THE LONG-TERM WEALTH EFFECT OF SHARE REPURCHASES EVIDENCE FROM TAIWAN

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ABSTRACT

This paper examines the long-term wealth effect of 948 share repurchase announcements in the Taiwan market. We also investigate what factors determine the wealth effect of share repurchases. Our findings show that share repurchases induce positive buy-and-hold abnormal returns during the 12-month post-announcement period. Undervaluation and unexpected operating profits are the two important factors explaining the wealth effect regardless of firms' investment opportunities. In addition, for firms with poor investment opportunities, estimated repurchase ratio also explains the wealth effect for the two-month period after repurchase announcements but not for the long-term. By contrast, this study does not find the explanatory power of the changes in free cash flow on either the short- or the long-term wealth. The overall evidence supports the undervaluation and the signaling hypotheses, rather than the free cash flow hypothesis.

JEL: G35; G14

KEYWORDS: Share Repurchase; Abnormal Return; Undervaluation; Signaling; Agency Theory

INTRODUCTION

Share repurchases have emerged as a popular payout mechanism in the last decade. For shareholders, share repurchases, which are similar to cash dividends, may convey information about future profitability or represent the firm's commitment to alleviate agency problems (Allen and Michaely, 2003). However, unlike cash dividends, firms are not obligated to accomplish the goals they have set after announcing share repurchases. Thus, the information conveyed by share repurchases is not as reliable as that signaled by dividends.

Share repurchase activity has been allowed in Taiwan since August 2000. Several attempts have been made to determine market reactions to the announcements and determinants which drive the event-period abnormal returns (Chen et al., 2004; Liao et al., 2005; and Lo et al., 2008). However, without a commitment to repurchasing shares, it is possible that the short-term abnormal returns surrounding the announcements are influenced by false information. For instance, the market reacts positively to announcements made by firms that possess potentially serious agency problems. While the market expects the disbursement of excess free cash flow, firms, on the other hand, may simply intend to increase the value of their organization by announcing share repurchases. In this context, examining the short-term abnormal returns may lead to evidence supporting the free cash flow hypothesis, whereas the firms are actually signaling undervaluation. An examination of the long-term abnormal returns can circumvent such concerns. Furthermore, this estimation can also assist in elucidating 1) whether or not share repurchases in Taiwan increase shareholders' wealth in the long-term, and 2) the factors that contribute to long-term wealth.

This paper hence aims to uncover whether share repurchases are capable of increasing shareholders' wealth over the long-term. Based on the evidence presented by Chen et al. (2004), this paper further seeks to discover whether or not the motivation behind repurchasing firms with poor investment opportunities and serious agency problems can be explained by the free cash flow hypothesis over the long-term. In addition, it is also of interest to determine the reasons why firms with a greater number of investment opportunities announce share repurchases, as disbursing excess cash flow is unlikely their purpose.

Our results indicate that share repurchases are made after undervaluation. The evidence is particularly striking for high-Q firms, which is consistent with our prediction and the evidence of Chen et al. (2004). Furthermore, this paper also confirms the existence of a long-term wealth effect during the post-announcement period, which is largely explained by undervaluation and unexpected operating profits. The evidence is solid for both low-Q and high-Q firms. These two factors, along with an estimated repurchase ratio, similarly possess notable explanatory power for the short-term wealth effect. This evidence, however, is more explicit for low-Q firms. On the other hand, this paper, even for firms with poor investment opportunities (low-Q firms), does not find clear evidence to support the free cash flow hypothesis.

The remainder of this paper is organized as follows: the following section discusses hypotheses and reviews the relevant literature; section 3 describes the sample; section 4 discusses the methodology and the formation of the models; section 5 presents the empirical results; and finally, section 6 presents certain conclusions related to our findings.

LITERATURE REVIEW

The undervaluation, signaling, and free cash flow hypotheses make up the three major theories explaining share repurchases. The undervaluation hypothesis predicts the undervaluation of share prices as the motivation for share repurchases; it also predicts that the announcement of share repurchases is preceded by negative abnormal returns and followed by positive abnormal returns. Unlike the undervaluation hypothesis, the signaling hypothesis does not predict whether or not firms are undervalued prior to repurchase announcements. Instead, this hypothesis primarily predicts that managers engage in share repurchasing in order to signal their future profitability and that the value of the firm will increase following the announcements, due to the expected improvement in profitability. In contrast with the two aforementioned hypotheses, the free cash flow hypothesis regards agency costs and investment opportunities as making up the motivation for share repurchases. As defined by Jensen (1986), the hypothesis predicts that firms with poor investment opportunities disburse the excess cash flow through dividends or share repurchases. Since cash payouts alleviate agency problems, firm values are expected to increase following payout announcements.

A number of studies investigate the undervaluation hypothesis by testing the performance of long-term returns. Ikenberry et al. (1995), examining the US market, show that the most undervalued portfolio has 135.91% of four-year buy-and-hold abnormal returns (BHARs) following announcements. Ikenberry et al. (2000) present negative abnormal returns during the twelve-month period preceding repurchase announcements and positive abnormal returns up to three years following announcements in the Canadian market. Evidence for negative BHARs preceding announcements is also presented by Oswald and Young (2004) for the UK market, Hatakeda and Isagawa (2004) for the market in Japan, and Liao et al. (2005) for the Taiwan market. Oswald and Young (2004) also present evidence indicating that the lower the preceding CARs, the more shares firms buy back. Hatakeda and Isagawa (2004) reveal that a drop in previous share prices increases the probability of real buybacks. This finding is consistent with Li and McNally's (2003) findings for Canada.

As for the validity of the signaling hypothesis, Dann et al. (1991) assert that unexpected earnings appear to be positive in each of the five years following the announcement of tender offer repurchases. Moreover, market reactions to tender offer repurchase announcements correlate positively with subsequent unexpected earnings. Hertzel and Jain (1991), who estimate revisions of analysts' earnings forecasts around repurchase announcements, demonstrate that market reactions are positively related to revisions of short-term earnings forecasts. In comparing repurchasing firms with their industry peers, Lie and McConnell (1998) suggest that the operating performance of the repurchase firms is superior, with the outperformance continuing for up to five subsequent years. Lie's (2005) evidence indicates that firms which actually buy back shares experience marked improvement in subsequent operating performance, whereas firms which merely make announcements do not.

Nevertheless, a number of studies advocate the free cash flow hypothesis. Dittmar (2000), who examines a set of theories simultaneously, asserts that undervaluation and excess cash flow are the two crucial factors explaining improvements caused by share repurchases. Her evidence is later supported by the research performed by Michell and Dharmawan (2007) for the Australian market. In their comprehensive study, Grullon and Michaely (2004) show that market reactions surrounding share repurchase announcements correlate well with the free cash flow held by firms that are more likely to overinvest. Similarly, in examining repurchases in Taiwan, Chen et al. (2004) proposes the idea that only firms with poor investment opportunities repurchase in order to forego excess cash flow. In contrast, those with good future prospects repurchase so as to signal undervaluation. Moreover, Lo et al. (2008) propose that preannouncement undervaluation can be attributed to agency problems although the undervaluation and the agency problems apparently possess explanatory power on the abnormal returns surrounding the announcement day.

DATA AND DESCRIPTIVE STATISTICS

The data are collected from two sources. The market observation post system (MOPS) of the Taiwan Stock Exchange provides the details of the share repurchases announced by the firms listed between the years 2000 and 2008. The data consist primarily of the announcement date, estimated repurchase ratio, repurchase ratio, and completion rate. The monthly return data and financial data are collected from the Taiwan Economic Journal (TEJ) database. Observations included in the sample are to meet the following criteria: 1) For each sample firm, only the first announcement in each of the sample years is included. 2) The financial data of the repurchasing firms should be accessible for the period between 1999 and 2008. 3) The firms do not classify as representatives of the finance industry. Overall, the sample contains 948 observations for 374 repurchasing firms.

Table 1: Descriptive Statistics for Share Repurchases between August 2000 and December 2008

Q Ranking	N		Q	ER	RR	CR
1	194	Mean	0.7442	0.0357	0.0207	0.6383
(Low)		Median	0.7613	0.0295	0.0144	0.6936
2	184	Mean	0.9262	0.0296	0.0197	0.7077
		Median	0.9443	0.0258	0.0171	0.8063
3	187	Mean	1.0947	0.0293	0.0186	0.6838
		Median	1.1160	0.0249	0.0151	0.8053
4	200	Mean	1.3791	0.0294	0.0182	0.6868
		Median	1.3848	0.0245	0.0155	0.8000
5	183	Mean	2.2758	0.0272	0.0169	0.6665
(High)		Median	2.0188	0.0239	0.0131	0.7643

This table reports the mean and median estimated repurchase ratio (ER), repurchase ratio (RR), and completion rate (CR) respectively based on Tobin's Q ratio quintile rank. The Q ratio of each observation is compared to all firms listed on the Taiwan Stock Exchange at the end of the year prior to repurchase announcements. The lowest-Q firms are ranked in quintile 1. Q ratio is the sum of the market value of equity and the book value of total debt, divided by the book value of total assets. N denotes the number of the observations in each quintile.

Table 1 shows the distribution of the announcements and the descriptive statistics of the share repurchases, according to Tobin's Q ratio. The Q ratio is computed as the sum of the market value of equity and the book value of total debt divided by the book value of total assets. The quintiles are determined at the end of the year prior to the repurchase announcement, and the ratio is compared to all firms listed on the Taiwan Stock Exchange. The Q ratio of quintile 1 and quintile 2 are, on average, less than one. The mean (median) for the two quintiles is 0.7442 (0.7613) and 0.9262 (0.9443), respectively. In contrast,

the Q ratio of the highest-Q firms (quintile 5) is 2.2758 for the mean, and 2.0188 for the median. The average (median) estimated repurchase ratio for the lowest-Q firms is 3.57% (2.95%), percentage much greater than those for the highest-Q firms (2.72% and 2.49% for the mean and median, respectively). Furthermore, on average, the low-Q firms repurchase with a higher percentage of their outstanding shares and have a repurchase ratio of 2.07% for the mean and 1.44% for the median. The completion rate, however, does not differ extensively across the five Q ratio quintiles, and ranges from 63.83% to 70.77%.

METHODOLOGY AND HYPOTHESES DEVELOPMENT

Unlike other payout policies, share repurchases take far more time to implement. This factor makes testing long-term performance important, as the market may not only react to repurchases on the day or in the month when the event takes place but also in subsequent periods. Even if certain repurchase programs are not implemented following the announcements, repurchase announcements remain a signaling mechanism for investors. Furthermore, this paper introduces models used to test directly which hypothesis more effectively predicts the wealth effect of the share repurchases.

Estimation of Long-Term Abnormal Returns

The monthly abnormal returns are estimated for a 25-month period, beginning up to 12 months prior to the repurchase announcement. In keeping with the idea that size and book-to-market ratio are the two most important risk factors which should be taken into account when predicting security returns (Fama and French, 1993), twenty-five reference portfolios have been ranked by size and market-to-book ratio (MB), both of which are determined at the end of the year prior to the announcement. The monthly abnormal returns of the observations (AR_{it}) are computed as the divergence between the monthly raw returns and the average returns of the corresponding reference portfolio. Cross-sectionally averaging the AR_{it} generates the monthly abnormal returns for each sample month (AR_t).

Kothari and Warner (1997) assert that long-term abnormal returns increase with the length of event periods. Following the procedures undertaken by Rau and Vermaelen (2002), this paper examines one thousand pseudo-portfolios to adjust for the skewness of the AR_t. Each pseudo-portfolio is created by randomly drawing a non-repurchasing firm-year from the corresponding reference portfolio for each repurchase announcement in the sample with replacement. Repeating the above drawing procedure a thousand times generates one thousand pseudo-portfolios and one thousand sets of pseudo abnormal returns. The bias-adjusted abnormal returns (AR_{adj}) are computed by subtracting the average pseudo monthly abnormal returns from the AR_t.

The undervaluation hypothesis predicts negative buy-and-hold abnormal returns (BHARs) and ARs prior to the announcements which are expected to precede positive ARs and BHARs.

Estimation of Long-Term Abnormal Returns by Q-Ratio Ranking

Evidence suggests that the free cash flow hypothesis predicts the short-term wealth effect of share repurchases in Taiwan, particularly for firms with poor investment opportunities (Chen*, et al.*, 2004; Lo*, et al.*, 2008). In order to ascertain whether the free cash flow hypothesis predicts the long-term wealth effect as well, this paper examines and compares long-term AR and BHAR performance by Q-ratio ranking. Tobin's Q ratio is utilized as the proxy for investment opportunities (Lang and Litzenberger, 1989). Low-Q firms, which have poor investment opportunities, are expected to repurchase shares in order to disburse any excess cash flow. The market is expected to react positively to their announcements. The free cash flow hypothesis predicts that low-Q firms should be undervalued to a greater extent prior to the announcements, due to their inherent agency problems.

In contrast, high-Q firms have less of an incentive to buy back shares in order to reduce excess cash flow, as they are involved in a greater number of positive-NPV investment projects. However, given that insiders and shareholders are privy to different amounts of information, the market may undervalue the

investment projects and their share prices, motivating high-Q firms to buy back shares. The positive-NPV projects may also generate a series of future cash flows, with which insiders are familiar, but that are unknown to general shareholders. According to the signaling hypothesis, high-Q firms may signal this information by announcing share repurchases in order to suggest their superiority over their peers. Overall, both the undervaluation and the signaling hypotheses predict that positive abnormal returns are a typical response to share repurchase announcements. Negative ARs or BHARs are also expected prior to announcements made by undervalued high-Q firms.

Examining the Determinants of the Long-Term Wealth Effect

This paper assumes that investors evaluate short-term and long-term firm values differently and presumes that they will gain greater access to relevant investment information over time. The market is likely to respond to the information announced by firms in the short-term, resulting in short-term ARs. In addition, share buybacks executed by the firms during this period also affect the ARs in month 0 and month 1. Thus, the short-term model is as follows:

$$\mathrm{BHAR}_{(0,1)} = \alpha + \beta_1\left(\mathrm{BHAR}_{(-9,-1)}\right) + \beta_2(\mathrm{ER}) + \beta_3(\mathrm{CR}) + \beta_4(\mathrm{COPFT}) + \beta_5(\mathrm{CFCF}) + \varepsilon \quad (1)$$

where $\mathrm{BHAR}_{(m,n)}$ stands for the adjusted buy-and-hold abnormal returns compounding from month m to month n. ER denotes the estimated repurchase ratio, that is, the number of shares announced to be bought back as the percentage of outstanding shares. CR refers to the completion rate, which is the number of the shares repurchased given as the percentage of the shares announced. Since the managers' real intention remains unknown when repurchases are announced, CR is employed as a proxy for the expected completion rate in model 1.

The change in operating profits, denoted by COPFT, is computed as the operating profit at the end of the announcement year (year 1) minus the operating profit at the end of the previous year (year 0), scaled in terms of the book equity at the end of the previous year (year 0). In line with the implicit assumption that operating profits are a random walk, COPFT is employed as a proxy for unexpected operating profits. The change in free cash flow (CFCF) is the difference between the free cash flow of year 1 and the free cash flow of year 0, scaled in terms of the book equity of year 0. The free cash flow is the sum of tax, capital expenditure, and the increases in the net working capital of year 0 subtracted from the earnings before interest, taxes, depreciation and amortization (EBITDA) of year 0.

With information increasingly available over the long-term, investors are more capable of distinguishing between true and false information. The firms can no longer expect to raise the firm value by announcing and signaling. Hence, the long-term wealth effect not only reflects the information conveyed by the announcements, but also whether or not the signaled information comes to pass. The long-term model is thus as follows:

$$\mathrm{BHAR}_{(0,12)} = \alpha + \beta_1\left(\mathrm{BHAR}_{(-9,-1)}\right) + \beta_2(\mathrm{RR}) + \beta_3(\mathrm{CR}) + \beta_4(\mathrm{COPFT}) + \beta_5(\mathrm{CFCF}) + \mathrm{e} \quad (2)$$

where RR stands for the repurchase ratio, computed as the number of the shares bought as the percentage of shares outstanding. As repurchase announcements in Taiwan are only valid for two months, the long-term model employs a real repurchase ratio (RR) rather than an estimated ratio (ER) to predict $\mathrm{BHAR}_{(0,12)}$.

Prior evidence indicates that share repurchase announcements release favorable information to the market and thus result in a positive wealth effect (Comment and Jarrell, 1991; Liao*, et al.*, 2005; and many others). Ikenberry et al. (1995) further propose that market reactions to the announcements positively correlate with the fraction of share sought. Thus, ER and CR are predicted to positively affect $\mathrm{BHAR}_{(0,1)}$. Similarly, a higher RR and CR represent the firms' solid commitment to actually repurchase shares; these two explanatory variables are expected to positively relate to $\mathrm{BHAR}_{(0,12)}$. In addition, after the announcements, the undervaluation hypothesis expects the market to revise the evaluations for those firms

which are undervalued during the pre-announcement period. In this context, the severer undervaluation should result in higher BHARs after the announcements. The coefficient of $BHAR_{(-9,-1)}$ is predicted to be negative in both of the models. Otherwise, if share repurchases are announced as a means of signaling better prospects of future earnings or profitability, COPFT should positively relate to $AR_{(0,1)}$ and $BHAR_{(0,12)}$. The free cash flow hypothesis also suggests that firms with excess cash flow should forego cash in order to mitigate agency problems, thereby indirectly increasing the firm value. The coefficient of CFCF, thus, is predicted to be negative.

The models are also estimated for low-Q and high-Q firms respectively so as to examine directly whether the wealth effect of the two types of firms are determined by different factors. Specifically, this paper expects that share repurchases announced by low-Q firms are explained by the free cash flow hypothesis, as they normally have poor investment opportunities and more free cash flow. Therefore, the CFCF coefficient for low-Q firms is expected to be of greater significance and more negative than for high Q firms. In comparison, high-Q firms with more positive-NPV investment opportunities are expected to have more incentives to suggest undervaluation or better future prospects.

As time and firm effects are inherent to our data, this paper utilizes fixed effect (LSDV) and random effect (GLS) methods to estimate the models. Greene (2003) and Wooldridge (2007) suggest that the two methods are a better choice and that the random effect method is more efficient in estimating coefficients when time and firm effects exist. Furthermore, comprehensive simulation research demonstrated by Petersen (2009) suggests that ordinary least square (OLS) underestimates the true standard errors. The standard errors estimated by the random effect method are unbiased when the firm effect is permanent. Even if the model contains unobservable variables, this bias of GLS standard errors is much smaller than that of OLS standard errors. The above advantages motivate fixed effect and random effect methods to be employed for the purposes of this paper.

EMPIRICAL RESULTS

Long-Term Abnormal Returns of Share Repurchases

Table 2 presents long-term abnormal returns (ARs), which are examined for 25 months, beginning at month -12. Consistent with the prediction of the undervaluation hypothesis, the adjusted abnormal returns (AR_{adj}) appear to be significantly negative in 8 out of 12 months. The announcing firms suffer from approximately 25.11% of undervaluation, in comparison to their reference portfolio, over 12 months prior to announcing share repurchases. The largest drop in BHARs is found in month -1, at -7.85%.

Surprisingly, the AR in the announcement month appears to be -6.24%. This result can be attributed to the fact that the market does not completely and immediately revise its evaluation based on the information conveyed by the announcements. The post-announcement ARs in the months following the announcements supporting this speculation show significant and positive ARs in six out of twelve months. The AR_1 is 1.97%, which is significantly positive.

The positive AR_1 reflects the signaling effect of the announcements. However, it may also be the result of the buyback activities executed by repurchasing firms. Perhaps the most striking result is that the five consecutive positive ARs from month 8 to month 12 cause the $BHAR_{adj}$ to rebound from -29.8% to -13.07%. All of the five abnormal returns are significant at a 1% level. The results imply that shareholders who buy the shares in month 0 and hold them for 12 months would gain about 18% of BHARs. Overall, the evidence is consistent with extant UK and US evidence, supporting the prediction that share repurchases promote a wealth effect in the long-term (Ikenberry*, et al.*, 1995; and Oswald and Young, 2004).

Table 2: Long-Term Abnormal Returns of Share Repurchase Announcements

Month	AR_{adj} (%)	t-stat	$BHAR_{adj}$ (%)	Month	AR_{adj} (%)	t-stat	$BHAR_{adj}$ (%)
				0	-6.24***	-16.61	-31.36
-12	-0.52	-1.32	-0.52	1	1.97***	5.43	-29.39
-11	-2.66***	-6.50	-3.19	2	-2.09***	-5.84	-31.48
-10	0.45	1.20	-2.74	3	-0.38	-1.05	-31.86
-9	-0.46	-1.23	-3.20	4	0.10	0.29	-31.75
-8	-0.96***	-2.58	-4.16	5	0.02	0.05	-31.74
-7	-1.14***	-3.09	-5.30	6	0.60	1.61	-31.14
-6	0.63*	1.69	-4.67	7	-0.62*	-1.77	-31.76
-5	0.01	0.04	-4.66	8	1.96***	5.50	-29.80
-4	-2.45***	-6.76	-7.11	9	1.55***	4.22	-28.24
-3	-4.25***	-11.59	-11.36	10	2.78***	7.69	-25.47
-2	-5.90***	-15.28	-17.27	11	4.80***	12.83	-20.67
-1	-7.85***	-20.89	-25.11	12	7.60***	19.56	-13.07

Table 2 presents the long-term abnormal returns estimated from month -12 to month 12 for the full sample. The abnormal returns (AR) are estimated by comparing the monthly raw returns to the returns of the corresponding reference portfolio. By employing bootstrapping technique, AR_{adj} is the abnormal returns subtracted by the average abnormal returns of the one thousand pseudo portfolios. $BHAR_{adj}$ is the adjusted buy-and-hold abnormal returns compounding from month -12. Statistical test of significance of AR_{adj} (different from 0) is measured by the ***standard error of the average abnormal returns. Significance at 0.01, 0.05 and 0.1 levels are marked with ***, **, and * respectively.***

Long-Term Abnormal Returns of Low- and High-Q Firms

Table 3: Long-Term Wealth Effect of Share Repurchases by Q-ratio Ranking

Rankings	1 (Low)	2	3	4	5 (High)	Q1-Q5
N	194	184	187	200	183	
$BHAR_{(-12,-10)}$	-2.84**	-3.57**	-2.71*	-4.90***	0.38	-3.23
	(-1.98)	(-2.44)	(-1.65)	(-3.27)	(0.26)	(-1.57)
$BHAR_{(-9,-7)}$	-5.17***	-3.68***	-0.32	-1.92	-1.55	-3.62*
	(-3.50)	(-2.52)	(-0.39)	(-1.34)	(-1.09)	(-1.77)
$BHAR_{(-6,-4)}$	5.13***	-0.12	-0.60	-6.30***	-7.11***	12.24***
	(3.94)	(0.02)	(-0.36)	(-4.35)	(-5.27)	(6.53)
$BHAR_{(-3,-1)}$	-9.65***	-19.22***	-18.50***	-20.91***	-21.85***	12.20***
	(-6.96)	(-12.88)	(-11.91)	(-14.63)	(-14.81)	(6.03)
AR_0	0.81	-5.06***	-8.25***	-7.99***	-10.88***	11.69***
	(1.05)	(-6.05)	(-9.12)	(-10.25)	(-13.10)	(10.29)
AR_1	6.00***	3.05***	1.38*	1.96**	-2.86***	8.86***
	(7.68)	(3.59)	(1.64)	(2.31)	(-3.33)	(7.63)
AR_2	-1.45*	-0.82	-0.86	-3.11***	-4.24***	2.78**
	(-1.95)	(-0.94)	(-0.97)	(-3.99)	(-4.99)	(2.46)
AR_3	-0.22	0.92	-0.54	-1.40*	-0.58	0.36
	(-0.29)	(1.08)	(-0.62)	(-1.66)	(-0.71)	(0.32)
$BHAR_{(4,6)}$	6.97***	1.98	-0.83	-0.58	-4.08***	11.04***
	(5.02)	(1.38)	(-0.56)	(-0.39)	(-2.86)	(5.55)
$BHAR_{(7,9)}$	4.50***	6.06***	0.61	1.16	2.17	2.33
	(3.22)	(4.23)	(0.40)	(0.86)	(1.54)	(1.17)
$BHAR_{(10,12)}$	11.46***	20.49***	16.18***	13.88***	13.49***	-2.04
	(7.61)	(13.42)	(10.50)	(9.81)	(9.31)	(-0.97)

*Table 3 presents the long-term abnormal returns estimated from month -12 to month 12 based on Q ratio rankings. The biased-adjusted abnormal returns in month m (AR_m) are computed as the monthly raw returns of the repurchasing firms minus those of the corresponding reference portfolio, adjusted by the average abnormal returns of the one thousand pseudo portfolios. $BHAR_{(m,n)}$ is the adjusted buy-and-hold abnormal returns compounding from month m to month n. Statistical test of significance of AR_m (different from 0) and $BHAR_{(m,n)}$ (different from 0) is measured by the standard error of the ARs or BHARs. Q1-Q5 presents the divergence of AR_m or $BHAR_{(m,n)}$ between quintile 1 and quintile 5. Statistical test of significance of the divergence is carried out by the independent sample t test. Student t statistics are reported in parentheses, and the significance at 0.01, 0.05 and 0.1 levels are marked with ***, **, and * respectively.*

Table 3 demonstrates the long-term wealth effect by Q-ratio ranking. The results emerging from comparing the BHARs and ARs of quintiles 1 and 5 reveal that high-Q firms suffer from serious undervaluation during the pre-announcement period. The $BHAR_{(-3,-1)}$ of high-Q firms is -21.85% (with a t-statistic of -14.81). In comparison, the $BHAR_{(-3,-1)}$ of low-Q firms is -9.65% (with a t-statistic of -6.96), percentage much higher than that of high-Q firms (with a t-statistic of 6.03). A similar situation is also found in the period (-6,-4). The evidence which is consistent with the findings of Chen et al. (2004) implies that high-Q firms tend to repurchase when their shares are undervalued. However, the results are not consistent with the free cash flow hypothesis, as they do not show that low-Q firms are more undervalued than high-Q firms.

With respect to the wealth effect surrounding the announcements, AR_0 and AR_1 are found to monotonously shrink or become more negative as the Q-ratio ranking increases. More specifically, AR_0 and AR_1 for low-Q firms are 0.81% and 6.00%, respectively, and -10.88% and -2.86%, respectively, for high-Q firms. The AR differences between the two quintiles are both significant at a level of 1%, which apparently supports the free cash flow hypothesis. However, later evidence indicates that the higher ARs for low-Q firms can be attributed to other factors.

During the post-announcement period, low-Q firms experience significantly higher ARs or BHARs than high-Q firms. The divergences, respectively significant at levels of 5% and 1%, are 2.78% for AR_2 and 11.04% for $BHAR_{(4,6)}$. Additionally, the only significantly positive BHAR for high-Q firms during the post-announcement period is $BHAR_{(10,12)}$, at 13.49%. Overall, the evidence in this section is generally consistent with the free cash flow hypothesis for low-Q firms, and the undervaluation and signaling hypotheses for high-Q firms, implying that share repurchases signal favorable information to the market. However, the information signaled by the two types of firms may differ.

Short-Term Abnormal Returns, Undervaluation, Profitability, and Free Cash Flow

The main discussions in this section focus on the fixed and random effect models due to the fact that the standard errors produced by OLS models tend to be under-estimated in the presence of time and firm effects (Petersen, 2009). Table 4 presents the regressions of $BHAR_{(0,1)}$ on several variables. Both the fixed and random effect models suggest that the unexpected operating profits (COPFT) positively and significantly relate to $BHAR_{(0,1)}$.

The random effect model shows that a 1% increase in COPFT result in a 0.315% increase in $BHAR_{(0,1)}$. Furthermore, while the random effect model suggests the estimated repurchase ratio (ER) to be the other significant factor explaining $BHAR_{(0,1)}$, the fixed effect model points instead to the pre-announcement buy-and hold abnormal returns ($BHAR_{(-9,-1)}$). The result from estimating the random effect model indicates that a 1% increase in ER provokes a 0.648% increase in $BHAR_{(0,1)}$. On the other hand, in the fixed effect model, in keeping with the predictions of the undervaluation hypothesis, the coefficient of $BHAR_{(-9,-1)}$ is -0.066, and its t statistic is -2.61, significant at a level of 1%.

As mentioned in the literature review, based on their findings for Taiwan repurchases, Chen et al. (2004) suggest that low-Q ($Q < 1$) firms repurchase in order to forego free cash flow while high-Q ($Q > 1$) firms repurchase as a means of signaling undervaluation. However, the evidence presented in Table 4 tells a completely different story. The coefficient on the change of free cash flow (CFCF) is not significant in any model. In particular, the coefficient is positive, albeit insignificant, in the model for low-Q firms, which is contrary to the prediction of the free cash flow hypothesis. In contrast, although partially consistent with Lo et al. (2008), ER and COPFT appear to have a significant effect on $BHAR_{(0,1)}$ in the low-Q model.

The coefficients of the two explanatory variables are 1.200 and 0.486, respectively. Both are significant at a level of 1%. Moreover, $BHAR_{(-9,-1)}$ and CR also explain $BHAR_{(0,1)}$, but the explanatory power is weaker than ER and COPFT. The coefficient of $BHAR_{(-9,-1)}$ is -0.062 and significant at a level of 5%,

indicating that the undervaluation hypothesis is capable of explaining low-Q firms. Meanwhile, the explanatory power of the model for high-Q firms is not as explicit as that for low-Q firms.

Table 4: Regressions of Short-Term BHARs on Several Factors

	Predicted Sign	Pooled Model	FE Model	RE Model	RE Q < 1	RE Q > 1
$BHAR_{(-9,-1)}$	-	-0.008	-0.066***	-0.030	-0.062**	-0.045*
		(-0.46)	(-2.61)	(-1.52)	(-1.98)	(-1.84)
ER	+	0.932***	0.092	0.648**	1.200***	-0.094
		(3.25)	(0.18)	(2.06)	(3.11)	(-0.21)
CR	+	0.002	0.007	0.005	0.045*	-0.031
		(0.13)	(0.30)	(0.26)	(1.80)	(-1.32)
COPFT	+	0.298***	0.367***	0.315***	0.486***	0.245*
		(3.79)	(3.05)	(2.91)	(3.28)	(1.90)
CFCF	-	-0.014	0.003	-0.005	0.051	-0.010
		(-0.57)	(0.12)	(-0.24)	(1.36)	(-0.39)
Intercept	+/-	-0.072***	-0.062***	-0.071***	-0.062**	-0.068***
		(-4.17)	(-2.63)	(-3.78)	(-2.50)	(-2.70)
R^2		0.026	0.010	0.023	0.074	0.019
F/X^2		4.91***	2.81**	13.77**	27.72***	7.51
N		943	943	943	386	557

*This table presents the regression model of $BHAR_{(0,1)}$ on several factors. $BHAR_{(m,n)}$ is the adjusted buy-and-hold abnormal returns compounding from month m to month n. FR and RE models denote fixed- and random-effect models respectively. ER and CR respectively denote the estimated repurchase ratio and the completion rate. COPFT and CFCF are respectively the change of operating profits and free cash flow in the year of share repurchases, scaled by the book equity at the end of the previous year. Statistical test of significance of the coefficients is carried out by t or Z test, depending on the regression approach. Estimated standard errors are robust to heteroscedasticity. Student t or Z statistics are reported in the parentheses. The mean VIF of the explanatory variables is 1.04. The significance at 0.01, 0.05 and 0.1 levels are marked with ***, **, and * respectively.*

Table 5: Regressions of Long-Term BHARs on Several Factors

	Predicted Sign	Pooled Model	FE Model	RE Model	RE Q < 1	RE Q > 1
$BHAR_{(-9,-1)}$	-	-0.098**	-0.218***	-0.132***	-0.178**	-0.182***
		(-2.53)	(-3.80)	(-3.05)	(-2.45)	(-3.39)
RR	+	0.746	-1.008	0.522	1.213	-0.870
		(0.82)	(-0.74)	(0.52)	(0.93)	(-0.62)
CR	+	-0.001	0.048	0.004	-0.015	0.028
		(-0.02)	(0.83)	(0.09)	(-0.25)	(0.52)
COPFT	+	1.093***	0.742***	1.073***	1.711***	0.909***
		(6.47)	(2.70)	(3.88)	(4.76)	(2.59)
CFCF	-	-0.028	-0.037	-0.031	0.058	-0.005
		(-0.54)	(-0.58)	(-0.55)	(0.69)	(-0.07)
Intercept	+/-	0.093***	0.063*	0.083***	0.198***	-0.002
		(3.32)	(1.96)	(2.89)	(5.05)	(-0.05)
R^2		0.046	0.027	0.045	0.086	0.048
F / X^2		8.97***	4.90***	23.05***	32.82***	15.68***
N		943	943	943	386	557

*This table presents the regression model of $BHAR_{(0,12)}$ on several factors. $BHAR_{(m,n)}$ is the adjusted buy-and-hold abnormal returns compounding from month m to month n. FR and RE models denote fixed- and random-effect models respectively. RR and CR respectively denote the repurchase ratio and the completion rate. COPFT and CFCF are respectively the change of operating profits and free cash flow in the year of share repurchases, scaled by the book equity at the end of the previous year. Statistical test of significance of the coefficients is carried out by t or Z test, depending on the regression approach. Estimated standard errors are robust to heteroscedasticity. Student t or Z statistics are reported in the parentheses. The mean VIF of the explanatory variables is 1.17. The significance at 0.01, 0.05 and 0.1 levels are marked with ***, **, and * respectively.*

$BHAR_{(-9,-1)}$ and COPFT are the only variables that possess explanatory power in the model for high-Q firms. The coefficients of the two variables are -0.045 and 0.245, respectively, but are only significant at a level of 10%. As opposed to the results for low-Q firms, the repurchase factors, ER and CR, do not have notable effects on the short-term abnormal return of high-Q firms.

Long-Term Abnormal Returns, Undervaluation, Profitability, and Free Cash Flow

Table 5 presents the regressions of the long-term post-announcement BHARs on the explanatory variables. Generally, the long-term model provides evidence consistent with that provided by the short-term model. Moreover, R-squares indicate that the explanatory power of the long-term model outperforms that of the short-term model. Notably, $BHAR_{(-9,-1)}$ and COPFT are the two explanatory variables significantly predicting the $BHAR_{(0,12)}$ for the full sample. The results from examining the random model show that a 1% decline in $BHAR_{(-9,-1)}$ causes a 0.132% increase in $BHAR_{(0,12)}$. Similarly, a 1% increase in COPFT stimulates a 1.073% increase in $BHAR_{(0,12)}$. The fixed effect model provides consistent evidence with that from the random effect model. In contrast, the coefficient for CFCF is -0.031 but insignificant. RR and CR, which are the proxies for the fulfillment of the repurchase programs, also lost their effect on the BHARs over the long-term. The evidence given here supports the predictions of the undervaluation and the signaling hypothesis outright.

The information gleaned from comparing the models for low-Q and high-Q firms further supports the undervaluation and the signaling hypotheses for both types of firms. The coefficients of $BHAR_{(-9,-1)}$ for the low-Q and the high-Q models are -0.178 and -0.182, respectively. Both are significant at a level of 1%. Furthermore, COPFT also demonstrates notable explanatory power for the long-term wealth effect. A 1% increase in COPFT increases the $BHAR_{(0,12)}$ for low-Q firms by approximately 1.711% and by 0.909% for high-Q firms. On the other hand, the free cash flow hypothesis predicts that low-Q firms repurchase shares in order to disburse their excess cash flow, which is favorable information for the market. However, CFCF is not found to have significant explanatory power for $BHAR_{(0,12)}$.

Robust Test

Various alternative variables are employed to insure that the results are not affected by the specification error. In the short-term model, $BHAR_{(0,1)}$ is replaced with AR_0, AR_1, and $BHAR_{(0,2)}$, respectively. In the long-term model, $BHAR_{(0,12)}$ is replaced with $BHAR_{(3,12)}$ in order to exclude the short-term effect potentially induced by the buyback executions during the two-month period following the announcements. In both models, $BHAR_{(-9,-1)}$ is replaced by $BHAR_{(-6,-1)}$. Moreover, the changes in operating profits and the changes in free cash flow are scaled in accordance with total assets. The replacements do not provide new information for this paper.

CONCLUSION

This paper aims to examine the long-term wealth effect of share repurchases and the determinants of the wealth effect for the Taiwan market. Firstly, this paper finds that share repurchase announcements are preceded by negative abnormal returns and followed by positive abnormal returns in the long-term. The evidence is consistent with the findings of Ikenberry et al. (1995), Oswald and Young (2004), Liao et al. (2005) and others. In addition, the findings of this paper indicate that the determinants for the long-term and the short-term wealth effect differ. The factors determining the wealth effect of low-Q and high-Q firms differ as well.

The findings for low-Q firms are somewhat remarkable. The market is found to react more positively to the announcements made by low-Q firms. Apparently, the evidence obtained from examining the abnormal returns supports the predictions of the free cash flow hypothesis. However, when the regression models directly examine the explanatory power of free cash flow, no evidence is found to support the hypothesis. On the contrary, the evidence suggests that the short-term abnormal returns of low-Q firms mainly result from pre-announcement undervaluation and future prospects of profitability,

thereby supporting the undervaluation and the signaling hypotheses. Not only are the two hypotheses capable of explaining the short-term abnormal returns, they predict the long-term abnormal returns with even greater success. Furthermore, consistent with Grullon and Michaely's (2004) findings, a higher repurchase ratio and completion rate also promote the short-term, but not the long-term, abnormal returns. The overall findings for low-Q firms imply that, to some extent, share repurchases made by low-Q firms are favorable to investors. However, neither the repurchase ratio nor the completion rate plays an important role in raising the firm value over the long-term. Instead, low-Q firms are expected to increase the shareholders' wealth by improving their operating profits, even though they do not have as many investment opportunities as high-Q firms.

With respect to high-Q firms, the evidence suggests that pre-announcement undervaluation and profitability prospects determine the long-term wealth effect. However, the two factors' explanatory power on the short-term wealth effect is inferior. In addition, the explanatory variables of share repurchases, ER, RR, and CR, do not have a significant effect on either long-term or short-term abnormal returns for high-Q firms, indicating that share repurchases made by high-Q firms do not coincide with investors' main interests. They are thus expected to improve profitability in order to raise the long-term firm value.

In summary, the overall evidence supports the undervaluation and the signaling hypotheses. Although share repurchases appear to be a useful means of increasing the value of a firm, profitability improvement is another key factor determining the wealth effect. A higher repurchase ratio or completion rate may help increase the firm value over the short term, but this effect does not last long. Finally, although firms with poor investment opportunities may repurchase in order to reduce free cash flow, this factor is not the main determinant for shareholders' short-term and long-term wealth.

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