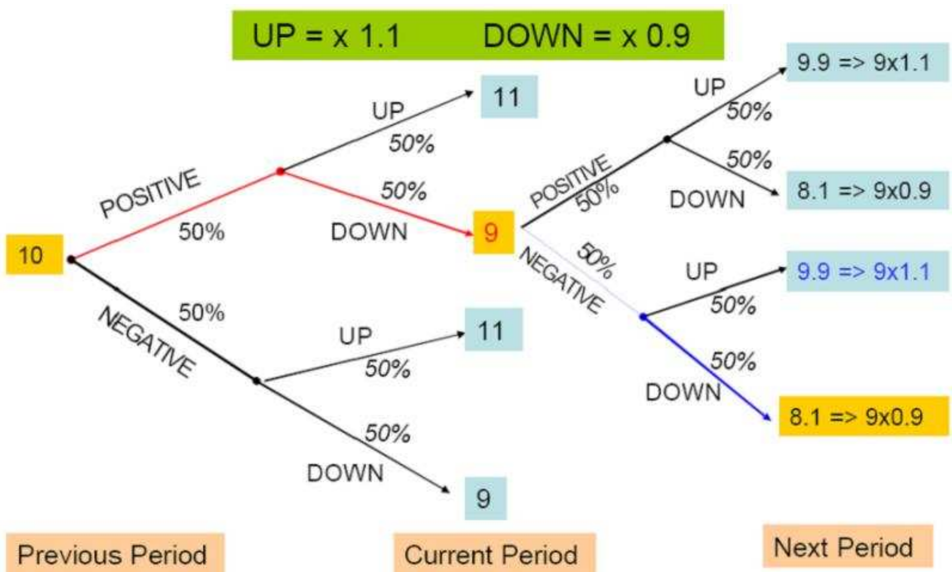
(b) Subsequent Period Dividend

Figure 1: Dividend Determination Process for Stock N

to traders in order to investigate their effect on trading decisions. In addition, before each trading period subjects are given a survey asking for their outlook on the current period dividend of *stock N*, i.e. whether they expect the dividend for the stock to increase (positive outlook) or decrease (negative outlook). As there is an equal probability for the dividend of stock N to



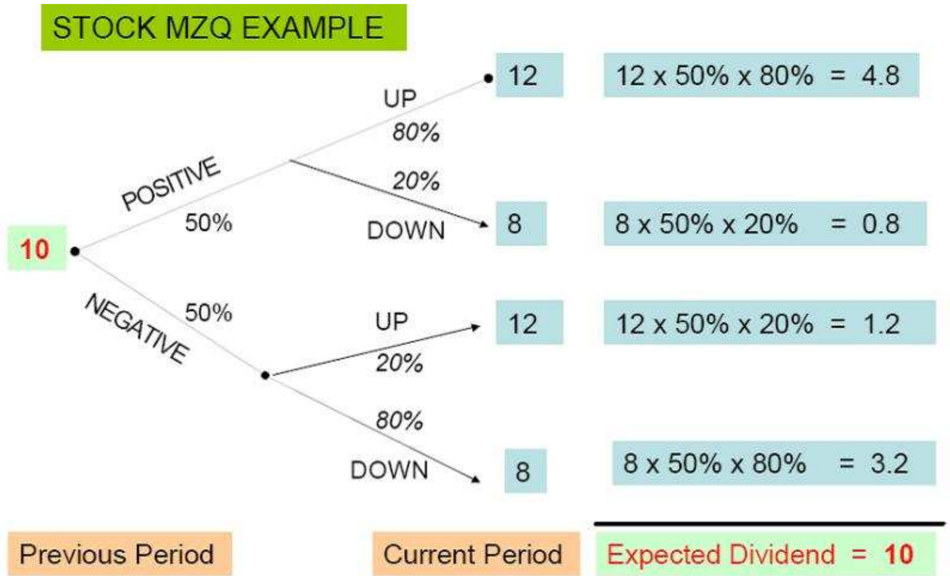
(a) Current Period Dividend



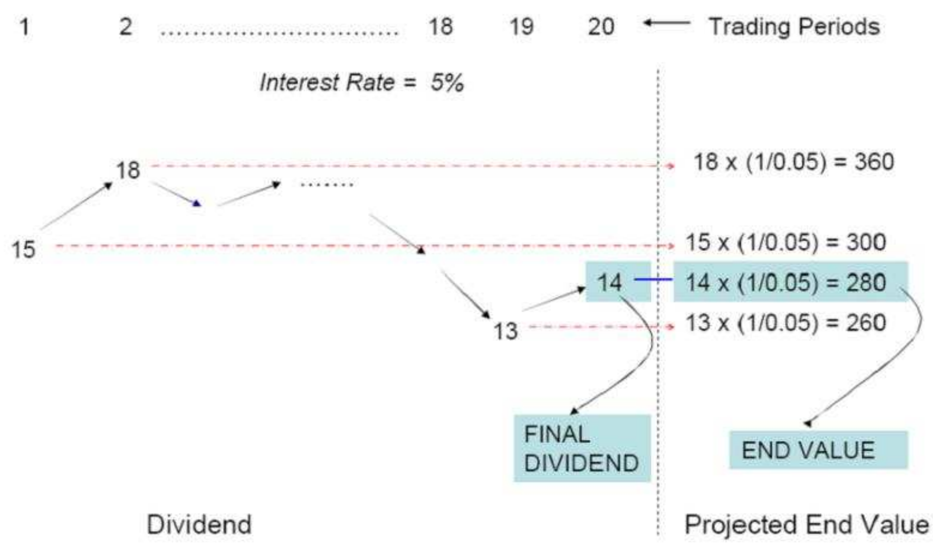
(b) Subsequent Period Dividend

Figure 2: Dividend Determination Process for Stock X

increase or decrease (refer to 1), the survey results do not provide any real objective information regarding the expected dividend for stock N, though they might provide information regarding the sentiment (optimistic or pessimistic) of traders. The subjects were paid if their outlook choice reflected the true outcome. In addition, three traders randomly chosen in each period had



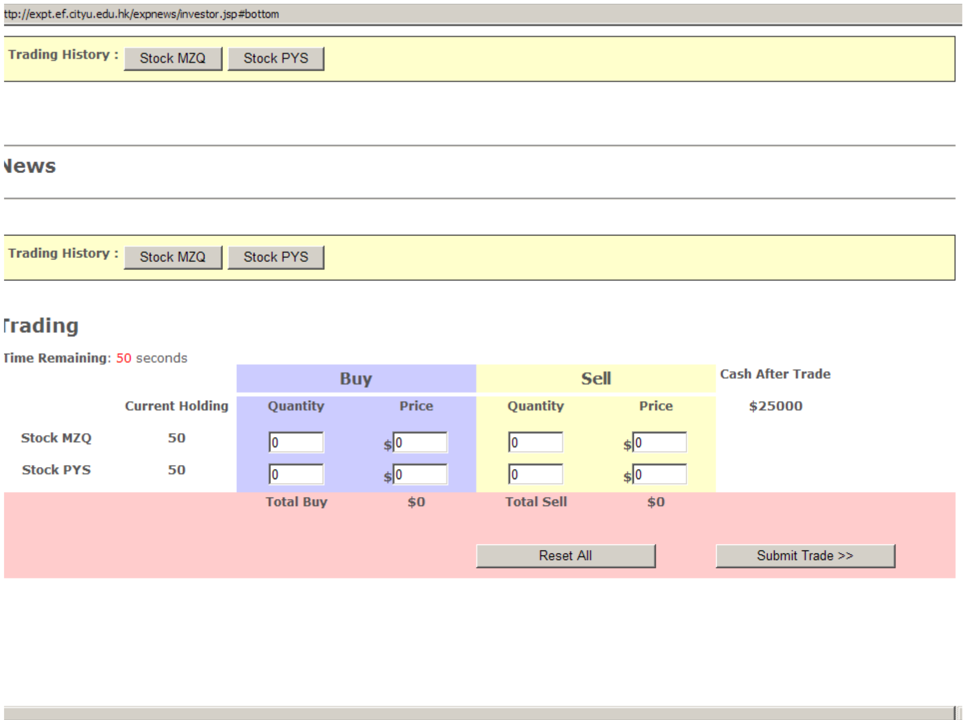
(a) Current and Expected Dividend



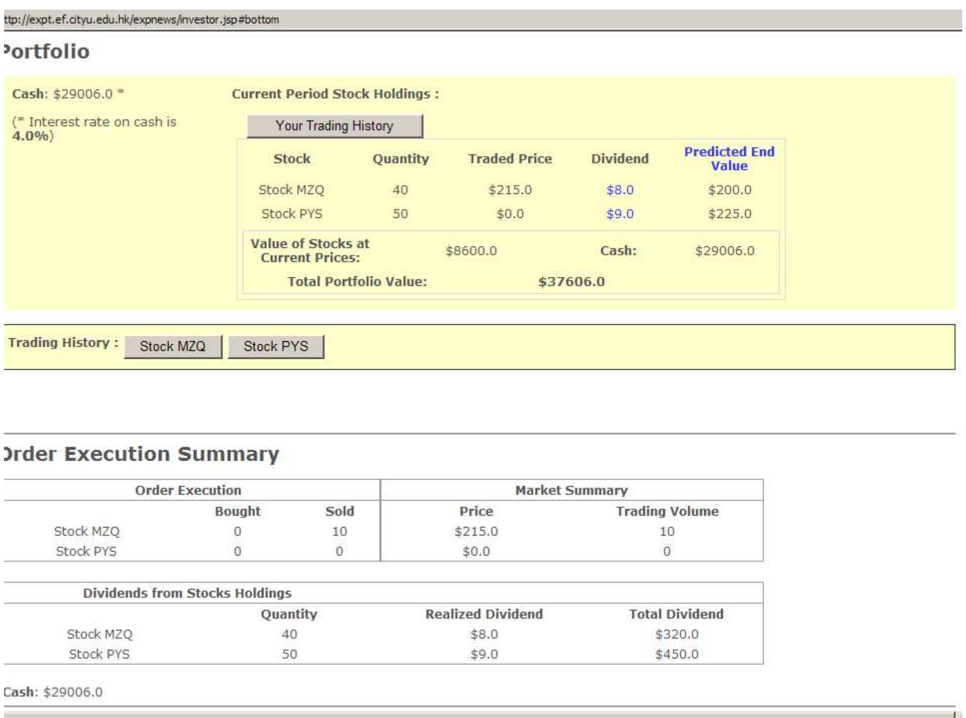
(b) Expected Redemption Value

Figure 3: Expected Dividend and Determination of Redemption Value

their survey choices, unknown to them, deliberately changed (if needed) to the true outcome. All traders were made aware of this arrangement beforehand. The number of subjects in all sessions was sufficiently high that the survey result after this change remains an unreliable predictor of future dividend. Our objective behind the slight alteration of the survey results is to add marginal (albeit statistically insignificant) information to an otherwise purely noisy predictor.



(a) Trading Interface



(b) Order Execution Interface

Figure 4: Screenshots of Experiment Program Interface

As mentioned earlier, news is classified based on two categories: reliability and presentation. Low reliability or unreliable information provides information about the predicted dividend from survey results (no objective information), while high reliable information provides statistically relevant information about the true dividend in addition to the survey predicted dividend. Unpackaged information provides the information on expected dividend (irrespective of low or high reliability) in a factual manner, while packaged information provides the same information presented in a more salient manner (i.e. as if originating from a communication department or a news agency). Based on this we create four different types of information: Unreliable-Unpackaged information (NR-NP) (see figure 5(a)), Unreliable-Packaged Information (NR-P) (see figure 5(b)), Reliable-Unpackaged Information (R-NP) (see figure 6(a)) and Reliable-Packaged Information (R-P) (see figure 6(b)). We also had a baseline treatment with no news, in which case no information was provided to the traders before they began trading, including information on survey results.

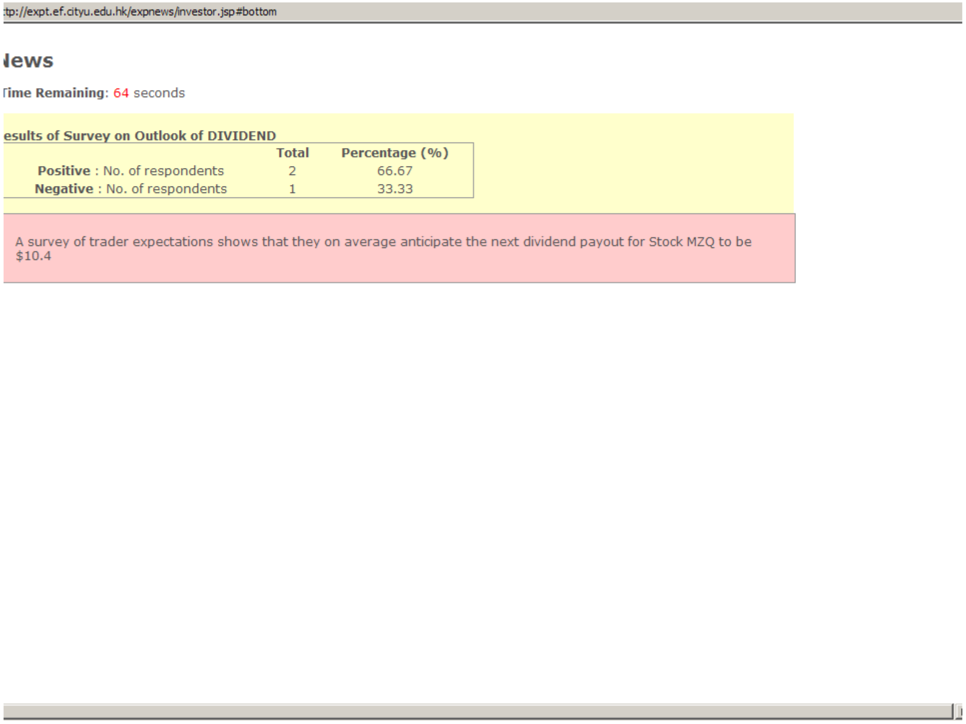
2.2. **Treatments.** We run a total of six different treatments comprising six experiment sessions. Each treatment had twenty trading periods and was run twice, on different cohorts of subjects. This provides us with individual and aggregate market data on 240 trading periods, with number of subjects varying from 35-46 depending on the session. In five of the treatments, participants receive information in each trading period, while in one treatment no information is released. The five "information" treatments differ from each other based on whether the information is unpackaged or packaged before its release and the pattern of the release over the trading session. The reliability of the information displayed to the subjects on the other hand is determined randomly, with equal probability on whether the information is reliable or unreliable. Therefore, the two aspects of the information flows in our experiment are characterized by randomly determined reliability and controlled determination of packaging of information. The different treatments are defined as follows:

No Information (NN): No information was provided, including survey results.

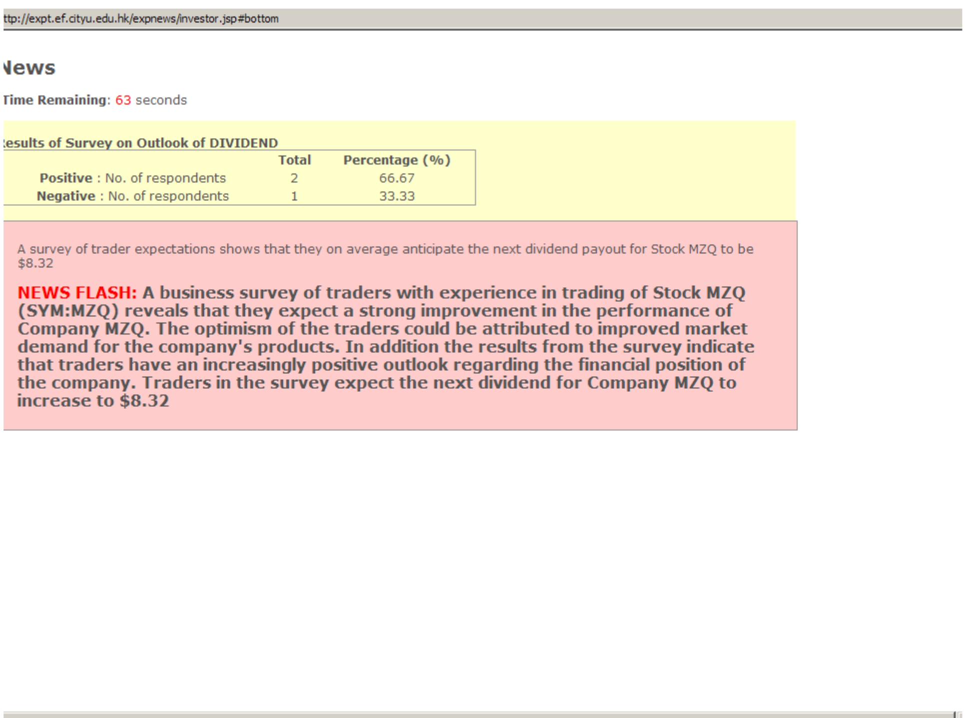
Unpackaged Information (NP): Information was provided in every period without any packaging.

Packaged Information (P): Packaged information was provided in every period.

Concentrated Packaging (CP): Sequence of *five* packaged information items followed by *five* unpackaged information items and repeated.



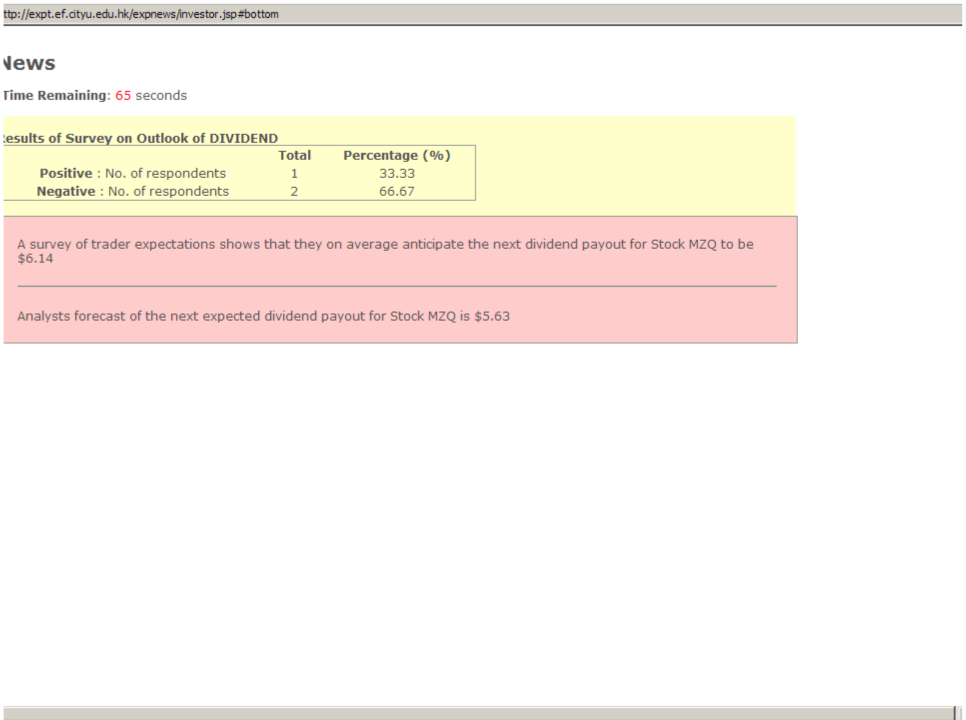
(a) Unreliable Unpackaged Information



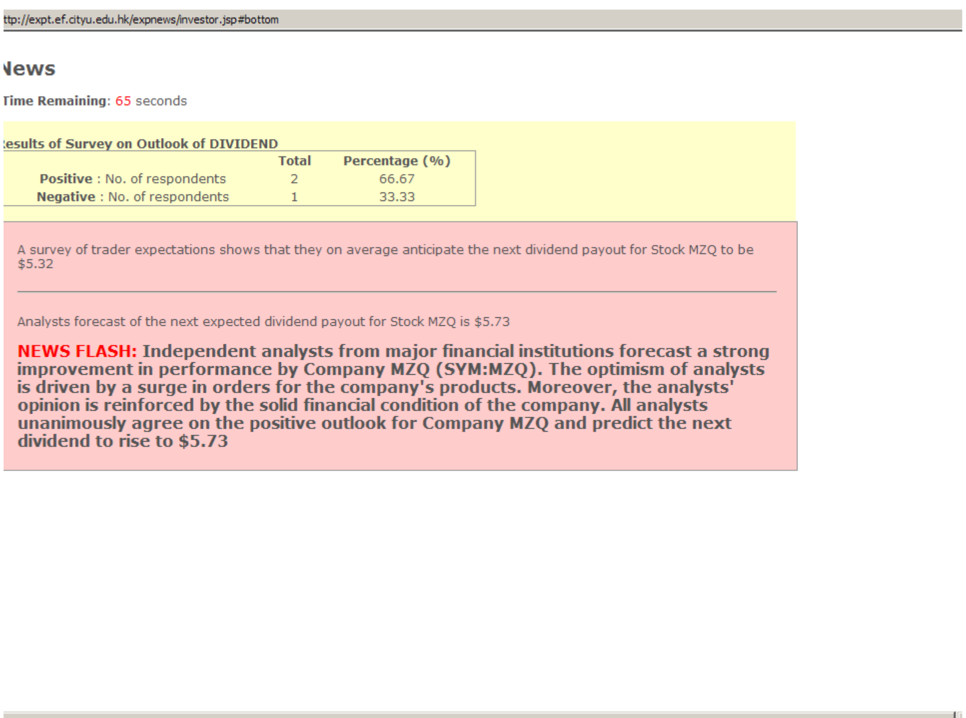
(b) Unreliable Packaged Information

Figure 5: Statistically Unreliable News

Decreasing Packaging (>P): Decreasing sequence of packaged information in the two blocks of 10 trading periods each, i.e. $PPPNPPPNPPNPNP \underbrace{\cdots\cdots\cdots}_{repeat\,10\,periods}$.



(a) Reliable Unpackaged Information



(b) Reliable-Packaged Information

Figure 6: Statistically Reliable News

Increasing Packaging (<P): Increasing sequence of packaged information in the two blocks of 10 trading periods each, i.e.

$$NPPNPPPNPPPPNP \underbrace{\cdots\cdots\cdots}_{repeat\ 10\ periods}.$$

Table 1 provides information on the number of subjects and the treatments in each session.

Table 1: Number of Subjects per Treatment

Experimental Sessions (S1-S6)							
Treatment	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**	**Total**
NN	na	43	na	na	35	na	78
NP	na	na	35	na	na	36	71
P	46	na	na	na	na	36	82
CP	46	na	na	45	na	na	91
>P	na	43	35	na	na	na	78
<P	na	na	na	45	35	na	80

[a] *There was a practice game at the beginning of each session followed by two separate treatments*

[b] *Each treatment had twenty trading periods*

3. Results

Table 2 provides aggregate data of trading activity for each of the treatments. In column 1 we display the average premium (or discount) of the market price on its predicted end value, as an indicator of the relative price level at which the stock was trading during the experiment. As the flow of reliable news is different across treatments, the premium should be interpreted as indicative rather than absolute. On average, we find stocks are trading at relatively high prices and the premium is always larger for stock N, the asset which has information flows associated with it. The average proportion of bidders (i.e. number of active bidders as a proportion of total traders) and average proportion of askers (i.e. number of traders offering to sell shares as a proportion of total traders) in column 2 and 3, reveal significant interest in trading, with around 40% active bidders and around 35% active askers for both stocks.

Given the risk free return of 4% on cash holdings, traders can guarantee a return of 4%. Table 3 shows the average portfolio returns for the traders from the various treatments. The average trader fails to reach the 4% risk free return rate they are otherwise guaranteed on their cash holdings.

3.1. **Regression Results.** Our main focus is on investigating the effect of packaging and reliability of information on trading behavior. We introduce four dummy variables corresponding to

Table 2: Treatment Summary Statistics: Averages per treatment over two trading sessions of twenty periods each

Treatment		Market Price Premium (1)	Average Bidders (2)	Average Askers (3)	Average Volume (4)
NN	Stock N	1.611	0.330	0.396	3.375
	Stock X	0.335	0.335	0.407	2.983
NP	Stock N	0.523	0.428	0.325	2.730
	Stock X	0.208	0.438	0.269	2.681
P	Stock N	1.054	0.413	0.379	2.839
	Stock X	0.558	0.353	0.359	3.12
CP	Stock N	0.303	0.466	0.388	3.318
	Stock X	-0.016	0.436	0.367	2.636
>P	Stock N	0.088	0.484	0.337	3.18
	Stock X	0.024	0.431	0.307	3.42
<P	Stock N	1.23	0.467	0.366	2.421
	Stock X	0.65	0.398	0.311	2.502
TOTAL	Stock N	0.802	0.431	0.365	2.977
	Stock X	0.293	0.398	0.337	2.89

[1] *Average Market Price Premium* = $Average[\frac{Market\,Price - PEV}{PEV}]$, *where PEV is the Predicted End Value*

[2] *Average Bidders* = $Average[\frac{Number\ of\ Traders\ making\ Bids}{\#T}]$, *where #T is the total number of traders*

[3] *Average Askers* = $Average[\frac{Number\ of\ Traders\ making\ Asks}{\#T}]$

[4] *Average Volume* = $Average[\frac{Traded\ Volume}{\#T}]$

the four possible packaging/reliability combinations and an additional one for the baseline case of no news, defined as follows:

NN: Indicator variable for trading periods when no information is released.

Table 3: Average Portfolio Returns

Treatment	Average Portfolio Returns ($\bar{r}$)
NN	0.0217 (0.0243)
AL	0.0412 (0.0164)
AH	0.0269 (0.0173)
LHB	0.0405 (0.0194)
DHS	0.0632 (0.0215)
IHS	0.0307 (0.0219)
TOTAL	0.0373 (0.0242)

[1] *Number in parenthesis denotes std. deviation*

NR_NP: Indicator variable for trading periods when unreliable unpackaged information is released.

NR_P: Indicator variable for trading periods when unreliable packaged information is released.

R_NP: Indicator variable for trading periods when reliable unpackaged information is released.

R_P: Indicator variable for trading periods when reliable packaged information is released.

In order to ascertain the impact of packaging on individual trading behavior, we estimate the effect of packaging on difference in opinion measured through the spread between per period average bids and asks. In addition we examine whether the potential effect of packaging on individual trading behavior transfers to market prices. We also examine whether the impact of packaging differs depending on the reliability of the information that is packaged. In the regressions, our dependent variables are the normalized bid-ask spread (the difference between average ask and average bid per period as a ratio of the predicted end value) and stock returns. Formally we define the following dependant variables:

$Spread_N$ **or** $Spread_P$**:** The difference between average ask and average bid per period as a proportion of the predicted end value for both stock N and stock X, i.e. $\text{Spread}\_{\_} = \dfrac{\text{Mean Ask} - \text{Mean Bid}}{\text{Predicted End Value}}$.

R_N **or** R_X**:** The proportionate change in current period market price compared to previous period price for stock N or stock X.

The effect of packaging/reliability combinations is tested on the dependant variables defined above. The regression equations we test are:

$$\begin{aligned} \text{Spread}_{t,N} = & \beta_{11} R_{t-1,N} + \beta_{12} \Delta DIV_{t-1} + \beta_{13}\,\text{NN} + \beta_{14}\,\text{NR\_P} + \beta_{15}\,\text{R\_NP} \\ & + \beta_{16}\,\text{R\_P} + \beta_{17}\,\text{NR\_NP} + \delta_1 \end{aligned} \tag{3.1a}$$

$$\begin{aligned} \text{R}_{t,N} = & \beta_{21} R_{t-1,N} + \beta_{22} \Delta DIV_{t-1} + \beta_{23}\,\text{NN} + \beta_{24}\,\text{NR\_P} + \beta_{25}\,\text{R\_NP} \\ & + \beta_{26}\,\text{R\_P} + \beta_{27}\,\text{NR\_NP} + \delta_2 \end{aligned} \tag{3.1b}$$

Table 4 displays the regression results for stock N. The variable $R_{t-1,N}$ refers to the market price change between the two previous periods, while $\text{DivDiff}_{t-1,N}$ refers to the dividend change between the previous two periods (note that traders are unaware of current period dividend change before trading). From column 1 we observe that for unreliable information the average mean (ask-bid) spread (i.e. variable Spread_N) increases from 0.228 when information is unpackaged (NR_NP) to 0.566 when it is packaged (NR_P). This is a significant increase in mean spread of 0.337 due to the packaged information. Similarly, when the information is reliable the mean spread is 0.165 for unpackaged information (R_NP) and 0.503 for packaged information(R_P). This amounts to a significant increase in mean spread of 0.338 due to the packaging information. The increased spread in average bids and asks both in the case of unreliable and reliable information hints that packaging of information seems to create confusion in subject evaluation about future returns.

Comparing the mean (ask-bid) spread changes when there is a change in reliability, we see that for unpackaged information there is a reduction in mean spread of about 0.06 when we move

Table 4: Regression: Effect of packaging on spread and price for stock N

	$\text{Spread}_{\mathbf{N}}$ (1)	$\mathbf{R_N}$ (2)
$R_{t-1,N}$	-0.561* (0.335)	0.352*** (0.068)
$\text{DivDiff}_{t-1,N}$	-0.685*** (0.190)	0.267*** (0.039)
NN	0.358*** (0.098)	-0.043** (0.019)
NR_P	0.566*** (0.076)	0.0017 (0.015)
R_NP	0.165* (0.081)	-0.0027 (0.016)
R_P	0.503*** (0.084)	-0.011 (0.0170)
NR_NP	0.228*** (0.094)	-0.049** (0.019)
#Obs	214	213
R^2	0.143	0.328
NR_P - NR_NP	0.337*** (0.121)	0.051** (0.025)
R_P - R_NP	0.338*** (0.117)	-0.009 (0.024)
R_NP - NR_NP	-0.062 (0.114)	na
R_P - NR_P	-0.0782 (0.1328)	na

Number inside parenthesis denotes std. error. Wald test is used for difference in coefficients.
**** denotes significance at 1% level, ** denotes significance at 5% but not 1% level and * denotes significance at 10% but not 5% level.*

from unreliable to reliable information. Similarly, for packaged information there is a reduction of about 0.078 in moving from unreliable to reliable information. Therefore, reliability as is to be expected reduces the spread by resolving some of the uncertainty regarding future returns.

The reduction of about 6-7% is close to the actual reduction in uncertainty of returns of about 10%. We also examine whether packaging also affects prices in the market. We observe from column 2 that packaged information has a significant effect on price when traders do not have statistically reliable information (unreliable information). Returns when packaged unreliable information is released are about 5% higher than when the information is disseminated raw. This might indicate that packaged information influences traders expectations about future returns especially when the news is not very statistically informative, i.e. has noise.

We now construct the regression models investigating the effect of packaging/reliability combinations on stock X. Note that the news did not contain any information on stock X, but were exclusively regarding stock N. By testing the effect of news based information flows on stock X explanatory variables, we are trying to ascertain whether information flows with regards to stock N have any effect on decisions regarding stock X. This is in effect a test for market sentiment. Similar to stock N, these effects are tested on two separate dependant variables, the difference or spread between average bids and average asks ($\mathrm{Spread}_{t,X}$) and the percentage change in market price between current and previous period $\mathrm{R}_{t,X}$.

$$\begin{aligned}\mathrm{Spread}_{t,X} =& \beta_{31} R_{t-1,X} + \beta_{32} \Delta DIV_{t-1} + \beta_{34}\,\mathrm{NR\_P} + \beta_{35}\,\mathrm{R\_NP} + \beta_{36}\,\mathrm{R\_P} \\ &+ \beta_{37}\,(\mathrm{NR\_NP + NN}) + \delta_3\end{aligned} \tag{3.2a}$$

$$\begin{aligned}\mathrm{R}_{t,X} =& \beta_{41} R_{t-1,X} + \beta_{42} \Delta DIV_{t-1} + \beta_{44}\,\mathrm{NR\_P} + \beta_{45}\,\mathrm{R\_NP} + \beta_{46}\,\mathrm{R\_P} \\ &+ \beta_{47}\,(\mathrm{NR\_NP + NN}) + \delta_4\end{aligned} \tag{3.2b}$$

Table 5 shows the results of the regression for stock X. Note that we should *not* expect any effect of news variables on stock X trading decisions, since all information flows are regarding future returns of stock N by design. But as can be seen from column 1 we observe significant effects of information flows for the other stock N on mean bid-ask spreads of stock X. We interpret this as sentiments created by news on stock N having spill-over effects on other stocks completely unaffected by such news. However, we do not see the effect of packaging spill over to market prices for stock X.

3.1.1. *Survey Data.* Finally, we include data from the survey results and run a slightly modified version of the above regressions. First, we define the following variables related to the survey:

- **SUR_Neg:** Indicator variable for those periods when the survey outcome predicted an expected decrease in dividend for stock N.

Table 5: Regression: Effect of packaging on spread and price for stock X

	$\text{Spread}_{\mathbf{X}}$ (1)	$\mathbf{R}_{\mathbf{X}}$ (2)
$R_{t-1,X}$	0.158 (0.243)	0.280*** (0.0689)
$\text{DivDiff}_{t-1,X}$	-0.587** (0.248)	0.335*** (0.068)
NR_P	0.005 (0.050)	-0.0023* (0.014)
R_NP	0.110** (0.0532)	0.008 (0.145)
R_P	0.295*** (0.055)	-0.008 (0.150)
NR_NP	0.180*** (0.044)	-0.014 (0.012)
#Obs	214	213
R^2	0.087	0.194
NR_P - NR_NP	-0.175*** (0.066)	0.011 (0.018)
R_P - R_NP	0.185** (0.077)	-0.017 (0.021)

*Number inside parenthesis denotes std. error. Wald test is used for difference in coefficients. *** denotes significance at 1% level, ** denotes significance at 5% but not 1% level and * denotes significance at 10% but not 5% level.*

SUR_Pos: Indicator variable for those periods when the survey outcome predicted an expected increase in dividend for stock N.

Additionally, we also define the following dummy variables:

NDivDiff_Neg: indicator variable for those periods when the dividend in current period is less than the previous period dividend.

NDivDiff_Pos: indicator variable for those periods when the dividend in current period is more than the previous period dividend.

We use market price difference $[(\mathrm{R}_{N,t})]$ as our dependent variable. We construct two regression equations, one for each stock, N and X respectively and are given by:

$$
\begin{aligned}
R_{N,t} =& \beta_{51}\,\mathrm{R}_{N,t-1} + \beta_{52}\,\mathrm{DivDiff}_{t-1,N} + \beta_{53}\,\mathrm{NN} + \beta_{5411}\,\mathrm{NR\_P} \times \mathrm{SUR\_Neg} \\
& + \beta_{5412}\,\mathrm{NR\_P} \times \mathrm{SUR\_Pos} + \beta_{55}\,\mathrm{NR\_NP} + \beta_{56}\,\mathrm{R\_NP} \times \mathrm{DivDiff}_{t,N} \\
& + \beta_{5711}\,\mathrm{R\_P} \times \mathrm{NDivDiff\_Neg} + \beta_{5712}\,\mathrm{R\_P} \times \mathrm{NDivDiff\_Pos} + \delta_5
\end{aligned}
\tag{3.3a}
$$

$$
\begin{aligned}
R_{X,t} =& \beta_{61}\,\mathrm{R}_{X,t-1} + \beta_{62}\,\mathrm{DivDiff}_{t-1,X} + \beta_{6411}\,\mathrm{NR\_P} \times \mathrm{SUR\_Neg} \\
& + \beta_{6412}\mathrm{NR\_P} \times \mathrm{SUR\_Pos} + \beta_{65}\,\mathrm{NR\_NP} + + \beta_{66}\,(\mathrm{R\_NP} + \mathrm{NN}) \times \mathrm{DivDiff}_{t,N} \\
& + \beta_{6711}\,\mathrm{R\_P} \times \mathrm{NDivDiff\_Neg} + \beta_{6712}\,\mathrm{R\_P} \times \mathrm{NDivDiff\_Pos} + \delta_6
\end{aligned}
\tag{3.3b}
$$

For stock N we again find from column 1 in Table 6 that there is a positive effect on returns of packaged information in general compared to the base treatment NN. Possibly negative sentiment (measured by a negative outlook in the survey) for stock N dampens traders enthusiasm for the stock and creates a larger residual interest for stock X. We test this by running a similar regression as before except we replace stock returns with order book size as our dependant variable. Order book size is defined as the total of bids and asks for a particular stock normalized with respect to aggregate wealth measured at market prices and the market price. We find from columns 3 and 4 that interest is larger for the unrelated Stock X when the sentiment for stock N is low, indicating a lack of enthusiasm for stock N is being compensated by more interest in stock X. When there is positive sentiment on stock N we see stronger interest in stock N. From column 1 we can also see that in the presence of reliable information, traders make use of the information. When stock N's dividend is predicted to increase returns are 7% higher compared to the base while at the same level of the base case for predictions of a falling dividend. The effect of packaging becomes apparent for a predictions of decreasing dividends.

3.2. **Effect of Dividend Patterns.** We examine the impact of the past pattern of realized dividends on the two dependent variables (spread and market returns) defined before. We identify variables based on the sequence of *changes* in dividends, both negative and positive and whether the sequence of changes is a short-run or a long-run phenomena. If the negative (positive) dividend change lasts only for one period before switching to positive (negative) then we denote this as a short-run pattern. On the other hand if the dividend change, either negative or positive, continues in the same direction for at least two successive periods then we denote this as a long-run pattern. This enables us to define the following variables:

Table 6: Regression: Effect on order book size and stock returns of N & X with survey data

	$(R_{N,t})$ (1)	$(R_{X,t})$ (2)	Book_Size$_N$ (3)	Book_Size$_X$ (4)
$R_{t-1,N}$	0.334*** (0.068)	na	-1.152 (2.472)	na
DivDiff$_{t-1,N}$	0.268*** (0.038)	na	0.184 (1.387)	na
$R_{t-1,X}$	na	0.283*** (0.065)	na	-0.182 (0.201)
DivDiff$_{t-1,X}$	na	0.342*** (0.068)	na	0.284 (0.209)
NN	-0.045** (0.020)	na	0.203 (0.711)	na
NR_P × SUR_Neg	0.021 (0.031)	0.009 (0.030)	0.930 (1.120)	0.458*** (0.091)
NR_P × SUR_Pos	-0.004 (0.018)	-0.005 (0.054)	1.540** (0.639)	0.326*** (0.047)
NR_NP	-0.049 (0.019)	-0.014 (0.011)	0.184 (1.387)	0.028 (0.209)
R_NP × DivDiff$_{t,N}$	0.023 (0.016)	-0.001 (0.014)	-0.025 (0.589)	-0.009 (0.044)
R_P × NDivDiff_Neg	-0.038 (0.022)	-0.024 (0.020)	2.331*** (0.826)	0.495*** (0.062)
R_P × NDivDiff_Pos	0.023 (0.026)	0.011 (0.023)	0.723 (0.935)	0.411*** (0.036)
#Obs	213	213	214	214
R^2	0.346	0.199	0.02	negative

*Number inside parenthesis denotes std. error. *** denotes significance at 1% level, ** denotes significance at 5% but not 1% level and * denotes significance at 10% but not 5% level.*

NDiv_SRN_1 or XDiv_SRN_1: Indicator variable for trading periods when the pattern of dividend changes for stock N or stock X till the previous period was short-run negative change.

NDiv_SRP_1 or XDiv_SRP_1: Indicator variable for trading periods when the pattern of dividend changes for stock N or stock X till the previous period was short-run positive change.

NDiv_LRN_1 or XDiv_LRN_1: Indicator variable for trading periods when the pattern of dividend changes for stock N or stock X till the previous period was long-run negative change.

NDiv_LRP_1 or XDiv_LRP_1: Indicator variable for trading periods when the pattern of dividend changes for stock N or stock X till the previous period was long-run positive change.

The regression equations for the effect of the past pattern of realized dividends are then given by:

$$\begin{aligned}\text{Spread}_{t,N} =& \beta_{71} R_{t-1,N} + \beta_{78}\,\text{NDiv\_SRP\_1} + \beta_{79}\,\text{NDiv\_LRP\_1} + \beta_{710}\,\text{NDiv\_SRN\_1} \\ &+ \beta_{711}\,\text{NDiv\_LRN\_1} + \delta_7\end{aligned} \tag{3.4a}$$

$$\begin{aligned}\text{R}_{t,N} =& \beta_{81} R_{t-1,N} + \beta_{88}\,\text{NDiv\_SRP\_1} + \beta_{89}\,\text{NDiv\_LRP\_1} + \beta_{810}\,\text{NDiv\_SRN\_1} \\ &+ \beta_{811}\,\text{NDiv\_LRN\_1} + \delta_8\end{aligned} \tag{3.4b}$$

Regarding the effect of dividend pattern changes on Spread_N we can see from column 1 in Table 7 that mean spreads are wider for negative dividend change sequences than for positive dividend change sequences, 0.45 and 0.47 for short-run and long-run negative dividend change sequences respectively, compared to 0.28 and 0.30 for short-run and long-run positive dividend change sequences respectively. Also the mean spreads tend to become wider the ‘longer’ the sequence.

Similarly, the effect of realized dividend patterns on stock X are tested through:

$$\begin{aligned}\text{Spread}_{t,X} =& \beta_{91} R_{t-1,X} + \beta_{98}\,\text{XDiv\_SRP\_1} + \beta_{99}\,\text{XDiv\_LRP\_1} + \beta_{910}\,\text{XDiv\_SRN\_1} \\ &+ \beta_{911}\,\text{XDiv\_LRN\_1} + \delta_9\end{aligned} \tag{3.5a}$$

$$\begin{aligned}\text{R}_{t,X} =& \beta_{101} R_{t-1,X} + \beta_{108}\,\text{XDiv\_SRP\_1} + \beta_{109}\,\text{XDiv\_LRP\_1} + \beta_{1010}\,\text{XDiv\_SRN\_1} \\ &+ \beta_{1011}\,\text{XDiv\_LRN\_1} + \delta_{10}\end{aligned} \tag{3.5b}$$

From Table 8, we see results similar to that observed for stock N. We again observe that mean spreads are wider for negative dividend change sequences than for positive dividend change sequences.

Table 7: Regression: Effect of dividend patterns on stock N

	$\text{Spread}_{\mathbf{N}}$ (1)	$\mathbf{R_N}$ (2)
$R_{t-1,N}$	-0.548 (0.377)	0.377*** (0.074)
NDiv_SRP_1	0.281*** (0.084)	0.029* (0.016)
NDiv_LRP_1	0.304*** (0.083)	0.041** (0.016)
NDiv_SRN_1	0.450*** (0.080)	-0.068*** (0.016)
NDiv_LRN_1	0.470*** (0.083)	-0.073*** (0.016)
#Obs	213	213
R^2	0.035	0.013

*Number inside parenthesis denotes std. error. *** denotes significance at 1% level, ** denotes significance at 5% but not 1% level and * denotes significance at 10% but not 5% level.*

4. Conclusions

Our primary result is the persistent effect of packaged information on trading behavior. This result is quite robust as it holds across a variety of variables and treatments. Interestingly, we find that the marginal effect of packaged information on trading decisions is even stronger when there is a lack of informativeness in news (i.e. statistically unreliable information). We also find that market sentiment created by news has spill-over effects on other stocks unaffected by such news. This is demonstrated by the fact that trading decisions regarding stock X are affected by news on stock N, even though subjects know that information flows are based on returns for stock N only.

Finally we observe that while packaging information has a strong effect on subjects' evaluation about future returns, highly reliable information as expected reduces the uncertainty about future expected returns, where the reduction is close to the actual changes in returns of 10%.

Table 8: Regression: Effect of dividend patterns on stock X

	$\text{Spread}_{\mathbf{X}}$ (1)	$\mathbf{R_X}$ (2)
$R_{t-1,X}$	0.140 (0.250)	0.243*** (0.066)
XDiv_SRP_1	0.146*** (0.050)	0.001 (0.013)
XDiv_LRP_1	0.025 (0.053)	0.051*** (0.014)
XDiv_SRN_1	0.166*** (0.050)	-0.0247* (0.013)
XDiv_LRN_1	0.232*** (0.050)	-0.045** (0.014)
#Obs	213	213
R^2	0.038	0.019

*Number inside parenthesis denotes std. error. *** denotes significance at 1% level, ** denotes significance at 5% but not 1% level and * denotes significance at 10% but not 5% level.*

References

Andreassen, P., 1990, “Judgmental Extrapolation and Market Overreaction: On the Use and Disuse of News", *Journal of Behavioral Decision Making*, 3, 153-174.

Barberis, N., A. Schleifer and R. Vishny, 1998, “A Model of Investor Sentiment,” *Journal of Financial Economics*, 49, 307-344.

Benartzi, S. and R. Thaler, 2001, “Naïve Diversification Strategies in Defined Contribution Savings Plans,” *American Economic Review*, 91, 79Ű98.

Bloomfield R., 1996, “Quotes, prices, and estimates in a laboratory market", *Journal of Finance*, 51, 1791-1808.

Conrad J. and G. Kaul, 1998, “An Anatomy of Trading Strategies,” *Review of Financial Studies*, 11(3), 489-519.

Daniel K., D. Hirschleifer, and A. Subrahmanyam, 1998, “Investor psychology and security market under- and over-reactions”, *Journal of Finance*, 53, 1839-1886.

Debondt, W. and R. Thaler, 1985, “Does the stock market overreact?,” *Journal of Finance*, 40, 793-805.

Debondt, W. and R. Thaler, 1987, “Further evidence on investor overreaction and stock market seasonality,” *Journal of Finance*, 42, 557-581.

Edwards, W., 1968, “Conservatism in human information processing,” in B. Kleinmuntz (ed.), *Formal representation of human judgment*, pp. 17-52. New York: Wiley.

Griffin, D. and A. Tversky, 1992, “The weighting of evidence and the determinants of confidence,” *Cognitive Psychology*, 24, 411-435.

Hong, H., and J. Stein, 1999, “A unified theory of under-reaction, momentum trading and overreaction in asset markets,”*Journal of Finance*, 54, 2143-2184.

Hong, H., T. Lim, and J. Stein, 2000, “Bad News Travels Slowly: Size, Analyst Coverage, and the Profitability of Momentum Strategies,” *Journal of Finance,* 55, 265-295.

Jegadeesh, N, and S. Titman, 2001, “Profitability of Momentum Strategies: An Evaluation of Alternative Explanations,” *Journal of Finance*, 56, 699-720.

Li, Feng, 2006, “Do stock market investors understand the risk sentiment of corporate annual reports?” Working paper, University of Michigan.

Nelson, M., Bloomfield, R., Hales, J. and R. Libby, 2001, “The Effect of Information Strength and Weight on Behavior in Financial Markets”, *Organizational Behavior and Human Decision Processes*, 86 (2), 168-196.

Odean, T., 1998, “Volume, Volatility, Price, and Profit When All Traders Are above Average,” *Journal of Finance*, 53 (6), 1887-1934.

Tetlock, Paul C., 2007, “Giving content to investor sentiment: The role of media in the stock market”, *Journal of Finance*, 62(3), 1139-1168.

Tetlock, Paul, C., Saar-Tsechansky, and Macskassy, S., 2008, “More Than Words: Quantifying Language to Measure Firms’ Fundamentals", *The Journal of Finance*, 63(3), 1437-1467.

Tversky, A. and D. Kahneman, 1974, “Judgment under Uncertainty: Heuristics and Biases,” *Science*, 185, pp. 1124 - 1131.