Quantitative Anchoring and Disposition Effects: Evidences From Daily Stock Return Data

by

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Abstract

We decompose the response of stock return to the sign of past stock return into the quantitative anchoring and disposition effects, where the quantitative anchoring is that the past positive stock return induces a positive stock return in the subsequent period (*plus anchoring*) and vice versa for the past negative stock return (*minus anchoring*) and disposition effect is that the tendency of investors to hold losing investments too long and sell winning investments too soon. To test these effects, we divide the stock returns into two groups by their signs and checked the subsequent responses of stock returns at the next periods. From the daily stock return data of 47 countries', we found (i) both the plus anchoring and minus anchoring exist. (ii) plus anchoring is bigger than minus anchoring if the disposition effect exists. (iii) if we assume the plus anchoring is equal to the minus anchoring, then the disposition effect is rejected in most countries.

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1 Introduction

It is now well perceived that to understand the market psychology is important, since the speculative bubbles often start from the psychological basis. In particular, Shiller (2004, p2) defines a speculative bubbles as “a situation in which news of price increase spurs investor enthusiasm, which spreads by psychological contagion from person to person, in the process amplifying stories that might justify the price increases”.

So the psychological factors to determine the investors’ response of past price increase or decrease should be more thoroughly investigated. With respect to this, in this paper, we focus on the quantitative anchor effect in Shiller (2004) and the disposition effect in Shefrin and Statman (1985). In particular, Shefrin and Statman (1985) introduced the concept of disposition effect, the tendency of investors to hold losing investments too long and sell winning investments too soon based upon the prospect theory of Kahneman and Tversky (1979). They found the patterns are consistent with a combined effect of tax considerations and the three other elements; mental accounting, regret aversion and self control. Odean (1998) also found investors demonstrate a strong preference for realizing winners rather than losers by analyzing trading records for 10,000 accounts at a large discount brokerage house.

However Odean (1998) was not able to distinguish between the two behavioral hypotheses. Both prospect theory and a belief in mean reversion predict that investors will hold their losers too long and sell their winners too soon. Both predict that investors will purchase more additional shares of losers than of winners.

In this paper, we decompose the response of stock return to the sign of past stock return into the quantitative anchoring and disposition effects, where the quantitative anchoring is that the past positive stock return induces a positive stock return in the subsequent period (*plus anchoring*) and vice versa for the past negative stock return (*minus anchoring*) and disposition effect is that the tendency of investors to hold losing investments too long and sell winning investments too soon. To test these effects, we divide the stock returns into two groups by their signs and checked the subsequent responses of stock returns at the next periods.

From the daily stock return data of 47 countries’, we found (i) both the plus anchoring and minus anchoring exist. (ii) plus anchoring is bigger than minus anchoring if the disposition effect exists. (iii) if we assume the plus anchoring is equal to the minus anchoring, then the disposition effect is rejected in most countries.

The rest of the paper is organized as follows. Section 2 introduces on the theories of quantitative anchor and disposition effects. In Section 3, we discuss on the empirical test results through the threshold regression. Section 4 concludes the paper.

2 Anchoring and Choice Under Risk

It is well known the stock price changes are unforecastable according to Fama's (1965) efficient markets argument. More specifically the stock price may be approximated by a random walk as follows:

$$p_t = p_{t-1} + u_t \tag{1}$$

where p_t is a log of stock price index. Thus the stock return is not unconditionally predictable as

$$E\left(\Delta p_t\right) = 0 \tag{2}$$

where $\Delta p_t \equiv p_t - p_{t-1}$.

However the claim (2) is not contradict with that the stock return is predictable conditionally.[2] For instance, we may write

$$E\left(\Delta p_t\right) = E\left(\Delta p_t|A\right)\Pr\left(A\right) + E\left(\Delta p_t|A^c\right)\Pr\left(A^c\right) = 0 \tag{3}$$

where $E\left(\Delta p_t|A\right)$ denotes a conditional expectation of Δp_t on an event A and $\Pr\left(A\right)$ denotes the probability of the event A. Note the equality (2) may hold even if $E\left(\Delta p_t|A\right) \neq 0$ or $E\left(\Delta p_t|A^c\right) \neq 0$.

The events we focus in the paper are $A \equiv \{\Delta p_{t-1} < 0\}$ and $A^c \equiv \{\Delta p_{t-1} \geq 0\}$: i.e., conditional expectation of stock return on the signs of past period's stock return. This conditional expectation may be decomposed with two important aspects of stock

[2] See Kaul (1996) for the preditability issue in stock returns.

returns: the quantitative anchor effect in Shiller (2004) and the disposition effect in Shefrin and Statman (1985). These effects are explained in following subsections.

2.1 Quantitative Anchor Effect

The sign of current stock return may depend on the sign of past period' stock return as a quantitative anchor. This idea is contained in Shiller (2004) extending the anchoring and adjustment of Tversky and Kahneman (1974). In particular, Shiller (2004, p149) asserts that "In making judgements about the level of stock prices, the most likely anchor is the most recently remembered price. The tendency of investors to use this anchor enforces the similarity of stock prices from one day to the next.....Past price changes may also provide an anchor, if attention is suitably drawn to them".[3]

So the current negative (or positive) stock return is followed by the negative (or positive) stock return of past period through Shiller's quantitative anchor effect as:

$$\begin{aligned} \Delta p_t &\propto \gamma_1 \Delta p_{t-1} \text{ if } \Delta p_{t-1} \leq 0 && (4) \\ &\propto \gamma_2 \Delta p_{t-1} \text{ if } \Delta p_{t-1} > 0, && (5) \end{aligned}$$

where $\gamma_1, \gamma_2 > 0$. Note we assume a symmetric response in (4) and (5) if we restrict $\gamma_1 = \gamma_2$.

2.2 Disposition Effect

According to the disposition effect in Shefrin and Statman (1985) or Odean (1998), the current stock return may also depend on the sign of past stock returns. To explain it more specifically, suppose there was a stock price change $\Delta p_{t-1} = x$. Further assume

[3] When the stock market crashed on October 19, 1987, Shiller (2004, p99) inquired directly of investors what they considered to be the significant news on that day. He found the most highly rated news stories among those he listed were those about past price declines themselves. The most important news story, according to the respondents, was 100-points drop in the Dow on the morning of October 19.

the error u_t in (1) has a symmetric distribution as:

$$\begin{aligned} u_t &= x \text{ with probability } \tfrac{1}{2} \\ &= -x \text{ with probability } \tfrac{1}{2} \end{aligned}$$

for the analytical simplicity. Note if an investor sells the stock at time t, then the amount of gain or lose at time t is fixed as x depending on the sign of x. However if he holds the stock, then there is the risk due to the possible change of stock price.

According to the choice of 'selling' or 'holding' the stock, the investor's gamble at time t may be arranged as:

Table 1 investor's gamble at time t

stock return at t-1 ($\equiv \Delta p_{t-1}$)	choice of action	possible outcome[1)]
x	sell	x
	hold	$\left(2x,\ \frac{1}{2}\right)$ or $\left(0,\ \frac{1}{2}\right)$
$-x$	sell	$-x$
	hold	$\left(0,\ \frac{1}{2}\right)$ or $\left(-2x,\ \frac{1}{2}\right)$

1) $\left(2x,\ \frac{1}{2}\right)$ denotes $2x$ revenue with probability 1/2

Under this structure, we may expect the choice of investor (i.e., sell or hold) from the prospect theory in Kahneman and Tversky (1979). Before proceeding, define $\langle b,\ 1/2\rangle$ as a gamble to gain b with probability 1/2 or to gain 0 with probability 1/2. Now the disposition effect is defined as the preference of investor as:

$$\text{to sell the stock at time t if } \Delta p_{t-1} > 0 \text{ because } \langle 2x,\ 1/2\rangle < \langle x, 1\rangle \tag{6}$$

and

$$\text{to hold the stock at time t if } \Delta p_{t-1} \leq 0 \text{ because } \langle -2x,\ 1/2\rangle > \langle -x, 1\rangle\,. \tag{7}$$

Note the inequality (6) denotes the risk aversion when the gain is expected while the inequality (7) denotes the risk seeking when the loss is expected.

Suppose we just focus on the above disposition effect. Then the current stock return becomes negative when the past stock return is positive because of stock selling and the price decrease. However the current stock return does not change when the past stock return is negative because of stock holding. Consequently, a disposition effect of stock return is arranged as:

$$\Delta p_t \propto 0 \text{ if } \Delta p_{t-1} \leq 0 \tag{8}$$

$$\propto -\lambda \Delta p_{t-1} \text{ if } \Delta p_{t-1} > 0 \tag{9}$$

where $\lambda > 0$.

In following section, we will discuss to estimate and conduct an inference on the parameters of above two effects.

3 Estimation and Inference

3.1 Threshold Model

The signs of past stock returns affect to the current stock return through above two effects simultaneously. So algebraically we may write these relations as:

$$\Delta p_t \propto \alpha \Delta p_{t-1} \text{ if } \Delta p_{t-1} \leq 0 \tag{10}$$

$$\propto \beta \Delta p_{t-1} \text{ if } \Delta p_{t-1} > 0, \tag{11}$$

considering (4) and (8) or (5) and (9) jointly where $\alpha \equiv \gamma_1$ and $\beta \equiv \gamma_2 - \lambda$.

Now the parameters α and β of the equations (10) and (11) may be consistently estimated from the regression of following two equations:

$$\Delta p_t = \alpha \Delta p_{t-1} + \varepsilon_{1t} \text{ if } \Delta p_{t-1} \leq 0$$

$$\Delta p_t = \beta \Delta p_{t-1} + \varepsilon_{2t} \text{ if } \Delta p_{t-1} > 0$$

where ε_{1t} and ε_{2t} denote the error terms.

In this estimation, note γ_2 and λ are not identified while γ_1 is exactly identified. However if we assume that quantitative anchoring effect is symmetric or $\gamma_1 = \gamma_2$, then the parameters are identified. In particular, we may estimate and conduct an inference on the parameter λ from following threshold autoregression model:[4]

$$\Delta p_t = \delta + \beta \Delta p_{t-1} + (\alpha - \beta) \Delta p_{t-1} 1_{\{\Delta p_{t-1} \leq 0\}} + u_t, \tag{12}$$

where δ is a constant, $1_{\{\Delta p_{t-1} \leq 0\}}$ is the indicator function and $\alpha - \beta = \lambda$.

From the regression of equation (12), we may test two hypotheses:

$$H_0^A : \beta \, (\equiv \gamma_2 - \lambda) = 0 \text{ vs. } \beta \neq 0.$$

and

$$H_0^B : \alpha - \beta \, (\equiv \lambda) = 0 \text{ vs. } \alpha - \beta \neq 0.$$

Note the rejection of H_0^A toward $\beta > 0$ implies $\gamma_2 > \lambda$ assuming there is a disposition effect or $\lambda > 0$. Further note the rejection of H_0^B toward $\alpha - \beta < 0$ implies there is not a disposition effect or $\lambda < 0$.

However if we assume $\gamma_1 \neq \gamma_2$, then $\alpha - \beta = \gamma_1 - \gamma_2 + \lambda$. Therefore the rejection of null H_0^B toward $\alpha - \beta < 0$ implies that $\gamma_1 < \gamma_2$ if we assume there is a disposition effect as $\lambda > 0$. In other words, there is a biased quantitative anchor effect toward the positive sign. A direct inference on the parameter λ is not possible in this case.

[4] The constant term captures the lower frequency variables (e.g., dividends, GDP) not varying in a daily frequency model.

3.2 Test Results

We tested above hypotheses using the data of stock market returns for 47 countries.[5] We expect the daily data are more subject to the psychological factors than lower frequency data.[6] For each country, the sample period begins when the Datastream starts to provide the data. The data are divided into two groups by its signs and analyzed the subsequent period responses of stock returns through the model (12).

Assume that quantitative anchoring effect is symmetric or $\gamma_1 = \gamma_2$. Then, first, we can reject the hypothesis H_0^A in all countries in 5% significance level except three countries. See Appendix and Table 2 to see the results. All estimated coefficients of β were positive which implies $\gamma_2 > \lambda$ assuming there is a disposition effect or $\lambda > 0$. See Table 3.

Second, we can reject the hypothesis H_0^B in 5% significance level from 27 countries. See Appendix and following Table 2. All estimated coefficients of $\alpha - \beta$ were negative except six countries, which implies there is not a disposition effect or $\lambda < 0$. See Table 3.

Table 2 Number of rejection for different critical levels[1)]

hypotheses	number of rejected countries				
	1%	5%	10%	others	sum
H_0^A	41	3	-	3	47
	(87.2)	(6.4)	(-)	(6.4)	(100)
H_0^B	15	12	1	19	47
	(31.9)	(25.5)	(2.1)	(40.4)	(100)

1) Number in parenthesis denotes percent proportion

[5] We have included all the countries for which the stock market returns are available from the Datastream. For China, two market indices are used in our analyses: the index for A shares and the index for B & H shares. A shares are quoted in Renminbi and traded mainly by local people. B shares are quoted in foreign currencies and were traded only by foreigners. However, since March 2001, local people are allowed to participate in the market for B shares with their foreign currency accounts. H shares are traded in Hong Kong Stock Exchange and other foreign stock exchanges.

[6] For instance, monthly or quarterly stock price may be subject to the lower frequency macro variables like earning news or gross national product announcing.

Third, the estimators of $\alpha\,(\equiv \gamma_1)$ are all positive except three countries. Finally note the coefficients $\alpha-\beta$ for all countries were all negative except six countries. Thus if we assume a symmetric quantitative anchor effect or $\gamma_1 = \gamma_2$, then the disposition effect does not exist for these countries. See following Table 3.

Then assume that quantitative anchoring effect is symmetric or $\gamma_1 \neq \gamma_2$. In this case, following inequality

$$\alpha - \beta = \gamma_1 - \gamma_2 + \lambda < 0.$$

implies that $0 \leq \gamma_1 < \gamma_2$ with disposition effect $\lambda \geq 0$ and $\alpha\ (\equiv \gamma_1) > 0$. So the positive anchor effect is larger than the negative anchor effect if we assume the existence of deposition effect.

Table 3 Distribution of estimated coefficients

estimator	ranges of estimators						
	∼-0.2	-0.2∼-0.1	-0.1∼0.0	0.0∼0.1	0.1∼0.2	0.2∼	sum
α	1	-	2	32	12	-	47
	(2.1)	(-)	(4.3)	(68.1)	(25.5)	(-)	(100)
β	-	-	-	10	28	9	47
	(-)	(-)	(-)	(21.3)	(60.0)	(19.1)	(100)
$\alpha - \beta$	4	11	26	6	-	-	47
	(8.5)	(23.4)	(55.3)	(12.8)	(-)	(-)	(100)

1) Number in parenthesis denotes percent proportion

4 Concluding Remark

We tested the quantitative anchoring and disposition effects from the daily stock return data. We found that both the plus anchoring and minus anchoring exist and plus anchoring is bigger than minus anchoring if the disposition effect exists. Further if we assume the plus anchoring is equal to the minus anchoring, then the disposition effect is rejected in most countries. It is interesting to check whether the same effects exist in other asset prices including the realty prices and foreign exchange rates. To identify and estimate the disposition parameter λ when the quantitative anchor effects are asymmetric toward signs is an interesting further study area.

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Appendix

Table 4 Test and Estimation Results by Country

Country	constant	α	β	$\alpha-\beta$	R^2
Argentina	-0.0008**	.0344	0.2437***	-0.2093***	0.026
Australia	0.0001	0.0901	0.1791***	-0.0890***	0.018
Austria	-0.0001	0.1488	0.3166***	-0.1678***	0.059
Belgium	0.0002	0.1206	0.1829***	-0.0623**	0.024
Brazil	0.0001	0.0552	0.1743***	-0.1191**	0.015
Canada	0.0001	0.0983	0.1849***	-0.0866***	0.020
Chile	-0.0001	0.1754	0.3906***	-0.2152***	0.092
China(A)	-0.0005	-0.0798	0.0806***	-0.1604***	0.004
China(B&H)	-0.0002	0.1171	0.2229***	-0.1058**	0.031
Columbia	0.0000	0.1906	0.3625***	-0.1719***	0.084
Cyprus	0.0002	0.1194	0.2144***	-0.0950**	0.033
Czech Rep.	0.0007**	0.1177	0.0641**	0.0536	0.008
Denmark	0.0003**	0.0643	0.1155***	-0.0512**	0.009
Finland	0.0000	0.0066	0.0902***	-0.0836**	0.003
France	0.0004**	0.0864	0.1135***	-0.0271	0.010
Germany	0.0001	0.0355	0.1097***	-0.0742**	0.006
Greece	0.0004	0.1239	0.1680***	-0.0441	0.022
Hong Kong	-0.0001	0.032	0.1322***	-0.1002***	0.007
Hungary	-0.0003	0.0221	0.2145***	-0.1924***	0.019
Indonesia	-0.0029***	-0.4189	0.1594***	-0.5783***	0.078
India	0.0003	0.071	0.1284***	-0.0574	0.010
Ireland	0.0003*	0.1081	0.1790***	-0.0709**	0.021
Israel	0.0001	0.0016	0.0746**	-0.0730	0.002
Italy	0.0001	0.0978	0.1630***	-0.0652**	0.017

***, **, * denote statistical significance at the 1%, 5%, and 10% level, respectively.

Table 4 (continued) **Test and Estimation Results by Country**

Country	constant	α	β	$\alpha-\beta$	R^2
Japan	-0.0002	0.0278	0.1558***	-0.1280***	0.011
Korea	0.0001	0.019	0.0596**	-0.0406	0.002
Luxembourg	0.0007***	0.0786	0.0127	0.0659	0.003
Malaysia	0.0003	0.0773	0.1145***	-0.0372	0.009
Mexico	0.0004	0.0972	0.2022***	-0.1050***	0.025
Netherlands	0.0004***	0.0146	0.0203	-0.0057	0.000
New Zealand	-0.0004**	-0.0874	0.1489***	-0.2363***	0.009
Norway	0.0000	0.0303	0.1407***	-0.1104***	0.009
Peru	0.0003	0.0946	0.1570***	-0.0624	0.017
Philippines	0.0006**	0.1981	0.1688***	0.0293	0.033
Poland	0.0005	0.1739	0.1235***	0.0504	0.023
Portugal	0.0000	0.0946	0.1864***	-0.0918**	0.021
Russia	0.0016***	0.0544	0.0114	0.0430	0.001
Singapore	0.0004**	0.1564	0.1068***	0.0496*	0.018
South Africa	0.0006***	0.0773	0.0921***	-0.0148	0.007
Spain	0.0004	0.0817	0.1010***	-0.0193	0.008
Sweden	0.0002	0.0571	0.1311***	-0.0740**	0.010
Switzerland	0.0002	0.0554	0.1008***	-0.0454	0.006
Taiwan	-0.0001	0.0256	0.0673***	-0.0417	0.002
Thailand	0.0001	0.0882	0.1394***	-0.0512	0.014
Turkey	0.0003	0.0078	0.1580***	-0.1502***	0.010
U.K.	0.0004***	0.0939	0.1102***	-0.0163	0.010
U.S.A	0.0002	0.0405	0.1015***	-0.0610**	0.005
Venezuela	0.0003	0.0984	0.2165***	-0.1181***	0.029

***, **, * denote statistical significance at the 1%, 5%, and 10% level, respectively.

Table 5 Sample Countries and Periods

Country	Period	Sample Size	Country	Period	Sample Size
Argentina	1993～2006	3498	Japan	1973～2006	8868
Australia	1973～2006	8868	Korea	1987～2006	5036
Austria	1973～2006	8868	Luxembourg	1992～2006	3910
Belgium	1973～2006	8868	Malaysia	1986～2006	5475
Brazil	1994～2006	3258	Mexico	1989～2006	4601
Canada	1973～2006	8867	Netherlands	1973～2006	8868
Chile	1989～2006	4563	New Zealand	1988～2006	4953
China(A)	1994～2006	3302	Norway	1980～2006	7041
China(B&H)	1993～2006	3503	Peru	1994～2006	3388
Columbia	1992～2006	3862	Philippines	1987～2006	5036
Cyprus	1992～2006	3656	Poland	1994～2006	3347
Czech Rep.	1993～2006	3427	Portugal	1990～2006	4432
Denmark	1973～2006	8867	Russia	1994～2006	3268
Finland	1988～2006	4894	Singapore	1973～2006	8868
France	1973～2006	8868	South Africa	1973～2006	8868
Germany	1973～2006	8868	Spain	1987～2006	5173
Greece	1990～2006	4433	Sweden	1982～2006	6518
Hong Kong	1973～2006	8868	Switzerland	1973～2006	8868
Hungary	1991～2006	4049	Taiwan	1988～2006	4868
Indonesia	1990～2006	4368	Thailand	1987～2006	5214
India	1990～2006	4433	Turkey	1988～2006	4953
Ireland	1973～2006	8868	U.K.	1965～2006	10594
Israel	1993～2006	3649	U.S.A.	1973～2006	8867
Italy	1973～2006	8868	Venezuela	1990～2006	4432