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Signal strength adjustment behavior: Evidence from share repurchases

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ABSTRACT

This paper extends the signaling hypothesis by investigating the signal strength adjustment behavior with respect to the announcement of an open market repurchase (OMR). Given that an OMR is a non-binding commitment for the repurchasing firm, the stock market would likely scrutinize the credibility of the undervaluation signal from the OMR announcement of the firm. This may compel the manager to engage in various mechanisms in order to strengthen the undervaluation signal of the OMR announcement. This paper investigates whether managers of repurchasing firms would modify the terms of the OMR program when the simultaneous announcements of bad news threaten the credibility of the signal from the OMR announcements. Consistent with our signal strength adjustment hypothesis, we find that managers of repurchasing firms increase (shorten) the repurchase plan size (period) with the magnitude of bad news in the simultaneous announcements. Our results also show that the stock market reacts positively to the signal strength adjustments, indicating that they are informative to the market. These results hold after using various techniques to control for sample selection bias.

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1. Introduction

Extant research has developed various hypotheses underpinning why share repurchases are conducted. Among these hypotheses, the signaling theory resonates as being the most widely accepted hypothesis for why firms choose to repurchase shares. Specifically, the signaling hypothesis argues that firms repurchase shares as a means of conveying the managers' belief of undervaluation in the firms' shares to the market (Vermaelen, 1981; Comment and Jarrell, 1991; Ikenberry et al., 1995; Louis and White, 2007; Bhattacharya and Jacobsen, 2016). While the signaling hypothesis is based upon standalone repurchase announcements, a share repurchase program is often announced simultaneously with repurchase-unrelated news.[1] For example, Apple Inc. announced a $100 billion share repurchase program when it announced earnings for the second quarter of 2018. Toyota Motor Corp. reported strong second quarter results and maintained earnings guidance for 2019, while simultaneously announcing a $1.8 billion share repurchase program. These examples suggest that the signal from the simultaneous announcement of repurchase-unrelated news could potentially have an influence over the credibility of the undervaluation signal of a repurchase announcement.

Share repurchases are generally conducted through a public tender offer or on an open market.[2] Under a public tender offer arrangement, the repurchasing firm is bound by the terms of the offer, which is held open for at least 20 business days before the firm acquires the number of shares it has committed to repurchase (Fried, 2000). Unlike public tender offers, firms conducting OMRs are not committed to the repurchase plan. Stephens and Weisbach (1998), for instance, document that while firms on average repurchase between 74% and 82% of the targeted shares within three years of the announcement, 10% of the firms repurchase less than 5% of the number of shares announced and a substantial number of firms repurchase no shares at all.[3] The lack of commitment of

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[1] Bonaimé (2012) reports that of the 3,693 OMRs identified between 1988 and 2007, 1,480 of them (40.1%) are released simultaneously with earnings or dividend announcements. Babenko et al. (2012), on the other hand, find 27.5% of their share repurchase sample is announced concurrently with other news, such as earnings results and future guidance.

[2] Privately negotiated repurchases (also known as targeted repurchases) are another way through which shares can be repurchased. Peyer and Vermaelen (2005) argue that the signaling hypothesis is not applicable to privately negotiated repurchases because they are essentially a two-party contract between the repurchasing firm and the informed seller. Therefore, we do not consider this repurchase method in our study.

[3] Prior studies report the mean repurchase completion rates in the US to be in the range of 70-80% (Stephens and Weisbach, 1998; Jagannathan et al., 2000;

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the firms in following through on the repurchase plan could undermine the credibility of the undervaluation signal of OMR announcements. This threat to credibility may lead the stock market to scrutinize the signal at the time the OMR is announced. Consequently, the managers may be compelled to allay this market scrutiny by engaging in various mechanisms to strengthen the undervaluation signal of the OMR announcement.

This paper asks two unique questions related to the signaling hypothesis for OMRs. First, does the simultaneous signal of repurchase-unrelated bad news announcements motivate managers to engage in the signal strength adjustment behavior with respect to OMRs? Second, with respect to the signal strength adjustment behavior, do the managers modify the terms of the repurchase program in order to strengthen the undervaluation signal of OMRs?

We seek to answer the above research questions using the Japanese setting because of the following reasons. First, managers of Japanese firms are required to provide full-year forecasts of earnings for the following year at each annual earnings announcement and update these forecasts at quarterly earnings announcements throughout the fiscal year. This abundance of management earnings forecasts coupled with the fact that nearly one half of the OMR announcements in our sample occurred at earnings announcement render Japan an ideal setting for measuring the signal of the simultaneous announcements of repurchase-unrelated news. We measure this signal by comparing management earnings forecasts with analysts' consensus earnings forecasts. Second, unlike the US, Japanese firms are required to disclose the repurchase plan period not exceeding one year. This enables us to use two items in the repurchase program (namely, repurchase plan size and period) to test our second research question.

Prior studies suggest that increasing the repurchase plan size enables managers of repurchasing firms to strengthen the undervaluation signal of OMRs. For example, Bonaimé (2012) argues that OMR announcements signal positive information, and that the magnitude of this signal tends to increase in the expected size of the repurchase, even though these announcements are not binding commitments to repurchase shares. Using a signaling model for OMRs, McNally (1999) provides consistent evidence in support of the positive effect of a larger repurchase plan size on the valuation of firms. Specifically, McNally (1999) shows that the valuation of firms tends to increase when the firm announces a larger repurchase plan size, suggesting a larger plan size creates a stronger signal. In line with McNally (1999), numerous empirical studies document a positive correlation between repurchase plan size and market returns of OMR announcements, and find that the correlation remains highly significant even after controlling for signal credibility in the market response models, such as prior completion rates and insider purchases of shares (Babenko et al. 2012; Bonaimé, 2012). These findings lead to our hypothesis that the repurchase plan size enhances the strength of the OMR signal after controlling for the level of credibility.

Gould (2019) and Ota et al. (2019) use the Australian and the Japanese settings, respectively, where the disclosure of the intended duration of repurchase program is required, and find that the shorter the program length specified in an OMR announcement the more likely the repurchasing firm is to follow through with its repurchase target. Both studies also find that the intended program length is negatively associated with announcement returns, suggesting the repurchase plan period has information content in explaining the market reaction to the OMR announcement. Based on these results, we also hypothesize that managers could strengthen the signal of OMRs by shortening the repurchase plan period. While the repurchase plan size and period are jointly disclosed in the repurchase notice, we assume that managers decide on how many shares to repurchase first before they determine the period over which the shares are to be repurchased. Consequently, we argue that given the same level of the repurchase plan size, having a shorter repurchase plan period would strengthen the signal of OMRs as it may indicate that the firm is more committed to the repurchase plan by showing the sense of urgency to repurchase the shares (Gould, 2019; Ota et al., 2019).

We develop a model based on Bonaimé (2012; 2015) to examine the signal strength adjustment behavior with respect to OMRs. We show that *ceteris paribus*, the repurchase plan size is negatively associated with the simultaneous announcement of earnings guidance surprise (as measured by the difference between management earnings forecasts and analysts' consensus earnings forecasts) in all our model specifications. Specifically, a 1-standard-deviation decrease in earnings guidance surprises is associated with an increase in the repurchase plan size of approximately 0.32 percentage points. This increase represents 15% of the mean repurchase plan size, an economically important amount. Moreover, we find that after controlling for the repurchase plan size, the repurchase plan period is positively associated with earnings guidance surprises. That is, a 1-standard-deviation decrease in earnings guidance surprises is associated with a decrease in the repurchase plan period of 2.66 days. Further analysis reveals that the repurchase plan period is uncorrelated with earnings guidance surprises when the repurchase plan size is small. However, when the repurchase plan size is large, the repurchase plan period is significantly positively correlated with earnings guidance surprises. Overall, our main results suggest that managers of repurchasing firms are likely to adjust the undervaluation signal of OMR announcements by specifying a larger plan size and a shorter period in the repurchase program, when the simultaneously disclosed earnings guidance falls short of meeting the analysts' consensus earnings forecast (i.e., when the simultaneous announcement of repurchase-unrelated news undermines the credibility of the undervaluation signal of the OMRs).

We also investigate the effect of earnings guidance surprises on three OMR related aspects: (1) the repurchase completion rate (measured by the ratio of actual to announced repurchases), (2) the actual repurchase size (measured as a percentage of shares outstanding), and (3) the market reaction to the repurchase announcement. Accordingly, we find no effect of earnings guidance surprises on the repurchase completion rates, suggesting that the firm with a negative earnings guidance surprise does not announce a larger repurchase size merely to minimize its negative effect on the share price. Actual repurchases increase in the magnitude of negative earnings guidance surprises. This result is consistent with our expectation given that a larger repurchase plan size is associated with a negative earnings guidance surprise, and that the completion rates are constant irrespective of earnings guidance surprises. The result of the market reaction to OMR announcements shows that an increase (decrease) in the repurchase plan size (period) is associated with a positive market reaction after controlling for the effect of earnings guidance surprises, suggesting that managers can successfully strengthen the signal of OMR announcements by modifying specific items in the repurchase program.

Our regression models in the main analysis use the repurchase-related variables, such as repurchase plan size and plan period,

Bonaimé, 2012; Bonaimé, 2015). However, Banyi et al. (2008) report a significantly large estimation error in the repurchase completion rates in the US prior to the revision of the Rule 10b-18 of the Securities Exchange Act of 1934 in December 2003. Ikenberry et al. (2000), Andriosopoulos et al. (2013), and Ota et al. (2019) overcome the estimation error of repurchase completion rates in the US by using more accurate share repurchase data from Canada, the UK, and Japan, respectively. Ikenberry et al. (2000) and Andriosopoulos et al. (2013) report the mean completion rates of 28.6% and 31.4%, respectively, which are significantly lower than the US, while Ota et al. (2019) report the mean completion rate of 77.4%, which is comparable to the US.

as response variables. However, these variables could only be observed for firms that announce share repurchases, which raises concerns regarding sample selection bias in the estimation results (Lennox et al., 2012). In order to control for the bias, we employ the two-stage Heckman procedure in our main analysis, whereby we estimate the participation equation (i.e., the decision to announce a repurchase) followed by the outcome equation (i.e., the effect of simultaneously announced earnings guidance surprises on the repurchase-related variables). Further, we use two alternative approaches to the Heckman procedure to minimize the effect of sample selection bias on the estimation results in our additional analysis. While both approaches estimate the abnormal portions of the repurchase-related variables by subtracting the expected values of the repurchase-related variables from the actual values, they differ in the way in which the expected values are estimated.

Under the first approach, we use the method adopted by Fama and French (2001) and Bonaimé (2015). We first model the repurchase-related measures using the data from the previously discarded portion of the sample (i.e., standalone OMR announcements). Next, we use the coefficients from this out-of-sample model to predict the expected values for the OMRs with simultaneous announcements. Under the second approach, we use the propensity score matching method in which an OMR with a simultaneous announcement is matched with a counterfactual derived from the standalone OMR announcements with close propensity scores. We then use the values obtained from the counterfactuals as the expected values for the OMRs with simultaneous announcements. Using the abnormal portions of the repurchase-related variables from the two alternative approaches, we find that the abnormal portion of the repurchase plan size (period) is negatively (positively) correlated with simultaneously announced earnings guidance surprises, consistent with our main results that managers modify the terms of the repurchase program to strengthen the signal of OMR announcements.

For our final analysis, we test whether our main results are robust to changes of the model, such as including a current earnings surprise at the earnings announcement, an indicator variable for economic downturns, and industry fixed effects. The robustness tests present evidence that is generally consistent with our main findings. That is, managers of repurchasing firms increase the repurchase plan size and shorten the repurchase duration with the magnitude of bad news in the simultaneous announcements.

Our study contributes to the literature on the signaling hypothesis related to share repurchases in two important ways. First, the signaling hypothesis has been the accepted norm for explaining why firms choose to repurchase shares. However, this norm ignores the signal from the simultaneous announcements of other repurchase-unrelated news, which may undermine the credibility of the undervaluation signal in the repurchase announcement and motivate the managers to adjust the signal strength of the announcement. Several prior studies demonstrate how past corporate events (such as prior repurchase completion rates and past insider acquisitions of the firm's shares) influence the credibility of current OMR announcements (Babenko et al., 2012; Bonaimé, 2012). However, these past events create a time delay because they typically take place several months (sometimes years) before the OMR announcements are made. Consequently, the time delay could weaken the link between the underlying corporate events and the credibility of current OMR announcements. Our study reinforces the link by using the earnings guidance that is announced simultaneously with an OMR, which would provide more direct evidence of managerial motivation to engage in the signal strength adjustment behavior. Second, to the best of our knowledge, our study is the first to demonstrate how managers strategically modify the terms of the OMR program when the credibility of the OMR announcements made by their firms is being scrutinized by the market. Specifically, we find that managers could increase (shorten) the repurchase plan size (period) according to the magnitude of bad news in the simultaneous announcements.

The structure of this paper is organized as follows. The next section provides a discussion of the institutional background, and Section 3 describes the sample selection procedure and presents the descriptive statistics. Section 4 specifies the research design for the study and provides the main analysis. The results of alternative approaches and robustness tests are provided in Sections 5 and 6, respectively. Finally, we offer a summary and conclusion in Section 7.

2. Institutional background

2.1. Share repurchases

The Company Act (the Act) governs share repurchase practices of Japanese public firms. The Act outlines four platforms for share repurchases:

(1) On-market trading (Article 165, Para. 1 of the Act);
(2) Off-market self-tender offer (Article 165, Para. 1 of the Act);
(3) An offer to transfer to all shareholders (Article 158, Para. 1 of the Act); and
(4) Negotiated transactions with selected shareholders (Articles 160-164 of the Act).

Listed firms in Japan generally choose platforms (1) and (2) to repurchase shares. This paper focuses on share repurchases through on-market trading (i.e., platform (1)). On-market trading can be conducted either during auction or off-auction hours. On-market trading during auction hours (more commonly known as OMR) occurs in the morning session (9:00-11:30 a.m.) and the afternoon session (12:30-3:00 p.m.). On the other hand, on-market trading during off-auction hours occurs on the Tokyo Stock Exchange Trading Network (ToSTNeT) before the morning session starts (8:20-8:45 a.m.).[4]

Like the rest of the world, OMRs are the most common form of share repurchases in Japan (Vermaelen, 2005; Manconi et al., 2018). Ota et al. (2019) document that more than 60% of share repurchases in Japan are conducted through OMRs for the period 2008-2017. An OMR program stipulates items including the motivation, the intended size of the repurchase plan (as a dollar value and the number of shares to be repurchased), and the length of repurchase period not exceeding one year. After the OMR announcement, the repurchasing firm spends around three months to make the actual repurchases before announcing the outcome of the repurchase program (including the number of shares repurchased and the amount of money spent).[5]

2.2. Management earnings forecasts

The Tokyo Stock Exchange (TSE) enforces the Timely Disclosure Rules (the Rules) to govern management forecasting practices in Japan. Under the Rules, listed firms are required to provide summarized financial statements (*Kessan-Tanshin*) upon the approval by the board of directors. These summarized financial statements contain financial results for the current period as well as earnings forecasts for the next period. This information is released at the

[4] ToSTNeT is a unique form of repurchase in Japan and is a kind of privately negotiated share repurchase between the repurchasing firm and the individual shareholder (Ota and Lau, 2021).

[5] In the US, the actual repurchase generally occurs over several years after the announcement of the repurchase program. Therefore, the timeframe between the announcement and the completion of the repurchase program is shorter in Japan than the US.

annual earnings announcement, which usually takes place 25 to 40 trading days after the fiscal year-end (Ota, 2010). Publicly listed firms are expected to provide initial forecasts of earnings for the next fiscal year at the annual earnings announcement date. In addition, these firms are also expected to revise the forecasts at each quarterly earnings announcement date.

Managers provide forecasts of sales, earnings before extraordinary items and taxes (EBET), net income (NI), earnings per share (EPS), and dividends per share (DPS). Except for forecasts of DPS, which could be in the form of a range, forecasts are provided in point form. Nearly all firms provide initial management forecasts in Japan, even though there are no legal or regulatory requirements to provide the forecasts (i.e., the provision of management earnings forecasts is still considered to be voluntary). Hence, prior studies refer to the provision of these forecasts as being 'effectively mandated' (Kato et al., 2009).

In addition to the regular disclosures of management forecasts at earnings announcements, the Ministry of Finance prescribes the "Significance Rule" that requires firms to make an announcement of revised forecasts immediately in the event of a significant change in previously published forecasts. A significant change is defined as being changes in sales estimates of ± 10% and/or changes in EBET and NI estimates of ± 30%. In regard to DPS, the changes in the estimates are ± 20%. Therefore, forecast revisions can be announced at any time other than at the quarterly earnings announcement dates.

3. Sample selection and descriptive statistics

3.1. Sampling and sample characteristics

We source the fiscal, forecast, and share price data from Nikkei Financial QUEST and IFIS Consensus Data. Share repurchase data are obtained from Financial Data Solutions (FDS) based on the following sample selection criteria: (1) the resolution on share repurchase matters made between 1 January 2004 and 31 December 2017, and (2) the repurchasing firms listed on the first, second, or Mothers (market for high-growth and emerging shares) sections of the TSE.[6] We then exclude other kinds of share repurchases from the sample: (1) share repurchases for special reasons (Article 155, Para. 1, 2 and 4-13 of the Act), such as odd-lot buyback and repurchasing shares from subsidiaries, (2) repurchases from specific shareholders (Articles 160-164 of the Act), (3) repurchases of unlisted preferred shares, (4) repurchases through off-market tender offers, (5) repurchases through resolutions approved at the meetings by both general shareholders and board of directors (Article 156, Para. 1 of the Act), and (6) repurchases that are executed during off-market hours via ToSTNeT. These criteria yield a sample of 5,112 OMRs conducted on the TSE for the period 2004-2017.

Table 1 describes the sample of 5,112 OMR announcements according to fiscal year, market type, frequency of share repurchases by the same firm, and simultaneous event. Panel A shows that the highest number of OMR announcements occur in 2008 ($N = 934$). Given that the share price increases following a repurchase announcement, the largest occurrences of OMR announcement in 2008 could be explained by the firms using repurchases to buck the trend of declining share prices during the global financial crisis (Liu and Swanson, 2016). Panel B shows that 79.6% of all OMR announcements are made by firms with large market value of equity (i.e., shares listed on the first section of the TSE). Panel C reports that 1,427 firms conducted OMRs for 5,112 times over the period 2004-2017 (i.e., each firm announces a share repurchase for an average of 3.58 times over the 14-year period). Moreover, two thirds of the firms in the sample have announced share repurchases multiple times during the 14-year period. Panel D shows that standalone OMR announcements make up 50.6% of the sample, while simultaneous announcements of repurchase-unrelated news (mostly first to fourth quarter earnings announcements) make up 49.4% of the sample. Approximately 15% of all OMRs are made at each of the second and the fourth quarter earnings announcements, about 8% of all OMRs are made at each of the first and the third quarter earnings announcements, and 3.1% of all OMRs are disclosed simultaneously with the irregular announcements of revised forecasts.[7]

Fig. 1 presents the frequency distribution of OMR announcements by trading days relative to the most recent earnings announcement date. The figure shows that nearly one half of the OMR announcements are made on the earnings announcement date and then the distribution plateaus for 40 trading days after the earnings announcement date. The distribution of the announcements declines with trading days thereafter. This could be because the firms are refraining from any forms of communication with the public as the next earnings announcement is imminent (i.e., quiet period).

3.2. Variable definitions and summary statistics

Table 2 presents the descriptive statistics and detailed definitions of variables used in our models. We classify all variables into three groups: (1) repurchase-related variables, (2) motivation dummy variables, and (3) other variables. With respect to repurchase-related variables, the planned number of shares to be repurchased (*PlanSize*) is on average 2.09% of the number of shares outstanding. The mean value of 4.0230 for *LnPlanDays* indicates that firms plan to spend around three months on average to complete the share repurchase program ($e^{4.0230} = 55.9$ trading days). The completion rate (*CompRate*) of an OMR program (the ratio of actual to announced repurchases) is on average 73.28% of the announced repurchase plan size. Actual repurchases in an OMR program expressed as a percentage of share outstanding (*ActualRep*) are on average 1.45%. The two-day cumulative abnormal returns (*CAR*) to the announcement of OMRs over the event window $t = 0$ to 1 are 2.80% on average.[8]

With respect to the repurchase motivation variables, we create dummy variables that equal to 1 if share repurchases are conducted for the following eight reasons: (1) *Flexible capital policy*, (2) *Capital efficiency*, (3) *Shareholder value*, (4) *Stock option*, (5) *Return to shareholders*, (6) *Share exchange*, (7) *Capital restructure*, and (8) *Others*.[9] Table 2 shows that 85.6% of the firms in the sample

[6] The coverage of the FDS share repurchase database begins in September 2003 at which time the Commercial Law was amended to allow firms to repurchase shares solely upon the approval of the board of directors. Prior to September 2003, share repurchases were required to be first approved at the general shareholders meeting and later at the board of directors meeting in which the specific terms of share repurchases were determined.

[7] Irregular revisions of management earnings forecasts occur when there are material changes in the most recently announced management earnings forecasts.

[8] The event day of the share repurchases whose announcements are made after the close of the market at 3:00 pm is defined as the next day of the announcement date. Therefore, we do not include the abnormal returns before the event day in the calculation of *CAR*. The results are qualitatively similar when the *CAR* over the event window $t = 0$ to 2, $CAR_{(0,+2)}$, are used. To calculate abnormal returns, we estimate the standard market model over a 200-day period, $-230 \leq t \leq -31$, with $t = 0$ being defined as the repurchase announcement event day. We use different market indexes for the different sections of the TSE on which firms are listed: the TOPIX for the first section of the TSE, the TSE Second Section Stock Price Index for the second section of the TSE, and the TSE Mothers Index for the Mothers section of the TSE.

[9] To the best of our knowledge, there are only five studies that investigate the stated motivations of share repurchases – two in the US (Peyers and Vermaelen, 2009; Bonaimé, 2012), two in Australia (Akyol and Foo, 2013; Gould, 2019), and one in Japan (Ota et al., 2019). These studies demonstrate that the stated motiva-

Table 1
Characteristics of open market share repurchases.

Panel A: Fiscal year					
	N	%		*N*	%
2004	216	4.2	2011	277	5.4
2005	398	7.8	2012	255	5.0
2006	437	8.5	2013	179	3.5
2007	567	11.1	2014	240	4.7
2008	934	18.3	2015	320	6.3
2009	295	5.8	2016	417	8.2
2010	279	5.5	2017	298	5.8
			Total	5,112	100.0

Panel B: Market type		
	N	%
TSE 1st section	4,070	79.6
TSE 2nd section	760	14.9
Mothers section	282	5.5
Total	5,112	100.0

Panel C: Share repurchase frequency by the same firm		
	No. of firms	%
1	472	33.1
2	288	20.2
3	206	14.4
4	135	9.5
5	83	5.8
6-7	88	6.2
8-10	83	5.8
11-14	39	2.7
Over 15	33	2.3
Total	1,427	100.0

Panel D: Simultaneous event occurring with the OMR announcement		
	N	%
1st Quarter earnings announcement	408	8.0
2nd Quarter earnings announcement	761	14.9
3rd Quarter earnings announcement	444	8.7
4th Quarter (Annual) earnings announcement	756	14.8
Irregular management forecast revisions	158	3.1
No simultaneous announcement	2,585	50.6
Total	5,112	100.0

This table describes the 5,112 OMR announcements that are made in the period 2004-2017. We present the 5,112 OMR cases according to the following categories: Fiscal year (Panel A), Market type (Panel B), Share repurchase frequency by the same firm (Panel C), and Simultaneous event occurring with the OMR announcement (Panel D).

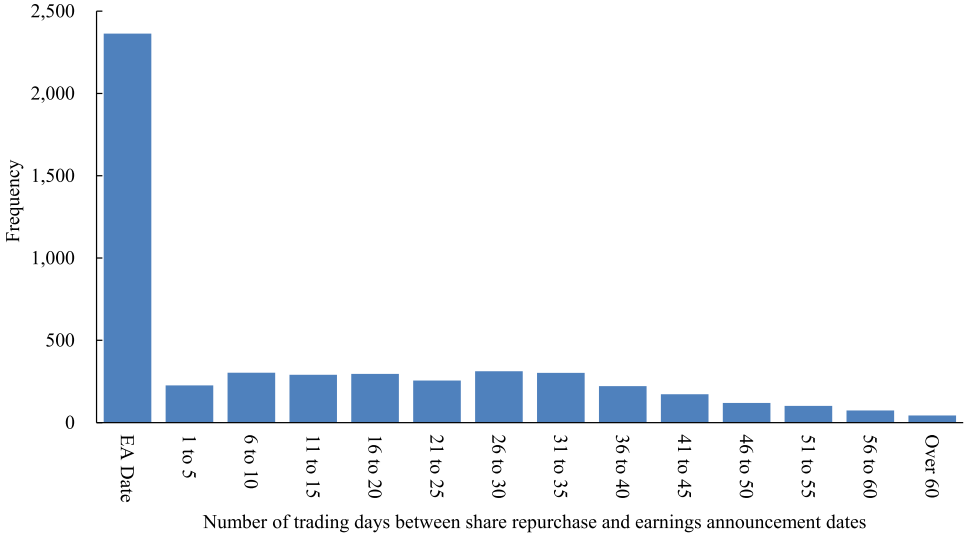

Fig. 1. The distribution of OMR announcements relative to earnings announcement date. This figure presents the frequency distribution of OMR announcements by trading days relative to the most recent earnings announcement date. The sample consists of 5,112 OMR cases identified in Table 1.

Table 2
Variable definitions and summary statistics.

				Percentiles		
	N	Mean	S.D.	25th	50th	75th
Repurchase-related variables						
PlanSize	5,078	0.0209	0.0173	0.0090	0.0158	0.0273
LnPlanDays	5,112	4.0230	0.7963	3.4340	4.0604	4.5747
CompRate	5,078	0.7328	0.3249	0.5462	0.8777	1.0000
ActualRep	5,078	0.0145	0.0136	0.0047	0.0107	0.0200
CAR	5,058	0.0280	0.0486	-0.0004	0.0193	0.0510
Motivation dummies						
Flexible capital policy	5,112	0.8560	0.3511	1.0000	1.0000	1.0000
Capital efficiency	5,112	0.2766	0.4474	0.0000	0.0000	1.0000
Shareholder value	5,112	0.0782	0.2686	0.0000	0.0000	0.0000
Stock option	5,112	0.0198	0.1392	0.0000	0.0000	0.0000
Return to shareholders	5,112	0.2482	0.4320	0.0000	0.0000	0.0000
Share exchange	5,112	0.0084	0.0913	0.0000	0.0000	0.0000
Capital restructure	5,112	0.0014	0.0370	0.0000	0.0000	0.0000
Others	5,112	0.0149	0.1210	0.0000	0.0000	0.0000
Other variables						
SRDum	65,120	0.0228	0.1493	0.0000	0.0000	0.0000
MFESurp	65,120	-0.0058	0.0216	-0.0076	-0.0019	0.0011
BMR	65,120	0.8927	0.5229	0.5111	0.8086	1.1709
LnMVE	65,120	11.3499	1.5349	10.2468	11.2499	12.3795
LagReturn	65,120	0.0296	0.1906	-0.0830	0.0200	0.1277
Cash	65,120	0.3002	0.2887	0.1210	0.2188	0.3743
CF	65,120	0.1210	0.1477	0.0526	0.0997	0.1671
Leverage	65,120	0.4816	0.2114	0.3162	0.4768	0.6399
SDReturn	65,120	0.0242	0.0099	0.0175	0.0221	0.0284
SDCF	65,120	0.0634	0.0897	0.0174	0.0345	0.0692
EmergeMkt	65,120	0.0590	0.2356	0.0000	0.0000	0.0000
BlockOwn	65,120	0.4914	0.1641	0.3750	0.4750	0.6130
OfficerOwn	65,120	0.0717	0.1302	0.0011	0.0068	0.0760
ForeignOwn	65,120	0.1710	0.1222	0.0746	0.1495	0.2441
Mimic	65,120	0.0219	0.0273	0.0000	0.0156	0.0328

This table presents the definitions and summary statistics of variables categorized into three groups – repurchase-related variables, motivation dummy variables, and other variables. All continuous variables are winsorized at the 1st and 99th percentiles.
Variable Definitions:
Repurchase-related variables
PlanSize = the number of shares to be repurchased divided by the total number of shares outstanding;
LnPlanDays = the natural logarithm of *PlanDays*, which is the repurchase plan period expressed in trading days;
CompRate = the actual number of shares repurchased divided by the number of shares to be repurchased;
ActualRep = the actual number of shares repurchased divided by the total number of shares outstanding; and
CAR = the 2-day market-model adjusted abnormal returns over the event window $t = 0$ to 1.
Motivation dummies
Motivation Dummies = dummy variables that equal to 1 for eight reasons of share repurchases: (1) *Flexible capital policy*, (2) *Capital efficiency*, (3) *Shareholder value*, (4) *Stock option*, (5) *Return to shareholders*, (6) *Share exchange*, (7) *Capital restructure*, and (8) *Others*.
Other variables
SRDum = a dummy variable that equals to 1 if an OMR is announced simultaneously with a management earnings forecast;
MFESurp = a management forecast of net income minus analysts' consensus forecast of net income scaled by the market capitalization at the end of the month prior to the announcement of a management earnings forecast;
BMR = the book-to-market ratio at the end of the most recent quarter prior to the announcement of a management earnings forecast;
LnMVE = the natural logarithm of the firm's market value of equity at the end of the month prior to the announcement of a management earnings forecast;
LagReturn = the market-index adjusted cumulative abnormal returns from 90 days to 1 day before the announcement of a management earnings forecast;
Cash = cash and short-term investments divided by the market capitalization at the end of the most recent quarter prior to the announcement of a management earnings forecast;
CF = trailing 12 months operating cash flows of the most recent second or fourth quarter divided by the market capitalization prior to the announcement of a management earnings forecast;
Leverage = total liabilities divided by total assets at the end of the most recent quarter prior to the announcement of a management earnings forecast;
SDReturn = the standard deviation of stock returns for the 200-day period from 210 days to 11 days before the announcement of a management earnings forecast;
SDCF = the standard deviation of semi-annual operating cash flows over the three years divided by the market capitalization at the end of the most recent quarter prior to the announcement of a management earnings forecast;
EmergeMkt = a dummy variable that equals to 1 if the firm is listed on the Mothers section of the TSE;
BlockOwn = the percentage ownership interest of 10 largest shareholders and special stakeholders at the end of the most recent quarter prior to the announcement of a management earnings forecast;
OfficerOwn = the percentage ownership interest of management and board members at the end of the most recent quarter prior to the announcement of a management earnings forecast;
ForeignOwn = the percentage ownership interest of foreign investors at the end of the most recent quarter prior to the announcement of a management earnings forecast; and
Mimic = the portion of firms in the same Nikkei 36 industry classification that announced a share repurchase in the calendar quarter, not including the firm itself.

state flexible capital policy as the reason for share repurchases. Also, roughly one quarter of the firms choose to repurchase shares for capital efficiency and return to shareholders related reasons.

As for other variables, the probability of announcing a share repurchase simultaneously with a management earnings forecast (*SRDum*) is 2.28%. The earnings guidance surprise (*MFESurp*) is our variable of interest and is measured as a management forecast of net income minus analysts' consensus forecast of net income scaled by the market value of equity. Therefore, the mean value of -0.0058 for *MFESurp* indicates that earnings guidance surprises are negative on average. The remaining variables are associated with various repurchase hypotheses and are used as control variables.[10] We include *BMR, LagReturn*, and *LnMVE* to be consistent with the signaling undervaluation hypothesis (Vermaelen, 1981; Comment and Jarrell, 1991; Ikenberry et al., 1995). *Cash* and *CF* are included to be consistent with the free cash flow hypothesis, which posits that share repurchases mitigate shareholder concerns about the misuse of excess funds (Jensen, 1986; Grullon and Michaely, 2004). In line with the optimal capital structure hypothesis, we include *Leverage* to control for the motivation of the firm to repurchase shares in order to inflate the firm's leverage until it reaches the level perceived suitable by the firm (Dittmar, 2000; Bonaimé et al., 2014; Lei and Zhang, 2016). *SDReturn* and *SDCF* are included to be consistent with the flexibility hypothesis, where firms use their discretion over the number and timing of shares to buy back (Bargeron et al., 2011; Bonaimé et al., 2016). *BlockOwn, OfficerOwn*, and *ForeignOwn* are included because prior studies find a relationship between ownership structure and repurchase-related variables (Wu, 2012; Gaspar et al., 2012). Finally, given that Massa et al. (2007) find that firms initiate OMRs to mimic their industry peers, we include *Mimic* to account for industry trends.

4. Main analysis

4.1. The likelihood of announcing an OMR

Our study investigates the impact of *MFESurp* on repurchase related variables – *PlanSize, LnPlanDays, CompRate, ActualRep*, and *CAR*. Since we can only observe the repurchase-related variables in firms that announce OMRs, the sample selection bias could arise (Lennox et al., 2012). To address this bias, we employ the Heckman two-stage procedure. In the first-stage procedure, we use the probit regression to estimate the following participation equation in which the probability of the firm announcing a share repurchase is included as the dependent variable.

$$\begin{aligned}&\Pr(SRDum_{it}=1|\mathbf{X})\\&=\Phi(\alpha_0+\alpha_1 MFESurp_{it}+\alpha_2 BMR_{it}+\alpha_3 LnMVE_{it}\\&\quad+\alpha_4 LagReturn_{it}+\alpha_5 Cash_{it}+\alpha_6 CF_{it}+\alpha_7 Leverage_{it}\\&\quad+\alpha_8 SDReturn_{it}+\alpha_9 SDCF_{it}+\alpha_{10} EmergeMkt_{it}+\alpha_{11} BlockOwn_{it}\\&\quad+\alpha_{12} OfficerOwn_{it}+\alpha_{13} ForeignOwn_{it}+\alpha_{14} Mimic_{it}\\&\quad+\boldsymbol{\delta} YearDummies_t),\end{aligned}\tag{1}$$

where the subscripts *i* and *t* indicate firm and year, respectively.

Eq. (1) models the probability of the firm announcing a share repurchase as a function of *MFESurp* and control variables for firm characteristics that are likely to influence the decision to announce a share repurchase (Bonaimé, 2015). The result from estimating Eq. (1) is presented in Table 3.

Table 3 shows that the coefficient on *MFESurp* is not statistically significant, indicating that simultaneously announced earnings guidance surprises do not affect the probability of the firm initiating a share repurchase program. Control variables are generally consistent with the predicted signs. *LnMVE* and *Cash* are positively correlated with the probability of announcing a repurchase plan. On the other hand, *LagReturn, Leverage, SDReturn*, and *EmergeMkt* are all negatively associated with the probability of announcing a repurchase plan. Firms with higher foreign ownership (*ForeignOwn*) and lower blockholder ownership (*BlockOwn*) are more likely to announce share repurchases. Moreover, the probability of announcing a repurchase plan is statistically unrelated to *CF* and weakly positively correlated with cash flow volatility (*SDCF*). As expected, the probability of announcing a share repurchase is strongly positively correlated with the portion of other firms in the same industry that announce share repurchases (*Mimic*).

In the second-stage procedure, we estimate the outcome equation whereby we run the regressions of the repurchase related measures (*PlanSize, LnPlanDays, CompRate, ActualRep*, and *CAR*) on *MFESurp* and control variables including the inverse Mills ratio (*InvMills*) derived from Eq. (1). The Heckman procedure requires that at least one regressor in the participation equation be excluded from the outcome equation (Lennox et al., 2012; Bonaimé, 2015). Consistent with Bonaimé (2015), we exclude *Mimic* from the outcome equations as it is unlikely that the portion of other firms in the same industry announcing share repurchases would affect the repurchase-related measures. Note that for each repurchase measure, we estimate the outcome equation with a slightly different vector of control variables. However, all the outcome equations include *InvMills* and exclude *Mimic*.

4.2. Announced plan size

Fig. 2 analyzes the relation between the first repurchase-related measure *PlanSize* and *MFESurp*. Specifically, we divide the sample according to the signs of *MFESurp*. This results in 902 observations for the bad news (BN) group and 408 observations for the good news (GN) group. Next, within each group sample, we partition the sample into four subsamples of equal size according to the values of *MFESurp*. Therefore, BN4 (GN4) consists of observations with lowest (highest) *MFESurp*. We then plot the mean *PlanSize* along the eight categories. Fig. 2 shows the relation between *PlanSize* and *MFESurp* roughly exhibits an inverse J-shaped curve. *PlanSize* is the largest in BN4 and generally decreases as *MFESurp* increases. Overall, Fig. 2 illustrates that managers of repurchasing firms announce a larger repurchase plan size when the firms simultaneously announce negative earnings guidance surprises.

We estimate the following outcome equation with a standard OLS regression method using *PlanSize* as the dependent variable.

$$\begin{aligned}&PlanSize_{it}\\&=\alpha_0+\alpha_1 MFESurp_{it}+\alpha_2 BMR_{it}+\alpha_3 LnMVE_{it}+\alpha_4 LagReturn_{it}\\&\quad+\alpha_5 Cash_{it}+\alpha_6 CF_{it}+\alpha_7 Leverage_{it}+\alpha_8 SDReturn_{it}+\alpha_9 SDCF_{it}\\&\quad+\alpha_{10} EmergeMkt_{it}+\alpha_{11} BlockOwn_{it}+\alpha_{12} OfficerOwn_{it}\\&\quad+\alpha_{13} ForeignOwn_{it}+\alpha_{14} InvMills_{it}+\boldsymbol{\gamma} MotivationDummies_{it}\\&\quad+\boldsymbol{\delta} YearDummies_t+\varepsilon_{it},\end{aligned}\tag{2}$$

where *InvMills* is the inverse Mills ratio derived from the first-stage participation equation in Eq. (1).

Columns (2a) and (2b) of Table 4 report the results from estimating Eq. (2) with the exclusion and inclusion of the *Motivation*

tions of share repurchases vary across countries. Consistent with Ota et al. (2019), we read the "Reason-for-repurchase" section of the share repurchase notices and classify the motivations into eight categories. When multiple motivations are mentioned in the notices, the respective dummy variable takes the value of one.

[10] For detailed explanations of various hypotheses related to the motivations for share repurchases, see Grullon and Ikenberry (2000), Dittmar (2000), Allen and Michaely (2003), Chan et al. (2004), and Vermaelen (2005).

Table 3
The probability of announcing a share repurchase.

Variable	Coefficient	*z*-statistic	Marginal effect
MFESurp	0.0854	0.16	0.004
BMR	-0.0198	-0.35	-0.001
LnMVE	0.0460	2.53**	0.002
LagReturn	-0.7983	-11.07***	-0.033
Cash	0.1536	1.93*	0.006
CF	0.0736	0.75	0.003
Leverage	-0.8207	-7.45***	-0.034
SDReturn	-11.8861	-6.00***	-0.493
SDCF	0.5532	1.85*	0.023
EmergeMkt	-0.1321	-1.84*	-0.005
BlockOwn	-0.3750	-2.70***	-0.016
OfficerOwn	0.1224	0.72	0.005
ForeignOwn	0.6259	2.84***	0.026
Mimic	3.6083	9.45***	0.150
Constant	-2.0075	-7.99***	n/a
Year Dummies	Included		
Pseudo R^2		0.0686	
N		65,120	

This table presents coefficient estimates from the probit model on the probability of a firm announcing a repurchase plan in Eq. (1). Marginal effects are the partial derivatives evaluated at means. In the case of the discrete variable, *EmergeMkt*, the marginal effect is the effect of a discrete change from 0 to 1. *z*-statistics are based on one-way cluster-robust standard errors by firm. All variables are defined in Table 2. *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively.

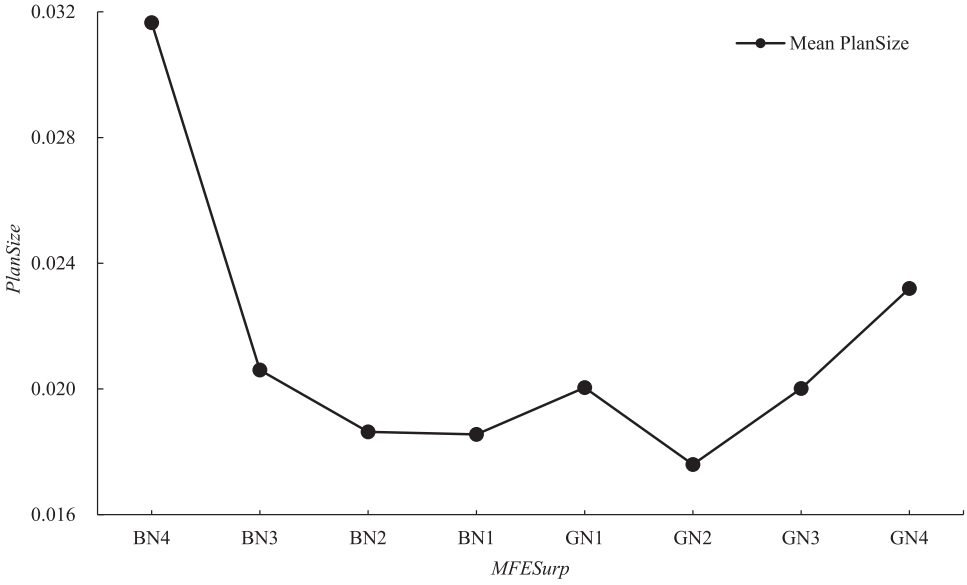

Fig. 2. The association between repurchase plan size and earnings guidance surprises. This figure plots the mean *PlanSize* along the eight categories of *MFESurp*. The sample is first divided according to the signs of *MFESurp*, then partitioned into four subsamples of equal size according to the values of *MFESurp*. BN4 (GN4) comprises observations with most negative (positive) earnings guidance surprises. All variables are defined in Table 2.

Dummies, respectively. Note that of the 2,527 OMRs with simultaneous announcements reported in Panel D of Table 1, only 1,215 are available for the estimation of Eq. (2). This is because the calculation of *MFESurp* requires analysts' consensus earnings forecasts, and only 43.5% of the firms listed on the TSE in the 2004-2017 period have analyst coverage based on IFIS Consensus Data. The coefficient on *MFESurp* is -0.1463 and -0.1487 in Columns (2a) and (2b), respectively, and is statistically different from zero. Given that the standard deviation of *MFESurp* is 0.0216, a 1-standard-deviation decrease in earnings guidance surprises follows an increase in the announced plan size of approximately 0.32 percentage points. This increase is economically meaningful as it represents 15% of the mean value of the repurchase plan size. Further, Table 4 suggests that firm size (*LnMVE*), lagged returns (*LagReturn*), firm leverage (*Leverage*), and blockholder ownership (*BlockOwn*) are significantly negatively related to *PlanSize*, while share price volatility (*SDReturn*) and foreign ownership (*ForeignOwn*) are significantly positively related to *PlanSize*. With respect to the stated-motivation variables in Column (2b), only *Capital efficiency* and *Stock option* are marginally statistically significant. However, the null hypothesis of all motivation variables being equal to zero is rejected at the 5% level (*F*-statistic = 2.39), justifying the need to include motivation variables in the model. The estimated coefficients on *InvMills* are not significant in both regressions, indicating that the null hypothesis of no selection bias is not rejected. Untabulated results show that the exclusion of *InvMills* from the regression models does not materially change the results. These results suggest that the sample selection bias does not pose a serious concern in the estimation of Eq. (2). Overall, the findings presented in this section are consistent with the hypothesis that managers increase the repurchase plan size to strengthen the signal of the OMR announcement when the simultaneously announced earnings guidance fails to meet the market's expectation.

Table 4
Repurchase plan size regressions.

	(2a)		(2b)	
Variable	Coefficient	*t*-statistic	Coefficient	*t*-statistic
MFESurp	-0.1463	-4.07***	-0.1487	-4.11***
BMR	0.0021	1.56	0.0025	1.80*
LnMVE	-0.0015	-2.99***	-0.0016	-3.08***
LagReturn	-0.0077	-2.17**	-0.0075	-2.09**
Cash	-0.0015	-0.98	-0.0019	-1.26
CF	0.0012	0.41	0.0012	0.39
Leverage	-0.0073	-1.95*	-0.0069	-1.76*
SDReturn	0.1911	2.34**	0.1990	2.40**
SDCF	-0.0019	-0.28	-0.0019	-0.27
EmergeMkt	-0.0027	-1.09	-0.0031	-1.20
BlockOwn	-0.0091	-2.05**	-0.0096	-2.14**
OfficerOwn	0.0062	1.05	0.0060	0.99
ForeignOwn	0.0097	1.94*	0.0103	2.05**
Flexible capital policy			0.0014	0.94
Capital efficiency			0.0020	1.86*
Shareholder value			0.0033	1.57
Stock option			-0.0052	-1.86*
Return to shareholders			0.0020	1.57
Share exchange			-0.0025	-0.62
Capital restructure			0.0007	0.33
Others			0.0055	1.46
InvMills	-0.0019	-0.51	-0.0016	-0.43
Constant	0.0373	3.20***	0.0348	2.88***
Year Dummies	Included		Included	
				F-statistic
F-test (motivation dummies = 0)				2.39**
Adjusted R^2	0.1211		0.1261	
N	1,215		1,215	

This table reports the results of estimating the repurchase plan size regression models in Eq. (2). Columns (2a) and (2b) present the results with the exclusion and inclusion of the motivation dummies, respectively. *InvMills* is the inverse Mills ratio calculated from the results of the first-stage participation equation in Eq. (1). Other variables are defined in Table 2. *t*-statistics are based on one-way cluster-robust standard errors by firm. *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively.

4.3. Announced plan period

In this section, we examine the second repurchase measure *LnPlanDays*, which is the natural logarithm of *PlanDays* (the announced repurchase plan period measured in trading days).

Fig. 3 analyzes the relation between *PlanDays* and *MFESurp* while holding *PlanSize* constant. The sample is separated into three subsamples based on the values of *PlanSize* (i.e., the plan size being less than 1%, between 1% and 2%, and over 2%). Next, each subsample is divided according to the signs of *MFESurp* and then partitioned into four subgroups of equal size according to the values of *MFESurp*. Therefore, BN4 (GN4) comprises observations with the most negative (positive) earnings guidance surprises. We then plot the mean *PlanDays* along the eight categories. The linear approximation line is drawn for each subsample for the ease of visualizing the relation between *PlanDays* and *MFESurp* in the subsample. When *PlanSize* is less than 1%, *PlanDays* is uncorrelated with *MFESurp*. Further, *PlanDays* is positively correlated with *MFESurp* when *PlanSize* is between 1% and 2%, and over 2%. Fig. 3 indicates that given the large repurchase plan size, managers shorten the repurchase plan period with the degree of bad news in the simultaneous announcements consistent with our hypothesis.

With respect to the second-stage outcome equation for *LnPlanDays*, we estimate the following regression model.

$$\begin{aligned} LnPlanDays_{it} &= \alpha_0 + \alpha_1 MFESurp_{it} + \alpha_2 PlanSize_{it} + \alpha_3 BMR_{it} \\ &+ \alpha_4 LnMVE_{it} + \alpha_5 Lag\text{Return}_{it} + \alpha_6 Cash_{it} + \alpha_7 CF_{it} + \alpha_8 Leverage_{it} \\ &+ \alpha_9 SD\text{Return}_{it} + \alpha_{10} SDCF_{it}\ \alpha_{11} EmergeMkt_{it} + \alpha_{12} BlockOwn_{it} \\ &+ \alpha_{13} OfficerOwn_{it} + \alpha_{14} ForeignOwn_{it} + \alpha_{15} InvMills_{it} \\ &+ \boldsymbol{\gamma} MotivationDummies_{it} + \boldsymbol{\delta} YearDummies_t + \varepsilon_{it}. \end{aligned} \quad (3a)$$

The independent variables in Eq. (3a) are the same as Eq. (2) except for the inclusion of *PlanSize*. Further, given the effect of *PlanSize* on the relation between *LnPlanDays* and *MFESurp* as indicated in Fig. 3, we estimate Eq. (3b) with the inclusion of the interaction variable between *MFESurp* and *PlanSize*. For the ease of interpretation of the results, we standardize *MFESurp* and *PlanSize* in Eq. (3b).

$$\begin{aligned} LnPlanDays_{it} &= \alpha_0 + \alpha_1 zMFESurp_{it} + \alpha_2 zMFESurp_{it} * zPlanSize_{it} \\ &+ \alpha_3 zPlanSize_{it} + \alpha_4 BMR_{it} + \alpha_5 LnMVE_{it} + \alpha_6 Lag\text{Return}_{it} \\ &+ \alpha_7 Cash_{it} + \alpha_8 CF_{it} + \alpha_9 Leverage_{it} + \alpha_{10} SD\text{Return}_{it} + \alpha_{11} SDCF_{it} \\ &+ \alpha_{12} EmergeMkt_{it} + \alpha_{13} BlockOwn_{it} + \alpha_{14} OfficerOwn_{it} \\ &+ \alpha_{15} ForeignOwn_{it} + \alpha_{16} InvMills_{it} + \boldsymbol{\gamma} MotivationDummies_{it} \\ &+ \boldsymbol{\delta} YearDummies_t + \varepsilon_{it}, \end{aligned} \quad (3b)$$

where *zMFESurp* and *zPlanSize* represent standardized earnings guidance surprises and repurchase plan size, respectively.

Columns (3a) and (3b) of Table 5 present the results from estimating Eqs. (3a) and (3b), respectively. The coefficient on *MFESurp* in Column (3a) is 2.1553 and is statistically different from zero at the 10% level. Since the standard deviation of *MFESurp* is 0.0216 and the mean value of *LnPlanDays* is 4.0230, a 1-standard-deviation decrease in earnings guidance surprises is associated with a decrease in the announced plan period of 2.66 days ($e^{(4.0230+2.1553*0.0216)} - e^{4.0230}$) evaluated at the mean of *LnPlanDays*. Column (3b) reports that the coefficient on *zMFESurp* is 0.0106 and is statistically uncorrelated with *LnPlanDays* when evaluated at the mean of *PlanSize* (i.e., *zPlanSize* = 0). However, *zMFESurp* becomes positively associated with *LnPlanDays* as the value of *zPlanSize* increases due to the significantly positive coefficient on

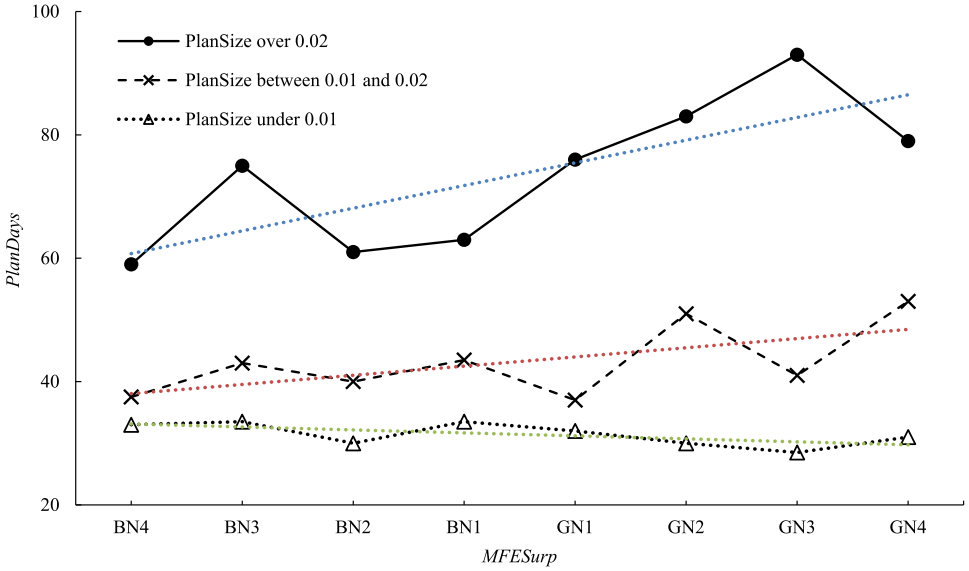

Fig. 3. The association between repurchase plan days and earnings guidance surprises. This figure plots the mean *PlanDays* along the eight categories of *MFESurp* conditional on *PlanSize*. The sample is divided into three subsamples based on the values of *PlanSize* (i.e., *PlanSize* $<$ 0.01, 0.01 $\leq$ *PlanSize* $\leq$ 0.02, 0.02 $<$ *PlanSize*). Each subsample is first divided according to the signs of *MFESurp*, then partitioned into four subgroups of equal size based on the values of *MFESurp*. BN4 (GN4) comprises observations with most negative (positive) earnings guidance surprises. The linear approximation line is drawn for each subsample to highlight the relation between *PlanDays* and *MFESurp*. All variables are defined in Table 2.

Table 5
Repurchase plan period regressions.

	(3a)		(3b)	
Variable	Coefficient	*t*-statistic	Coefficient	*t*-statistic
MFESurp	2.1553	1.93*		
PlanSize	20.5216	17.81***		
zMFESurp			0.0106	0.42
*zMFESurp*zPlanSize*			0.0377	3.43***
zPlanSize			0.3678	17.54***
BMR	0.0718	1.58	0.0802	1.77*
LnMVE	0.0428	2.10**	0.0484	2.37**
LagReturn	0.2126	1.52	0.1979	1.42
Cash	-0.0195	-0.32	-0.0226	-0.37
CF	0.0279	0.25	0.0623	0.55
Leverage	0.1096	0.75	0.0676	0.46
SDReturn	-9.9165	-2.95***	-9.3721	-2.81***
SDCF	-0.7248	-3.09***	-0.6456	-2.66***
EmergeMkt	0.1765	2.26**	0.1663	2.15**
BlockOwn	-0.2595	-1.63	-0.2640	-1.67*
OfficerOwn	-0.3704	-1.75*	-0.3985	-1.84*
ForeignOwn	-1.0898	-5.09***	-1.0825	-5.08***
Flexible capital policy	0.0130	0.22	0.0120	0.20
Capital efficiency	-0.0189	-0.43	-0.0263	-0.60
Shareholder value	-0.0447	-0.72	-0.0411	-0.67
Stock option	-0.4409	-3.04***	-0.4300	-2.98***
Return to shareholders	-0.0306	-0.62	-0.0282	-0.58
Share exchange	0.2264	1.83*	0.1986	1.65*
Capital restructure	0.2227	0.44	0.1974	0.38
Others	0.3453	2.12**	0.3339	2.05**
InvMills	-0.2119	-1.39	-0.1563	-1.02
Constant	3.9842	8.82***	4.1946	9.15***
Year Dummies	Included		Included	
Adjusted R^2	0.2853		0.2907	
N	1,215		1,215	

This table reports the results of the repurchase plan period regressions. Specifically, Columns (3a) and (3b) present the results of estimating Eqs. (3a) and (3b), respectively. *zMFESurp* and *zPlanSize* are standardized *MFESurp* and *PlanSize*, respectively. *InvMills* is the inverse Mills ratio calculated from the results of the first-stage participation equation in Eq. (1). Other variables are defined in Table 2. *t*-statistics are based on one-way cluster-robust standard errors by firm. *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively.

the interaction variable (*zMFESurp*zPlanSize*). When evaluated at 1 standard deviation above the mean of *PlanSize* (i.e., *zPlanSize* = 1), the coefficient on *zMFESurp* is 0.0484 (0.0106 + 0.0377 × 1.0) and is significant at the 5% level (*t* statistic = 2.18, unreported). When evaluated at 1.5 standard deviations above the mean of *PlanSize* (i.e., *zPlanSize* = 1.5), the coefficient on *zMFESurp* is 0.0672 (0.0106 + 0.0377 × 1.5) and is significant at the 1% level (*t* statistic = 2.98, unreported).

Table 5 provides evidence in support of Fig. 3 by showing that when the repurchase plan size is sufficiently large, the repurchase plan period for an OMR shortens in proportion to the degree of the negative earnings guidance surprise. Overall, these results are consistent with the hypothesis that when the simultaneously announced earnings guidance fails to meet the market's expectation, managers shorten the repurchase plan period in order to strengthen the signal of the OMR announcements.

4.4. Other repurchase-related variables

In this section, we test how repurchase program specifications and the simultaneously announced earnings guidance affect the repurchase-related outcome variables (completion rate, actual repurchases, and announcement returns). The basic form of the outcome estimation model expressed in Eq. (4) is similar to Eq. (2) with one exception. That is, while the *CompRate* and *CAR* estimation models include both *PlanSize* and *LnPlanDays*, the *ActualRep* estimation model includes only *LnPlanDays* (Bonaimé, 2015).

$$\begin{aligned} Outcome_{it} &= \alpha_0 + \alpha_1 MFESurp_{it} + \alpha_2 PlanSize_{it} + \alpha_3 LnPlanDays_{it} \\ &+ \alpha_4 BMR_{it} + \alpha_5 LnMVE_{it} + \alpha_6 Lag\text{Return}_{it} + \alpha_7 Cash_{it} + \alpha_8 CF_{it} \\ &+ \alpha_9 Leverage_{it} + \alpha_{10} SD\text{Return}_{it} + \alpha_{11} SDCF_{it} + \alpha_{12} EmergeMkt_{it} \\ &+ \alpha_{13} BlockOwn_{it} + \alpha_{14} OfficerOwn_{it} + \alpha_{15} ForeignOwn_{it} \\ &+ \alpha_{16} InvMills_{it} + \boldsymbol{\gamma} MotivationDummies_{it} + \boldsymbol{\delta} YearDummies_t + \varepsilon_{it}, \end{aligned} \tag{4}$$

where *Outcome* takes three repurchase-related outcome variables, namely, *CompRate, ActualRep*, and *CAR*.

Columns (4a), (4b), and (4c) of Table 6 present the results from estimating the completion rate, the actual repurchase, and the market response models, respectively. The result from estimating the completion rate model in Column (4a) is generally consistent with Bonaimé (2012), Gould (2019), and Ota et al. (2019). The estimated coefficients on *PlanSize* and *LnPlanDays* are both significantly negative (-2.5228 and -0.0418, respectively), suggesting that a smaller plan size and a shorter plan period are associated with a higher completion rate. However, the insignificant coefficient on *MFESurp* indicates the completion rate of an OMR is not affected by the simultaneously announced earnings guidance surprise. This implies that firms with negative earnings guidance surprises do not announce a larger repurchase size merely to mitigate the negative impact on their share prices (Fried, 2001; 2005).

Further, the result in Column (4b) shows that the coefficient on *MFESurp* is -0.0940 and is statistically significant. This suggests that actual repurchases of an OMR program increase in the magnitude of a negative surprise from the simultaneously announced earnings guidance. The finding is unsurprising given that a larger planned repurchase size is associated with a negative guidance surprise and that the completion rates do not vary by the earnings guidance surprises. The result in Column (4c) shows that the coefficients on *PlanSize* and *LnPlanDays* are 0.9155 and -0.0091, respectively, and both coefficients are statistically significant. This suggests that an increase in the repurchase plan size and a decrease in the repurchase plan period are both associated with a larger positive market reaction after controlling for the effect of earnings guidance surprises. Overall, the findings in this section provide evidence that managers do not merely increase the plan size in the repurchase program to strengthen the signal, but they actually follow through on completing the program and the market reacts positively to the signal strength adjustments of both repurchase plan size and period.

5. Alternative approaches

5.1. Out-of-sample prediction approach

In this section, we adopt alternative approaches to the Heckman two-stage procedure used in our main analysis to address the endogeneity concern arising from the sample selection bias. Accordingly, two approaches are used to gauge the abnormal portions of the repurchase-related variables – *AbPlanSize, AbLnPlanDays, AbCompRate, AbActualRep*, and *AbCAR*. Under the first approach, we estimate the abnormal portions of the repurchase-related variables using out-of-sample OLS prediction models, which is similar in spirit to the dividend estimation model from Fama and French (2001) and the repurchase-related variable estimation model from Bonaimé (2015). Panel D of Table 1 shows that one half of the 5,112 share repurchase cases identified for the period 2004-2017 occur at earnings announcements and irregular management forecast revisions (i.e., the simultaneous subsample), while the other half occur without simultaneous announcements (i.e., the independent subsample). For the Heckman two-stage procedure described in Section 4, we discard the independent subsample due to the lack of simultaneous news (i.e., management earnings forecasts). However, under the alternative approach, we build an expected model for each repurchase-related variable using this independent subsample and calculate the expected value for each repurchase-related variable using the simultaneous subsample. We then subtract the expected value from the actual value of the repurchase-related variable in order to obtain the abnormal portion of the variable. For example, to estimate the abnormal portion of the repurchase plan size (*AbPlanSize*), we first estimate Eq. (5) using only the independent subsample.

$$\begin{aligned} PlanSize_{it} &= \alpha_0 + \alpha_1 BMR_{it} + \alpha_2 LnMVE_{it} + \alpha_3 Lag\text{Return}_{it} + \alpha_4 Cash_{it} \\ &+ \alpha_5 CF_{it} + \alpha_6 Leverage_{it} + \alpha_7 SD\text{Return}_{it} + \alpha_8 SDCF_{it} \\ &+ \alpha_9 EmergeMkt_{it} + \alpha_{10} BlockOwn_{it} + \alpha_{11} OfficerOwn_{it} \\ &+ \alpha_{12} ForeignOwn_{it} + \boldsymbol{\gamma} MotivationDummies_{it} + \boldsymbol{\delta} YearDummies_t + \varepsilon_{it}. \end{aligned} \tag{5}$$

Eq. (5) is basically the same as Eq. (2) except *MFESurp* and *InvMills* are excluded from the model. Next, we derive the expected value of the repurchase plan size (*E*[*PlanSize*]) using the simultaneous subsample with the estimated coefficients obtained from Eq. (5).

$$\begin{aligned} E[PlanSize_{it}] &= \hat{\alpha}_0 + \hat{\alpha}_1 BMR_{it} + \hat{\alpha}_2 LnMVE_{it} + \hat{\alpha}_3 Lag\text{Return}_{it} + \hat{\alpha}_4 Cash_{it} \\ &+ \hat{\alpha}_5 CF_{it} + \hat{\alpha}_6 Leverage_{it} + \hat{\alpha}_7 SD\text{Return}_{it} + \hat{\alpha}_8 SDCF_{it} \\ &+ \hat{\alpha}_9 EmergeMkt_{it} + \hat{\alpha}_{10} BlockOwn_{it} + \hat{\alpha}_{11} OfficerOwn_{it} \\ &+ \hat{\alpha}_{12} ForeignOwn_{it} + \hat{\boldsymbol{\gamma}} MotivationDummies_{it} \\ &+ \hat{\boldsymbol{\delta}} YearDummies_t. \end{aligned}$$

Finally, we calculate the abnormal portion of the repurchase plan size (*AbPlanSize*) for the simultaneous subsample by subtracting the expected value of the repurchase plan size (*E*[*PlanSize*]) from the actual value of the repurchase plan size (*PlanSize*).

$$AbPlanSize_{it} = Actual\ PlanSize_{it} - E[PlanSize_{it}].$$

Table 6
Repurchase outcome regressions.

	(4a) *CompRate*		(4b) *ActualRep*		(4c) *CAR*	
Variable	Coefficient	*t*-statistic	Coefficient	*t*-statistic	Coefficient	*t*-statistic
MFESurp	-0.0319	-0.08	-0.0940	-3.30***	0.6394	6.00***
PlanSize	-2.5228	-4.31***			0.9155	7.04***
LnPlanDays	-0.0418	-3.31***	0.0067	12.21***	-0.0091	-3.98***
BMR	0.0413	2.32**	0.0023	2.18**	0.0137	3.37***
LnMVE	0.0008	0.11	-0.0016	-4.30***	0.0002	0.14
LagReturn	-0.0921	-1.42	-0.0063	-2.28**	-0.0325	-2.51**
Cash	0.0081	0.36	-0.0012	-1.04	-0.0014	-0.34
CF	-0.0032	-0.06	0.0015	0.63	0.0148	1.69*
Leverage	-0.0120	-0.20	-0.0009	-0.29	0.0006	0.05
SDReturn	1.0583	0.75	0.2445	3.80***	0.8438	2.64***
SDCF	-0.2087	-1.61	-0.0081	-1.34	-0.0154	-0.76
EmergeMkt	-0.0773	-2.07**	-0.0050	-2.80***	0.0016	0.20
BlockOwn	-0.1667	-2.31**	-0.0055	-1.74*	0.0164	1.13
OfficerOwn	-0.0346	-0.37	0.0064	1.31	-0.0325	-1.43
ForeignOwn	0.0083	0.10	0.0155	3.93***	-0.0107	-0.63
Flexible capital policy	-0.0504	-2.92***	-0.0002	-0.22	0.0041	0.87
Capital efficiency	0.0165	1.04	0.0025	2.99***	0.0033	0.98
Shareholder value	0.0119	0.58	0.0015	1.05	-0.0006	-0.11
Stock option	0.0189	0.45	-0.0013	-0.81	0.0033	0.35
Return to shareholders	-0.0029	-0.17	0.0011	1.22	0.0015	0.41
Share exchange	0.0418	1.28	-0.0027	-0.99	-0.0205	-1.68*
Capital restructure	0.0810	0.71	0.0017	1.26	-0.0184	-1.96**
Others	0.0536	1.07	0.0022	0.69	0.0243	1.56
InvMills	-0.0355	-0.53	-0.0038	-1.27	0.0010	0.08
Constant	1.1013	5.64***	0.0050	0.51	-0.0234	-0.54
Year Dummies	Included		Included		Included	
Adjusted R^2	0.0780		0.2595		0.1797	
N	1,215		1,215		1,212	

This table reports the results of the repurchase outcome regressions in Eq. (4). Specifically, Columns (4a), (4b), and (4c) present the results of estimating the completion rate, the actual repurchase, and the market reaction models, respectively. *InvMills* is the inverse Mills ratio calculated from the results of the first-stage participation equation in Eq. (1). Other variables are defined in Table 2. *t*-statistics are based on one-way cluster-robust standard errors by firm. *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively.

Table 7 shows the estimated results of the expected models for the five repurchase-related dependent variables (*PlanSize, LnPlanDays, CompRate, ActualRep*, and *CAR*) using the independent subsample. The independent variables included in the expected models vary slightly across the models. Using the coefficient estimates reported in Table 7, we obtain the expected value of each dependent variable for the simultaneous subsample. The abnormal portion of each dependent variable is then estimated for the simultaneous subsample by subtracting the expected values from the actual values.

We conjecture that managers adjust the repurchase plan size and period when the negative surprises from the simultaneously announced earnings guidance undermine the credibility of the signal of OMRs. Based on this argument, we expect the abnormal portions of the repurchase-related variables to have significant correlation with *MFESurp* in predicted directions. To verify this association, we estimate the regression of the abnormal portion of each repurchase-related variable on *MFESurp*.

The estimated regression results reported in Table 8 are generally consistent with the Heckman two-stage approach reported in Tables 4 to 6. With regard to the program specification variables, *AbPlanSize* (*AbLnPlanDays*) are significantly negatively (positively) correlated with *MFESurp* consistent with the signal strength adjustment behavior. That is, managers of OMR announcing firms tend to increase (shorten) the repurchase plan size (plan period) when the simultaneously announced earnings guidance fails to meet the analysts' consensus forecast. With respect to the repurchase-related outcome variables, *AbCompRate* is uncorrelated with *MFESurp*, while *AbActualRep* is significantly negatively correlated with *MFESurp*. These results suggest that the completion rate of a repurchasing firm is unaffected by the content of the simultaneous earnings guidance and that actual repurchases increase in the magnitude of negative earnings guidance surprises. *AbCAR* is positively related to *MFESurp*, indicating that the simultaneous earnings guidance has incremental information content beyond what is contained in an OMR announcement. Overall, the estimation results using an out-of-sample OLS prediction approach yield similar results to the main analysis and confirm the presence of the signal strength adjustment behavior in OMR announcements.

5.2. Propensity score matching approach

The second approach uses the propensity score matching (PSM) method to estimate the abnormal portions of the repurchase-related variables. The intuition behind this alternative approach is that we construct a counterfactual from the independent subsample that closely resembles each share repurchase in the simultaneous subsample with respect to various characteristics (covariates). The differences in the repurchase-related variables between the share repurchases in the simultaneous subsample and the counterfactuals from the independent subsample are considered as the abnormal portions of the repurchase-related variables.

Under the PSM approach, the abnormal portion of the repurchase plan size (*AbPlanSize*) is calculated as follows. We first consider the simultaneous subsample as the treatment group (*SimulDum* = 1) and the independent subsample as the control group (*SimulDum* = 0). Next, we obtain the propensity score for each ob-

Table 7
Out-of-sample prediction for repurchase-related variables.

Variable	(5a) *PlanSize*	(5b) *LnPlanDays*	(5c) *CompRate*	(5d) *ActualRep*	(5e) *CAR*
PlanSize		16.1538	-2.8022		0.7339
		(17.26)***	(-6.86)***		(12.64)***
LnPlanDays			-0.0517	0.0030	-0.0050
			(-5.92)***	(9.22)***	(-5.31)***
BMR	0.0015	0.1738	-0.0078	0.0001	0.0052
	(1.80)*	(5.04)***	(-0.53)	(0.16)	(3.00)***
LnMVE	-0.0029	-0.0361	0.0113	-0.0011	-0.0022
	(-7.47)***	(-2.09)**	(1.75)*	(-3.70)***	(-2.95)***
LagReturn	-0.0061	0.1611	-0.1750	-0.0087	-0.0163
	(-2.87)***	(1.89)*	(-4.97)***	(-5.22)***	(-3.32)***
Cash	0.0019	-0.1031	0.0087	0.0012	0.0002
	(1.72)*	(-2.62)***	(0.43)	(1.47)	(0.08)
CF	-0.0018	-0.0800	-0.0187	-0.0015	0.0031
	(-1.09)	(-0.98)	(-0.55)	(-1.25)	(0.76)
Leverage	0.0016	0.2486	-0.1002	-0.0017	0.0051
	(0.75)	(2.79)***	(-2.82)***	(-1.11)	(1.27)
SDReturn	0.2897	-11.4179	2.5939	0.2311	0.9203
	(5.71)***	(-5.66)***	(2.93)***	(6.36)***	(7.39)***
SDCF	-0.0068	-0.2721	-0.0299	-0.0045	-0.0052
	(-1.69)*	(-1.66)*	(-0.45)	(-1.65)*	(-0.51)
EmergeMkt	-0.0028	-0.0495	-0.1329	-0.0037	0.0037
	(-2.60)***	(-1.07)	(-6.71)***	(-4.79)***	(1.56)
BlockOwn	0.0026	0.5005	-0.1823	-0.0057	0.0102
	(0.93)	(3.97)***	(-3.40)***	(-2.67)***	(1.58)
OfficerOwn	-0.0024	-0.0899	0.0724	0.0029	0.0021
	(-0.66)	(-0.55)	(-0.59)	(1.04)	(0.24)
ForeignOwn	0.0231	-0.5337	-0.0442	0.0140	0.0072
	(5.21)***	(-2.75)***	(1.12)	(4.26)***	(0.86)
Constant	0.0405	4.2169	0.9594	0.0104	0.0243
	(7.24)***	(17.76)***	(9.34)***	(2.27)**	(2.10)**
Motivation Dummies	Included	Included	Included	Included	Included
Year Dummies	Included	Included	Included	Included	Included
Adjusted R^2	0.1113	0.1828	0.1905	0.1717	0.3380
N	2,460	2,460	2,460	2,460	2,456

This table presents the results of estimating the repurchase-related variable regressions using a subsample of OMR cases without simultaneous announcements. Columns (5a), (5b), (5c), (5d), and (5e) present the results of estimating the plan size, the plan period, the completion rate, the actual repurchase, and the market response models, respectively. All variables are defined in Table 2 with the exception that we change the event of the announcement from management earnings forecasts to OMRs. *t*-statistic is presented in parentheses below each coefficient estimate and is based on one-way cluster-robust standard error by firm. *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively.

servation by estimating the probit model expressed in Eq. (6).

$$\begin{aligned}&\Pr(SimulDum = 1|\mathbf{X})\\&= \Phi(\alpha_0 + \alpha_1 BMR_{it} + \alpha_2 LnMVE_{it} + \alpha_3 LagReturn_{it}\\&\quad + \alpha_4 Cash_{it} + \alpha_5 CF_{it} + \alpha_6 Leverage_{it} + \alpha_7 SDReturn_{it} + \alpha_8 SDCF_{it}\\&\quad + \alpha_9 EmergeMkt_{it} + \alpha_{10} BlockOwn_{it} + \alpha_{11} OfficerOwn_{it}\\&\quad + \alpha_{12} ForeignOwn_{it} + \boldsymbol{\gamma} MotivationDummies_{it} + \boldsymbol{\delta} YearDummies_t).\end{aligned} \tag{6}$$

The independent variables in Eq. (6) are the same as Eq. (5). We construct a counterfactual for each observation in the treatment group by choosing and weighting multiple observations in the control group matched on the propensity scores. The number of observations and their weights to construct a counterfactual are determined by the bandwidth and the kernel function, respectively (Guo and Fraser, 2014). We set the bandwidth at 0.05 and use the Epanechnikov kernel.[11] Finally, we calculate the abnormal portion of the repurchase plan size (*AbPlanSize*) for the treatment group by subtracting the counterfactual value of *PlanSize* from the actual value of *PlanSize*.

$$AbPlanSize_{it} = Actual\ PlanSize_{it} - Counterfactual\ PlanSize_{it}.$$

Consistent with the predictive models in Table 7, the independent variables included in a probit model to calculate the propensity scores vary slightly according to the dependent variable used.

Table 9 presents the results of the balancing test for covariates used in the plan size probit model in Eq. (6). The balancing test examines the quality of correspondence between the treatment and the control groups under the PSM method. While the differences in mean values between the treatment and the control groups are statistically significant for many covariates before the matching (e.g., *BMR, LnMVE, LagReturn, Cash, CF*), the differences are no longer significant for all covariates after the matching. This suggests that the PSM procedure yields high-quality counterfactual matches to the treatment group. Although the results of the balancing tests differ slightly across the probit models used to calculate the propensity scores, untabulated results show that they are qualitatively similar to Table 9.

Table 10 reports the results of estimating the regression of the abnormal portion of each repurchase-related variable on *MFESurp*. The results are essentially the same as those reported using the out-of-sample prediction approach in Table 8. With regard to the

[11] The Epanechnikov kernel function has a parabolic shape with support [-1, 1], which means more weight is given to the close neighbors and less weight to distant points compared with the Gaussian kernel function that has fatter tails. However, the results are robust to the use of other kernel functions including the Gaussian kernel. The bandwidth is the fraction that is used to determine the number of observations that fall into a span. The bandwidth of 0.05 indicates that for each observation in the treatment group, 5% of the nearest observations in the control group (123 observations in this study) are used to construct the counterfactual. Again, the results barely change by changing the bandwidth from 0.01 to 0.10, incremental by 0.01.

Table 8
Regressions of the abnormal portions of the repurchase-related variables using out-of-sample prediction approach.

Variable	(6a) *AbPlanSize*	(6b) *AbLnPlanDays*	(6c) *AbLnPlanDays*	(6d) *AbCompRate*	(6e) *AbActualRep*	(6f) *AbCAR*
MFESurp	-0.1352	3.5048		-0.4063	-0.1159	0.5872
	(-3.93)***	(3.64)***		(-1.12)	(-4.31)***	(5.50)***
zMFESurp			0.0523			
			(2.21)**			
*zMFESurp*zPlanSize*			0.0412			
			(3.94)***			
zPlanSize			0.0809			
			(3.80)***			
Intercept	0.0000	-0.0222	-0.0379	0.0477	0.0011	0.0015
	(0.10)	(-1.07)	(-1.93)*	(6.36)***	(3.00)***	(1.06)
Adjusted R^2	0.0282	0.0107	0.0256	0.0003	0.0356	0.0566
N	1,215	1,215	1,215	1,215	1,215	1,212

This table presents the results for the regressions of the abnormal portions of the repurchase-related variables calculated using the out-of-sample prediction approach on simultaneously announced earnings guidance surprises. Columns (6a), (6b), (6c), (6d), (6e), and (6f) show the estimation results of the abnormal plan size, the abnormal plan period, the abnormal plan period (conditional on plan size), the abnormal completion rate, the abnormal actual repurchase, and the abnormal market response models, respectively. *AbPlanSize, AbLnPlanDays, AbCompRate, AbActualRep*, and *AbCAR* are the abnormal portions of *PlanSize, LnPlanDays, CompRate, ActualRep*, and *CAR*, respectively, that are calculated using the out-of-sample prediction approach. *zMFESurp* and *zPlanSize* are standardized *MFESurp* and *PlanSize*, respectively. Other variables are defined in Table 2. *t*-statistic is presented in parentheses below each coefficient estimate and is based on one-way cluster-robust standard error by firm. *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively.

Table 9
Balancing test.

	Before matching			After matching		
Covariate	Treatment	Control	*t*-statistic	Treatment	Control	*t*-statistic
BMR	1.165	1.070	4.91***	1.165	1.148	0.81
LnMVE	10.988	10.668	6.26***	10.988	10.961	0.51
LagReturn	-0.021	-0.033	2.30**	-0.021	-0.026	0.87
Cash	0.476	0.420	3.56***	0.475	0.469	0.33
CF	0.142	0.119	3.80***	0.141	0.140	0.23
Leverage	0.453	0.461	-1.33	0.453	0.451	0.24
SDReturn	0.023	0.023	-1.41	0.023	0.023	-0.44
SDCF	0.099	0.090	2.01**	0.099	0.098	0.13
EmergeMkt	0.171	0.238	-5.83***	0.171	0.174	-0.31
BlockOwn	0.467	0.498	-7.32***	0.467	0.471	-0.87
OfficerOwn	0.063	0.083	-5.84***	0.063	0.065	-0.65
ForeignOwn	0.168	0.136	8.54***	0.168	0.167	0.26
Flexible capital	0.832	0.894	-6.30***	0.833	0.830	0.26
Capital efficiency	0.330	0.224	8.36***	0.330	0.337	-0.54
Shareholder value	0.093	0.067	3.46***	0.094	0.098	-0.53
Stock option	0.018	0.018	0.02	0.018	0.023	-1.30
Return to shareholders	0.319	0.178	11.59***	0.319	0.317	0.13
Share exchange	0.008	0.010	-0.75	0.007	0.007	0.06
Capital restructure	0.001	0.001	-0.44	0.001	0.001	0.30
Others	0.014	0.015	-0.22	0.014	0.017	-0.71
Year Dummies	Included			Included		

This table presents the results of the balancing test for the covariates used in the plan size probit model expressed in Eq. (6). The table compares the means of the covariates between the treatment group (*SimulDum* = 1) and the control group (*SimulDum* = 0) using a *t*-test. The second and the third columns of the table show the results before and after the PSM is performed, respectively. *SimulDum* is a dummy variable that equals to 1 if an OMR is announced simultaneously with a management earnings forecast and equals to 0 if an OMR is announced independently without a management earnings forecast. Other variables are defined in Table 2 with the exception that we change the event of the announcement from management earnings forecasts to OMRs. *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively.

program specification variables, *AbPlanSize* is significantly negatively correlated with *MFESurp*. Further, *AbLnPlanDays* is significantly positively correlated with *MFESurp* when conditioned on *PlanSize*. These findings suggest that managers of repurchasing firms increase (shorten) the repurchase size (period) with the negative earnings guidance surprise in the simultaneous announcements. With respect to the repurchase-related outcome variables, while *AbCompRate* is statistically uncorrelated with *MFESurp*, *AbActualRep* (*AbCAR*) is significantly negatively (positively) related to *MFESurp*. Overall, the evidence from the two alternative approaches (i.e., the out-of-sample predictive approach and the PSM approach) is consistent with the Heckman two-stage method in the main analysis and supports our hypothesis. The managers of repurchasing firms appear to engage in the signal strength adjustment behavior in OMR announcements when the credibility of the signal is undermined by the simultaneously announced repurchase-unrelated news.

6. Robustness tests

6.1. Current earnings surprise

We have investigated hitherto the effect of management earnings forecasts that are released simultaneously with OMRs on the terms of the repurchase programs. However, as shown in Panel D of Table 1, nearly half of OMRs in Japan are announced at quarterly and annual earnings announcements, implying that simultaneously announced current earnings could also have an effect on the terms of the repurchase programs. To explore the possibility, we capture the 'surprise' element in current earnings (*EarnSurp*) by taking the

Table 10
Regressions of the abnormal portions of the repurchase-related variables using propensity score matching approach.

Variable	(7a) *AbPlanSize*	(7b) *AbLnPlanDays*	(7c) *AbLnPlanDays*	(7d) *AbCompRate*	(7e) *AbActualRep*	(7f) *AbCAR*
MFESurp	-0.2077	0.6380		0.2490	-0.1502	0.2139
	(-5.84)***	(0.63)		(0.70)	(-5.43)***	(1.74)*
zMFESurp			0.0658			
			(2.79)***			
*zMFESurp*zPlanSize*			0.0356			
			(3.26)***			
zPlanSize			0.342			
			(15.89)***			
Intercept	-0.0016	-0.1124	-0.1080	0.0805	0.0008	-0.0044
	(-3.37)***	(-4.98)***	(-5.49)***	(10.47)***	(2.12)**	(-2.76)***
Adjusted R^2	0.0648	0.0000	0.1812	0.0000	0.0508	0.0061
N	1,215	1,215	1,215	1,215	1,215	1,212

This table presents the results for the regressions of the abnormal portions of the repurchase-related variables calculated using the PSM approach on simultaneously announced earnings guidance surprises. Columns (7a), (7b), (7c), (7d), (7e), and (7f) show the estimation results of the abnormal plan size, the abnormal plan period, the abnormal plan period (conditional on plan size), the abnormal completion rate, the abnormal actual repurchase, and the abnormal market response models, respectively. *AbPlanSize, AbLnPlanDays, AbCompRate, AbActualRep*, and *AbCAR* are the abnormal portions of *PlanSize, LnPlanDays, CompRate, ActualRep*, and *CAR*, respectively, that are calculated using the PSM approach. *zMFESurp* and *zPlanSize* are standardized *MFESurp* and *PlanSize*, respectively. Other variables are defined in Table 2. *t*-statistic is presented in parentheses below each coefficient estimate and is based on one-way cluster-robust standard error by firm. *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively.

difference between the actual net income released at the annual earnings announcement date and analysts' consensus forecast of net income, scaled by the market capitalization at the end of the month prior to the announcement of the actual net income.

It is important to note that we can only measure *EarnSurp* at annual earnings announcements because analysts' earnings forecasts in Japan are usually provided in the form of full-year forecasts (i.e., quarterly analysts' earnings forecasts are not readily available in Japan).[12] Consequently, the sample size is reduced considerably (from 1,215 to 388 observations).

Panel A of Table 11 reports the re-estimation results of the repurchase plan size and period regressions in Table 4 (Columns (2a) and (2b)) and Table 5 (Columns (3a) and (3b)) with *EarnSurp* being added as an additional independent variable.[13] Panel A shows that while the estimated coefficient on *MFESurp* is generally significant across all model specifications, *EarnSurp* is not statistically significant in all regressions. In addition, untabulated results reveal that replacing *MFESurp* in these models with *EarnSurp* does not yield significant coefficients on *EarnSurp*. These results are surprising given the significantly positive correlation between *MFESurp* and *EarnSurp* ($\rho = 0.2016$) suggests that a positive earnings surprise is associated with a positive earnings guidance surprise. Taken together, current earnings surprises at earnings announcements appear to be subsumed by the concurrently announced earnings guidance surprises and do not impact the terms of the repurchase programs.[14]

6.2. Recession

Maslar et al. (2021) find that during economic downturns or periods of higher macroeconomic uncertainty, managers tend to change their forecasting behavior and adjust the features of their earnings forecasts such as forecast form, width, and horizon. Their findings indicate the possibility that firms in Japan may also modify the terms of their OMR programs in times of higher macroeconomic uncertainty. Following Maslar et al. (2021), we define economic downturns as recessionary months identified by the Economic and Social Research Institute (ESRI) affiliated with the Japanese Cabinet Office, and we create an indicator variable *Recession* that equals one if a share repurchase is announced during ESRI-identified recessionary periods (i.e., February 2008 – March 2009 and March – November 2012), and zero otherwise. Of the 5,112 share repurchases in our sample, 22.6% are announced during the recession.

Panel B of Table 11 reports the re-estimation results of the repurchase plan size and period regressions in Table 4 (Columns (2a) and (2b)) and Table 5 (Columns (3a) and (3b)) with *Recession* being included in the models as an additional independent variable. Panel B shows that the estimated coefficient on *Recession* is not statistically significant in all model specifications. Furthermore, untabulated analysis shows that the results remain unchanged even after including an interaction variable between *MFESurp* (*zMFESurp*) and *Recession* in these models. Overall, these findings suggest that managers in Japan do not modify the terms of the repurchase programs during recessionary periods to a greater extent than they do during non-recessionary periods.

6.3. Industry fixed effects

In our main analysis, we treat *Mimic* (i.e., the portion of other firms in the same industry that announce OMRs) in the first-stage probit regression as an exclusion restriction, and omit it from the second-stage outcome regressions in Tables 4 and 5 (Lennox et al., 2012; Bonaimé, 2015). We also do not include industry fixed effects in the outcome regressions due to the concern about their possible correlation with *Mimic*. Nevertheless, it is possible that firms in the same industry modify the terms of the OMR program differently than firms in other industries. To investigate the possibility, we re-estimate the repurchase plan size and period regressions in Table 4 (Columns (2a) and (2b)) and Table 5 (Columns (3a) and

[12] We also estimate *EarnSurp* at quarterly earnings announcements by converting analysts' full-year earnings forecasts to quarterly earnings forecasts using the formula below:
Quarterly earnings forecast = Analysts' full-year earnings forecast × (Prior year's actual quarterly earnings ÷ Prior year's actual full-year earnings).
This procedure increases the sample size to 1,118 observations. However, the inclusion of the estimated *EarnSurp* at quarterly earnings announcements in the sample produces results that are qualitatively similar to those reported in Panel A of Table 11.

[13] Note that to be consistent with Column (3b) of Table 5, we use the standardized *EarnSurp* (*zEarnSurp*) in Column (3b) of Panel A, Table 11.

[14] We also re-estimate the market response regression in Column (4c) of Table 6 with *EarnSurp* included as an additional independent variable. The result shows that while the estimated coefficient (*t*-statistic) on *MFESurp* is 0.8000 (3.05) and remains significant at the 1% level, the estimated coefficient (*t*-statistic) on *EarnSurp* is 0.1597 (0.74) and is statistically indistinguishable from zero. It appears *EarnSurp* is not informative to the market in the presence of *MFESurp*.

Table 11
Robustness tests.

Panel A: Current earnings surprise				
Variable	(2a) *PlanSize*	(2b) *PlanSize*	(3a) *LnPlanDays*	(3b) *LnPlanDays*
EarnSurp	0.0631	0.0065	-1.7003	
	(1.17)	(1.31)	(-0.94)	
MFESurp	-0.2218	-0.2282	4.1795	
	(-3.51)***	(-3.53)***	(1.95)*	
zEarnSurp				-0.0246
				(-0.81)
zMFESurp				0.0315
				(0.62)
*zMFESurp*zPlanSize*				0.0477
				(2.11)**
zPlanSize				0.4487
				(12.33)***
Control Variables	Included	Included	Included	Included
Adjusted R^2	0.1131	0.1416	0.3349	0.3391
N	388	388	388	388
Panel B: Recession				
Variable	(2a) *PlanSize*	(2b) *PlanSize*	(3a) *LnPlanDays*	(3b) *LnPlanDays*
Recession	0.0030	0.0026	-0.0183	-0.0355
	(1.33)	(1.16)	(-0.22)	(-0.42)
MFESurp	-0.1432	-0.1461	2.1377	
	(-3.95)***	(-4.00)***	(1.92)*	
zMFESurp				0.0097
				(0.38)
*zMFESurp*zPlanSize*				0.0038
				(3.45)***
zPlanSize				0.3681
				(17.52)***
Control Variables	Included	Included	Included	Included
Adjusted R^2	0.1215	0.1262	0.2848	0.2902
N	1,215	1,215	1,215	1,215
Panel C: Industry fixed effects				
Variable	(2a) *PlanSize*	(2b) *PlanSize*	(3a) *LnPlanDays*	(3b) *LnPlanDays*
MFESurp	-0.1456	-0.1482	2.3712	
	(-4.03)***	(-4.07)***	(2.04)*	
zMFESurp				0.0152
				(0.57)
*zMFESurp*zPlanSize*				0.0375
				(3.38)***
zPlanSize				0.3611
				(17.28)***
Industry Dummies	*F*-statistic	*F*-statistic	*F*-statistic	*F*-statistic
	9.57***	8.89***	9.03***	6.97***
Control Variables	Included	Included	Included	Included
Adjusted R^2	0.1586	0.1608	0.3250	0.3302
N	1,215	1,215	1,215	1,215

This table presents the estimation results of including the additional independent variables, namely, *EarnSurp* (Panel A), *Recession* (Panel B), and *Industry Dummies* (Panel C), to the repurchase plan size and period regressions in Table 4 (Columns (2a) and (2b)) and Table 5 (Columns (3a) and (3b)). *EarnSurp* is an actual net income released at the annual earnings announcement date minus analysts' consensus forecast of net income scaled by the market capitalization at the end of the month prior to the announcement of the actual net income; *zEarnSurp* is the standardized variable of *EarnSurp; Recession* is an indicator variable that equals one if a share repurchase is announced during recessions identified by the Economic and Social Research Institute affiliated with the Japanese Cabinet Office (February 2008 – March 2009 and March – November 2012), and zero otherwise; and *Industry Dummies* are a set of dummy variables for industries specified by the Nikkei 36 industry classification. Other variables are defined in Table 2. *t*-statistic is presented in parentheses below each coefficient estimate and is based on one-way cluster-robust standard error by firm. *F*-statistic is provided for joint significance testing of *Industry Dummies* in Panel C. *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively.

(3b)) with *Industry Dummies* (i.e., a set of dummy variables for industries specified by the Nikkei 36 industry classification) being added as additional independent variables. The results are reported in Panel C of Table 11.

Panel C shows that the joint significance test of *Industry Dummies* yields significant *F*-statistic in all model specifications, highlighting the importance of controlling for the variations in repurchase plan size and period across industries. However, the estimated coefficient value and the statistical significance of our variable of interest *MFESurp* remain largely unchanged after the inclusion of industry fixed effects in all regressions. Overall, the results reported in Panel C confirm the robustness of our main analysis to the inclusion of industry fixed effects.

7. Conclusion

The signaling hypothesis argues that a firm announces a share repurchase to signal to the market that the manager believes the

share is undervalued. However, the stock market may scrutinize the credibility of the undervaluation signal for OMRs because these repurchases are non-binding commitments. Moreover, when firms simultaneously announce bad news, the signal of the announcements may further undermine the credibility of the OMR signal. Prior studies show that the market participants consider several factors (e.g., past repurchase completion rate, insider purchases of its shares before the announcement) when evaluating the credibility of the signal from OMR announcements. This paper investigates whether managers of repurchasing firms modify the terms of the OMR program when simultaneous announcements of bad news threaten the credibility of the signal from the OMR announcements.

Using a sample of 5,112 OMR announcements over the period 2004-2017, we show that managers of repurchasing firms increase the repurchase plan size and shorten the repurchase plan period with the magnitude of the simultaneously announced bad news. We also find that these signal strength adjustments are informative to the market. These results hold after using various methods that control for sample selection bias. Overall, our study contributes to the share repurchase literature by extending the signaling hypothesis. To the best of our knowledge, our study is the first to demonstrate how managers strategically modify the terms of the repurchase program in order to strengthen the signal of the OMR announcements, especially when the credibility of this signal is undermined by the bad news in the simultaneous announcements.

CRediT authorship contribution statement

Koji Ota: Conceptualization, Data curation, Methodology, Formal analysis, Writing – review & editing. **David Lau:** Conceptualization, Data curation, Methodology, Formal analysis, Writing – review & editing. **Hironori Kawase:** Conceptualization, Data curation, Methodology, Formal analysis.

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References

Akyol, A.C., Foo, C.C., 2013. Share repurchase reasons and the market reaction to actual share repurchases: Evidence from Australia. International Review of Finance 13, 1–37.
Allen, F., Michaely, R., 2003. Payout policy. In: Constantinides, G., Stulz, R., Harris, M. (Eds.), Handbook of the Economics of Finance 1A. Elsevier, pp. 337–429.
Andriosopoulos, D., Andriosopoulos, K., Hoque, H., 2013. Information disclosure, CEO overconfidence, and share buyback completion rates. Journal of Banking & Finance 37, 5486–5499.
Babenko, I., Tserlukevich, Y., Vedrashko, A., 2012. The credibility of open market share repurchase signaling. Journal of Financial and Quantitative Analysis 47, 1059–1088.
Banyi, M.L., Dyl, E.A., Kahle, K.M., 2008. Errors in estimating share repurchases. Journal of Corporate Finance 14, 460–474.
Bargeron, L., Kulchania, M., Thomas, S., 2011. Accelerated share repurchases. Journal of Financial Economics 101, 69–89.
Bhattacharya, U., Jacobsen, S., 2016. The share repurchase announcement puzzle: Theory and evidence. Review of Finance 20, 725–758.
Bonaimé, A.A., 2012. Repurchases, reputation, and returns. Journal of Financial and Quantitative Analysis 47, 469–491.
Bonaimé, A.A., 2015. Mandatory disclosure and firm behavior: Evidence from share repurchases. The Accounting Review 90, 1333–1362.
Bonaimé, A.A., Hankins, K.W., Jordan, B.D., 2016. The cost of financial flexibility: Evidence from share repurchases. Journal of Corporate Finance 38, 345–362.
Bonaimé, A.A., Öztekin, Ö., Warr, R.S., 2014. Capital structure, equity mispricing, and stock repurchases. Journal of Corporate Finance 26, 182–200.
Chan, K., Ikenberry, D.L., Lee, I., 2004. Economic sources of gain in stock repurchases. Journal of Financial and Quantitative Analysis 39, 461–479.
Comment, R., Jarrell, G.A., 1991. The relative signalling power of Dutch-auction and fixed-price self-tender offers and open-market share repurchases. The Journal of Finance 46, 1243–1271.
Dittmar, A.K., 2000. Why do firms repurchase stock? The Journal of Business 73, 331–355.
Fama, E.F., French, K.R., 2001. Disappearing dividends: Changing firm characteristics or lower propensity to pay? Journal of Financial Economics 60, 3–43.
Fried, J.M., 2000. Insider signaling and insider trading with repurchase tender offers. University of Chicago Law Review 67, 421–477.
Fried, J.M., 2001. Open market repurchases: Signaling or managerial opportunism? Theoretical Inquiries in Law 2, 865–894.
Fried, J.M., 2005. Informed trading and false signaling with open market repurchases. California Law Review 93, 1323–1386.
Gaspar, J.M., Massa, M., Matos, P., Patgiri, R., Rehman, Z., 2012. Payout policy choices and shareholder investment horizons. Review of Finance 17, 261–320.
Gould, G.P., 2019. Repurchases and intended program length. Pacific-Basin Finance Journal 56, 234–247.
Grullon, G., Ikenberry, D.L., 2000. What do we know about stock repurchases? Journal of Applied Corporate Finance 13, 31–51.
Grullon, G., Michaely, R., 2004. The information content of share repurchase programs. The Journal of Finance 59, 651–680.
Guo, S., Fraser, M.W., 2014. Propensity score analysis: Statistical methods and applications, 2nd edition Sage Publications Inc., Thousand Oaks, CA.
Ikenberry, D.L., Lakonishok, J., Vermaelen, T., 1995. Market underreaction to open market share repurchases. Journal of Financial Economics 39, 181–208.
Ikenberry, D.L., Lakonishok, J., Vermaelen, T., 2000. Stock repurchases in Canada: Performance and strategic trading. The Journal of Finance 55, 2373–2397.
Jagannathan, M., Stephens, C.P., Weisbach, M.S., 2000. Financial flexibility and the choice between dividends and stock repurchases. Journal of Financial Economics 57, 355–384.
Jensen, M.C., 1986. Agency costs of free cash flow, corporate finance, and takeovers. The American Economic Review 76, 323–329.
Kato, K., Skinner, D.J., Kunimura, M., 2009. Management forecasts in Japan: An empirical study of forecasts that are effectively mandated. The Accounting Review 84, 1575–1606.
Lei, Z., Zhang, C., 2016. Leveraged buybacks. Journal of Corporate Finance 39, 242–262.
Lennox, C.S., Francis, J.R., Wang, Z., 2012. Selection models in accounting research. The Accounting Review 87, 589–616.
Liu, H., Swanson, E.P., 2016. Is price support a motive for increasing share repurchases? Journal of Corporate Finance 38, 77–91.
Louis, H., White, H., 2007. Do managers intentionally use repurchase tender offers to signal private information? Evidence from firm financial reporting behavior. Journal of Financial Economics 85, 205–233.
Manconi, A., Peyer, U.C., Vermaelen, T., 2018. Are buybacks good for long-term shareholder value? Evidence from buybacks around the world. Journal of Financial and Quantitative Analysis 54, 1899–1935.
Maslar, D.A., Serfling, M., Shaikh, S., 2021. Economic downturns and the informativeness of management earnings forecasts. Journal of Accounting Research 59, 1481–1520.
Massa, M., Rehman, Z., Vermaelen, T., 2007. Mimicking repurchases. Journal of Financial Economics 84, 624–666.
McNally, W.J., 1999. Open market stock repurchase signaling. Financial Management 28, 55–67.
Ota, K., 2010. The value relevance of management forecasts and their impact on analysts' forecasts: Empirical evidence from Japan. ABACUS 46, 28–59.
Ota, K., Kawase, H., Lau, D., 2019. Does reputation matter? Evidence from share repurchases. Journal of Corporate Finance 58, 287–306.
Ota, K., Lau, D., 2021. Share repurchases on the Tokyo Stock Exchange Trading Network. Journal of the Japanese and International Economies 61, 1–17.
Peyer, U.C., Vermaelen, T., 2005. The many facets of privately negotiated stock repurchases. Journal of Financial Economics 75, 361–395.
Peyer, U.C., Vermaelen, T., 2009. The nature and persistence of buyback anomalies. Review of Financial Studies 22, 1693–1745.
Stephens, C.P., Weisbach, M.S., 1998. Actual share reacquisitions in open-market repurchase programs. The Journal of Finance 53, 313–333.
Vermaelen, T., 1981. Common stock repurchases and market signalling: An empirical study. Journal of Financial Economics 9, 139–183.
Vermaelen, T., 2005. Share repurchases. now Publishers Inc., Hanover, MA.
Wu, R., 2012. Does corporate governance quality lend credibility to open-market share repurchase announcements? Corporate Governance: An International Review 20, 490–508.