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'Short Interest Pressure' and Competitive Behaviour

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Abstract: This study introduces and examines a new-to-strategy form of Wall Street pressure – 'short interest pressure' – the tension felt by management caused by short sales of the firm's stock. Drawing from a sample of over 5000 competitive actions carried out by competing firms over a 6-year time period, we test whether the level of short interest pressure experienced by the firm in one time period is predictive of properties of the firm's competitive action repertoire in the ensuing time period. Our findings suggest that when faced with short interest pressure firms tend to carry out a higher number of competitive actions in the following time period, as well as a set of actions that deviate from the industry norm. In addition, *post hoc* analysis reveals that this effect is amplified for poorly performing firms. Thus, our study contributes to a deeper understanding of the relationship between capital market signals and competitive strategy.

In a 1998 speech, the then-chairman of the Securities and Exchange Commission, Arthur Levitt, expressed concern over responses to capital market pressure, such as earnings estimates, felt by managers:

> Increasingly, I have become concerned that the motivation to meet Wall Street earnings expectations may be overriding common sense business practices. In the zeal to satisfy consensus earnings estimates and project a smooth earnings path, wishful thinking may be winning the day over faithful representation. (Levitt, 1998)

Zeal indeed. Managers are so strongly motivated to meet earnings estimates because they fear the severe negative reaction in the stock market when estimates are missed. For example, in early 2005 *eBay* missed quarterly earnings estimates by only one penny for the first time in 2 years. This sent its stock price tumbling by nearly 20% over the ensuing two-day period that resulted in a 4 billion dollar loss in market capitalization. Thus, the market imposes a well-understood corrective discipline in response to underperformance that managers actively seek to avoid.

Capital market pressure is a form of attainment discrepancy, defined as the gap between expected and actual performance as seen by the firm's internal and external stakeholders (Wiseman and Bromiley, 1996). Earnings pressure, for example, occurs when the investment community's expectation of a given firm's future performance is higher than that of management's own estimates. As noted by chairman Levitt, this often motivates managers to take quick corrective action in an effort to narrow the gap in earnings estimates. Indeed, managers who face earnings pressure oftentimes engage in 'public earnings guidance' or 'creative accounting' to narrow the difference between outsiders' and insiders' earnings expectations (Cotter, Tuna and Wysocki, 2006; Degeorge, Patel and Zeckhauser, 1999). Earnings pressure can also lead managers to postpone or forgo long-term projects or decrease spending in advertising and R&D in an effort to shore up short-term earnings (Graham, Harvey and Rajgopal, 2005).

The question of how capital market pressure influences the firm's competitive strategy is less understood and has received limited theoretical and empirical attention. In a study that helped motivate ours, Zhang and Gimeno (2010) found that earnings pressure predicted the firm's decision to restrict output in the electricity production industry which resulted in higher prices and a quick boost in the firm's short-term earnings. These authors stress the need for future research that explores how capital market pressure influences other aspects of competitive behaviour beyond pricing and capacity actions.

We aim to answer this call by examining how a specific form of capital market pressure, short interest pressure, predicts competitive behaviour characterized as competitive action intensity, the range of different types of competitive actions carried out by the firm, and the extent to which the firm's repertoire of competitive actions deviates from that of competitors. We draw our core ideas from a stream of research in strategic management known as competitive dynamics, which conceptualizes competitive actions as visible, market-directed competitive moves carried out by the firm to improve its relative competitive position (see Grimm, Lee and Smith, 2006; Chen and Miller 1994; Smith, Ferrier and Ndofor, 2001). As such, our paper contributes to the competitive dynamics literature that has explored important managerial, organizational, industry and outcome-related drivers of competitive behaviour. We also provide

new insights to research in finance that links financial market expectations of firm performance, like earnings estimates, to competitive strategy. In particular, we bring greater clarity to the question of how capital market pressure corresponds to the firm's competitive actions carried out over finite periods of time.

Short interest pressure

Our study introduces and examines a new-to-strategy form of capital market pressure, *short interest pressure*, which we define as the tension felt by management that results from the firm's stock being sold 'short' in the market. Short selling is an option-like device used by investor-speculators who anticipate a decline in the price of a given firm's stock price. Here, an investor who sells a stock 'short' at the current price does not actually own the stock, but instead borrows the shares from a brokerage house. If the firm's stock price does indeed drop, the investor covers the short position by buying back the shares at the lower price and returning them to the initial lender. The investor's profit is the difference between the higher selling price and lower buy-back price. However, if the price of the stock increases, the short seller's potential losses are unlimited.

The study of the effects of short selling is unprecedented in strategy research and is of utmost importance because short interest, measured as the number of shares sold short relative to total shares outstanding, is a variable that finance scholars have shown to have a profoundly negative impact on future share prices. Indeed, prior studies that examined the relationship between short interest and future abnormal returns found that firms with little to no short interest experienced returns on a par with the broader stock indices (Boehmer, Huszar and Jordan, 2010), whereas firms having 5% or more of their outstanding shares sold short experienced, on average, 18% losses in future share price (Dechow *et al.*, 2001). So, as a signal of future poor performance, it is critical to explore how short interest pressure impacts the firm's future competitive strategy.

A key difference between short interest pressure and earning pressure, for example, is that investors are able to short a stock at any time; there are no quarterly estimates to meet. The use of earnings guidance will do little to alleviate the effects of short interest on the downward pressure on the firm's future stock. Instead, consistent with Zhang and Gimeno's (2010) findings, we believe that the level of short interest pressure experienced in a given time period will correlate with the firm's strategic choices in the ensuing time period. Finance scholars Fuller and Jensen (2002) agree, stating that 'the valuation Wall Street puts on a company's securities and the trajectory of those prices affects the nature of the strategies firms adopt and, hence, their prospects for success' (p. 63). Short interest pressure as an indicator of poor future performance is similar in effect to Altman's bankruptcy predictor (Altman, 1968; Chakravarthy, 1986). Prior

research found that performance-distressed firms which compete in otherwise favourable conditions (high industry growth, high barriers to entry) are likely to compete in a highly aggressive manner in an attempt to restore competitiveness and performance (Ferrier *et al.*, 2002). Our study explores how short interest pressure predicts the nature of and, in particular, three properties of the firm's competitive action repertoire that, as will be discussed more fully below, prior research has firmly established as being predictive of high levels of performance (Basdeo *et al.*, 2006; Deephouse, 1999; Ferrier, Smith and Grimm, 1999; Miller and Chen, 1996a; Young, Smith and Grimm, 1996). In other words, when faced with short interest pressure, managers take corrective action by carrying out competitive actions captured by specific attributes of the firm's competitive action repertoire.

Strategy-as-action

Built from the notion within Austrian economics that views competition as a process in which firms continually strive to outcompete each other (Jacobsen, 1992; Kirzner, 1973; Thomas and Pollock, 1999), the stream of research widely known as competitive dynamics has garnered widespread attention not only in the field of strategic management but also in entrepreneurship, marketing, inter-organizational networks and others (Hutzschenreuter and Israel, 2009; Ketchen, Snow and Hoover, 2004; Smith, Ferrier and Ndofor, 2001). At its core, competitive dynamics views a firm's strategy as observed competitive action (Grimm, Lee and Smith, 2006; Smith, Grimm and Gannon, 1992). Scholars in this area have explored, for example, how individual competitive actions stimulate competitive responses (Chen and Miller, 1994; Chen, Smith and Grimm, 1992) and how characteristics of the firm's entire repertoire of competitive actions influence firm performance (Ferrier, Smith and Grimm, 1999; Miller and Chen, 1994, 1996a, 1996b). Competitive dynamics also complements hypercompetition theory in so far as it empirically examines the aggressiveness with which firms carry out competitive actions as they strive for strategic supremacy by attempting to erode or neutralize the competitive advantage of rivals (D'Aveni, 1994; Ferrier, Smith and Grimm, 1999; Young, Smith and Grimm, 1996).

Given the impact of competitive actions on rival firms and relative performance, it is vital to understand the managerial, organizational and contextual antecedents of competitive action. To this end, prior research has empirically examined how a variety of organizational- and industry-level factors serve as drivers of competitive behaviour: firm size (Chen and Hambrick, 1995), top management team characteristics (Ferrier, 2001; Hambrick, Cho and Chen, 1996), past performance (Ferrier *et al.*, 2002; Miller and Chen, 1994), the structure of inter-organizational networks (Chi, Ravichandran and Andrevski, 2010; Gnyawali, He and Madhavan, 2006), multinational competition (Yu and Cannella, 2007) and nascent versus established product markets (Rindova, Ferrier and Wiltbank, 2010).

More recently, research has shifted toward an exploration of the cognitive and perceptual drivers of competitive action. For instance, Chen, Su and Tsai (2007) explored how 'competitive tension' — defined as the extent to which a firm's managers perceive a certain level of strain in a competitive situation and feel pressure to take action — is predictive of aggressive competitive behaviour directed towards rival firms. Similarly, Livengood and Reger (2010) developed the concept of an 'identity domain' — defined as the areas of the competitive market that hold particular psychological importance to managers — to explain why firms might compete more aggressively than usual. Marcel, Barr and Duhaime (2011) explored how different managerial cognitive schemas influence the likelihood and speed with which a firm carries out retaliatory actions against rivals. Perhaps most germane to our study, Zhang and Gimeno (2010) explored the effect of upwards 'earnings pressure' — a situation that arises when external analysts' earnings forecasts are higher than the firm's own earnings expectations — on competitive behaviour. As noted above, earnings pressure predicted subsequent restrictions in levels of capacity utilization among electric utility companies. In sum, this stream of research centres on a variety of situational signals that are predictive of subsequent competitive behaviour. Our study examines the effect of a particular kind of situational signal – short interest pressure – on three properties of a firm's competitive action repertoire.

Short interest pressure and competitive behaviour

Scholars in competitive dynamics have developed theory and empirical methods centring on conceptualization of firm strategy as competitive action, defined broadly as an externally directed, market-based competitive move carried out with the intent to improve a firm's competitive position (Grimm, Lee and Smith, 2006; Smith, Ferrier and Ndofor, 2001). Early research in this stream focused attention on the action—reaction dyads level of analysis (e.g. Chen, Smith and Grimm, 1992), whereby the characteristics of an individual competitive action, for example, are important predictors of a rival's competitive response. Research has examined the antecedents and consequences associated with the entire set of competitive actions carried out in a specific period of time. This is the competitive action repertoire level of analysis (e.g. Ferrier, Smith and Grimm, 1999; Miller and Chen, 1994, 1996a, 1996b). In head-to-head rivalry, firms are engaged in carrying out an endless series of competitive moves and countermoves, e.g. price cutting, introducing new products, marketing campaigns, capacity expansions etc., with the intent to keep each other off balance and their own firm profitable (D'Aveni, 1994; Kirzner, 1973; Smith, Ferrier and Ndofor, 2001). As previous studies have shown, a variety of antecedents predict competitive behaviour. We extend this research by examining short interest pressure as related to three fundamental characteristics of a firm's competitive action repertoire: action repertoire intensity (how many actions the firm carries out), action repertoire complexity (the extent to which the firm's set of actions consists of a broad range of different types of actions) and action

repertoire non-conformity (the extent to which the firm's set of actions is different from that of rivals).

Action repertoire intensity

An important tenet of competitive dynamics and hypercompetition posits that firms that are able to initiate and sustain competitive attacks consisting of many actions will keep rivals off balance and on the defensive (D'Aveni, 1994; Kirzner, 1973). This suggests a more-actions-are-better posture for the firm's competitive strategy. Indeed, prior research found that firms that were less inertial and carried out more competitive actions than rivals were positively related to profitability, gains in market share, and overall reputation (Basdeo *et al.*, 2006; Ferrier, 2001; Ferrier, Smith and Grimm, 1999; Miller and Chen, 1994; Young, Smith and Grimm, 1996).

Like earnings pressure, short interest pressure is a form of attainment discrepancy between insiders' and outsiders' expectations of the firm's future performance (Wiseman and Bromiley, 1996). Yet, whereas earnings pressure is the result of analysts' earnings forecasts being above internal forecasts, short interest pressure is the result of short-selling investors' expectations of future share prices being lower than perhaps what the broader investment market expects. So, the firm's financial- and accounting-based fundamentals and current valuation notwithstanding, we argue that short interest pressure serves as an additional signal of poor future performance that increases situational competitive tension and the pressure to take corrective action.

Prior research suggests that poor past performance is associated with higher levels of competitive aggressiveness manifest in a higher number of competitive actions carried out (Ferrier, 2001; Ferrier *et al.*, 2002). Further, aggressive competitive action also helps the firm establish a positive reputation in the eyes of key external stakeholders (Basdeo *et al.*, 2006). We predict that the level of short interest pressure experienced by the firm in a given time period, as a signal of poor future performance, will be related to a high number of competitive actions carried out in the ensuing time period. Here, a high number of competitive actions serves as a signal to the investment community that the firm is committed to take corrective action by competing more aggressively in an effort to improve its performance *vis-à-vis* rivals and hence its future stock returns.

H1: Short interest pressure will be positively related to action repertoire intensity.

Action repertoire complexity

Another key principle of competitive interaction posits that firms should carry out a sufficiently diverse competitive strategy in an effort to dampen the ability or motivation of competitors to respond (D'Aveni, 1994; Ferrier, 2001; Miller and Chen, 1996a). In the context of dynamic competitive manoeuvring, a firm's rivals can easily interpret, predict and respond to a simple competitive action repertoire (consisting of only a few types of competitive actions) carried out by the focal firm. Conversely, a complex competitive action repertoire (consisting of a broad range of different types of competitive actions) may stun and confuse rivals because it is more difficult to decipher and unravel, thereby slowing the ability of rivals to respond (D'Aveni, 1994). Indeed, prior empirical research has found that competitive strategy consisting of actions of many different types is positively related to profitability, market share gain, stock returns and reputation (Basdeo *et al.*, 2006; Ferrier and Lee, 2002; Ferrier, Smith and Grimm, 1999; Miller and Chen, 1996a; Ndofor, Sirmon and He, 2011; Rindova, Ferrier and Wiltbank, 2010).

Prior research has found that poor performance experienced by the firm in a given period of time is associated with a more complex competitive action repertoire in the following time period (Miller and Chen, 1996a). In other words, firms carry out a broader, more diverse set of competitive actions in the hope that, by carrying out actions of many different types, future performance will improve. We expect that high levels of short interest pressure will be related to a more diverse mix of competitive actions carried out by the firm in the following time period. A noticeably broad repertoire of actions could signal to the investment community, and short sellers in particular, that the firm is engaged in a sufficiently aggressive and comprehensive competitive strategy to improve its competitive position and future performance.

H2:Short interest pressure will be positively related to action repertoire complexity.

Action repertoire non-conformity

Theory and empirical research in strategic management appear to have led to equivocal results and explanations about the relationship between strategic non-conformity and performance. On one hand, firms that carry out a competitive strategy different from that of rivals outperform firms that adhere to industry norms (D'Aveni, 1994; Desai, 2014; Gimeno and Woo, 1996; Ndofor, Sirmon and He, 2011; Norman, Artz and Martinez, 2007), especially in industries characterized by a high degree of uncertainty (Geletkanycz and Hambrick, 1997). This point of view is consistent with the Austrian perspective of strategy which argues that competitive advantage is derived from a unique alertness to new opportunities and doing things differently from what other firms are doing (Jacobsen, 1992; Jones, 2001; Kirzner, 1973). On the other hand, prior research found that, owing to a degradation of competitive legitimacy in the eyes of key stakeholders, strategic non-conformity is negatively associated with performance (Chen and Hambrick, 1995; Miller and Chen, 1996b). However, Deephouse (1999) found that 'balanced' competitive behaviour (expressed as an inverted U-shaped relationship) that was neither too different nor too similar to that of rivals exhibited the optimal mix of both uniqueness and legitimacy.

This prior research notwithstanding, we argue that poor past performance and market signals of poor future performance are important yet underexplored antecedents to strategic (non)conformity. Indeed, poor performance often motivates firms to take corrective action and try something different; managers learn to sustain the competitive actions they attribute to good outcomes and cease actions they believe are ineffective (Lant and Mezias, 1992; Levitt and March, 1988). In particular, we argue that short interest pressure is a form of attainment discrepancy that serves as a signal that a significant portion of the investment community questions the legitimacy of the firm's ability to meet investors' future expected performance. So, whereas strategic conformity has been shown in prior research to be positively related to the firm's legitimacy in the eyes of some key stakeholders, short interest pressure is associated with poor future performance and weakened legitimacy in the eyes of other stakeholders (Deephouse, 1996; Humphreys and Brown, 2002).

We argue that, through short interest pressure, managers are motivated to try something different in an effort to re-establish legitimacy. This logic is consistent with the core ideas from prospect theory, whereby poor performing firms are more likely to engage in risk-seeking, deviant competitive behaviours in an effort to catch up with rivals and improve poor performance

(Fiegenbaum, 1990; Kahneman and Tversky, 1979). Yet, if taken to an extreme, strategic non-conformity may exacerbate, rather than improve, future performance (Deephouse, 1999).

Thus, we predict that, when confronted with short interest pressure, firms will carry out a set of competitive actions that is increasingly different from that of rivals. In so doing, managers will seek to signal to the short-selling community that they are willing to break out of the mould and try something new in order to jump-start competitiveness and improve future performance.

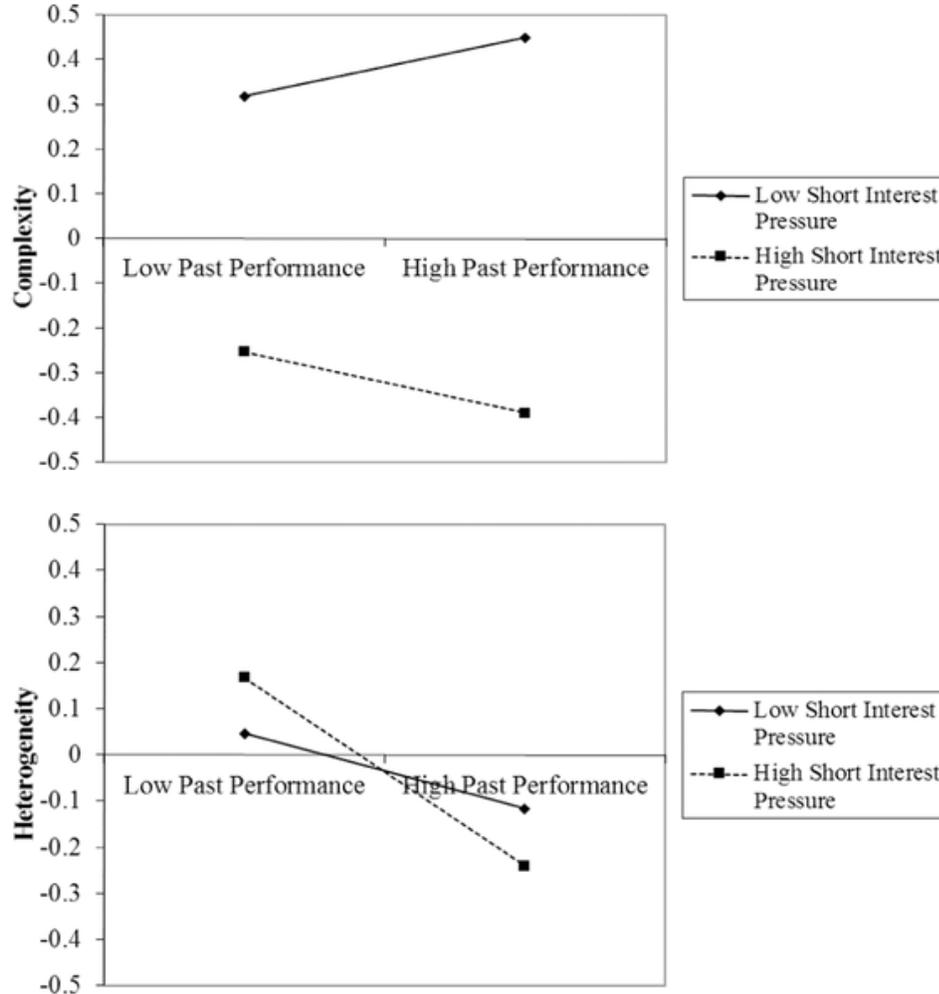*H3*: Short interest pressure will be positively related to action repertoire non- conformity.

Figure 1. Effects on past performance of the interaction of short interest pressure and competitive behaviour.

Data and methods

We drew a sample of firms that list pharmaceutical preparations as their primary business (SIC code 2834). The pharmaceutical industry is ideal to study the relationship between firm actions and stock market reactions because it has clearly identifiable boundaries which ensure that the competitive moves carried out among industry participants are directed at improving a company's position in the industry relative to other industry players. Also, the stock market valuations of many firms in this industry rely heavily on future cash flows, which ensure that firms widely publicize competitive moves aimed to enhance the future value-generating ability of the firm. Here, investors are, in part, likely to use judgements about competitive strategy — especially actions associated with risky new drug projects — as the basis for future value creation. Firms in this industry also use a wide range of competitive actions associated with improving their competitive position in existing products relative to rivals.

Our sample includes all publicly traded firms in the COMPUSTAT database that designated SIC code 2834 (pharmaceutical preparation industry) as their primary business each year 2009−2014. This sampling process yielded a final research sample consisting of a pooled, 6-year monthly cross-sectional database for the 104 publicly traded firms that compete within the pharmaceutical industry. The *N* for our analysis was 7488, or 12 months × 6 years × 104 firms. The time frame for our study is particularly salient due to short sellers being blamed for the downfall of Lehman Brothers and Bear Stearns at the onset of the financial crisis in 2008 (Saporito, 2008). As a result, managers were keen to avoid high levels of short interest in the following years.

Dependent variables

Using structured content analysis of published news reports and press releases, scholars in competitive dynamics have developed a systematic procedure to retrieve and code news about a firm's competitive moves into different action categories (Grimm, Lee and Smith, 2006; Smith, Ferrier and Ndofor, 2001). Consistent with this approach, we used Factiva as the news source and conducted a comprehensive search for all published news reports associated with each firm in our sample over the study time period. This yielded thousands of news reports that served as the basis for identifying potential competitive actions. We applied a set of keywords associated with six different types of competitive actions (pricing actions, marketing actions, new product actions, legal actions, capacity actions and signalling actions) examined in prior multi-industry studies to establish our initial set of competitive actions (Ferrier, 2001; Ferrier, Smith and Grimm, 1999). Then, following the example of prior research, we recalibrated the set of action categories to reflect some elements of competitive behaviour unique to the pharmaceutical industry.[1] More specifically, we added the following five action types to the initial set of actions: clinical trial announcements, licensing agreements, product improvements, legal actions and reputation-

enhancing actions. An example news headline associated with a clinical trials action, for example, is *Bristol-Myers, liposome begin phase II testing of ABLC drug*. An example news headline we categorized into a reputation-enhancing action is *Eli Lilly to donate drugs to battle tuberculosis crisis in Russia*. An example of a pricing action is *Abbott Laboratories has lowered prices on about 50 of its injectable anesthetics and intravenous products*.

This process yielded 5268 actions distributed across the following categories: capacity actions (26), clinical actions (475), product improvement actions (102), incentive actions (128), legal actions (419), licensing actions (821), marketing actions (804), signalling actions (426), pricing actions (95), new product actions (1183) and promotional actions (489). To check the reliability of our action category coding, academic experts in strategic management independently coded a representative sample ($N = 300$) of news headlines into one of the 11 action type categories. Using Perreault and Leigh (1989) index of reliability, this categorization approach yielded a reliability index of 0.89, which exceeds the convention of 0.70 (Denzin and Lincoln, 2000).

In contrast to prior research that examined annual competitive action repertoires, our analysis centres on the characteristics of firm's competitive action repertoire month by month. Prior research that explored the relationship between characteristics of the firm's action repertoire and performance used only annual performance measures, like profitability, and market share. By contrast, our dependent variable — short interest — is reported monthly, and will probably vary in accordance with investors' reactions to short-term attributes of competitive behaviour.[2]

Action repertoire intensity

The intensity of a firm's competitive action repertoire was calculated as the total number of competitive actions (irrespective of action type) carried out each month (Chen, Su and Tsai, 2007; Ferrier, Smith and Grimm, 1999; Young, Smith and Grimm, 1996).

Action repertoire complexity

To measure the extent to which a firm's competitive action repertoire consists of a broad range (as compared to a narrow range) of different action types, we used a Herfindahl-type index that accounts for the weighted diversity among all 11 action types (Ferrier, Smith and Grimm, 1999; Miller and Chen, 1996a). The complexity measure was computed as follows:

$$\text{action repertoire complexity} = 1 - \sum_{a}(N_a/NT_L)^2$$

where N_a/NT_L is the proportion of competitive actions in the ath action category carried out in a given month.

This index takes into account both the number of action categories and the degree of concentration of actions within each category. For example, a competitive action repertoire carried out in a given month that consisted mainly of marketing actions is considered a simple repertoire. By contrast, a firm's competitive repertoire that exhibits a relative representative balance among all action types is considered a complex repertoire. Simply put, firms with a low action complexity score favoured just a few action types. Conversely, a firm with a high complexity score carried a broad range of action types.

Action repertoire non-conformity

To capture the extent to which a firm's competitive action repertoire deviates from the industry norm, we used a measure consistent with prior research (Deephouse, 1996, 1999; Finkelstein and Hambrick, 1990; Geletkanycz and Hambrick, 1997). We first calculated the frequency of each type of action (i.e. pricing, marketing, product and so on) carried out by each firm in the industry in a given month. We then calculated the Euclidean distance between the focal firm's competitive action repertoires in a given month relative to the industry average.

$$\text{action repertoire non-conformity} = \sum_{a}\left(\frac{I_a}{I_T} - \frac{F_a}{F_T}\right)^2$$

where I_a is the industry average of the frequency of competitive actions in the ath category, I_T is the industry total competitive actions, F_a is the frequency of the firm's competitive actions in the ath category and F_T is the firm's total competitive actions.

High scores indicate that a firm carries out very different competitive action repertoires from its rivals (non-conformity), whereas low scores indicate that the firms carry out a mix of competitive actions very similar to other firms in the industry (conformity).

Independent variables

Short interest pressure

Short interest pressure is measured by the proportion of the number of shares sold short to the total shares outstanding. Short interest is reported on NASDAQ.com. For calculation simplicity, each month the shorted interest portfolios were created on the last day of the month based on the current short interest information as reported on the NASDAQ website. We used the lagged values ($t - 1$) of short interest pressure in our analysis.

Control variables

We included a range of relevant control variables in our analysis in an attempt to account for, at least in part, the possibility that both short interest pressure and the properties of the firm's competitive action repertoire are influenced by one or more omitted factors. Our choice of control variables was informed by both prior research in competitive dynamics research that explored a variety of antecedents of competitive behaviour and studies of earnings pressure that has recently generated significant interest in the strategic management literature (Zhang, 2005; Zhang and Gimeno, 2010).

Given our emphasis on short interest pressure as a signal of (lagged) poor future performance, it is essential to distinguish it from poor past performance. Equally important, *past performance* was used as control variable in nearly all studies in competitive dynamics that explored the antecedents of the attributes of the firm's competitive action repertoire.[3] Owing to its composite and comprehensive nature, we used Altman's Z score to measure past performance. It is a weighted index of accounting and market-based indicators of performance and liquidity (e.g. earnings before interest and tax/total assets, working capital/total assets, market value of equity to book value of liabilities) (Altman, 1968). Although it is commonly used as a predictor of financial distress and bankruptcy, it is also an important measure of strategic performance and financial capability (Chakravarthy, 1986; Ferrier *et al.*, 2002). Low Z scores signify financial distress and risk of bankruptcy (poor performance), while high Z scores denote financial strength (good performance). We used the lagged values ($t - 1$) of Altman's Z score in our analysis.

Other control variables commonly used in competitive dynamics research focused on predicting competitive behaviour include firm size and firm age (Andrevski, Brass and Ferrier, 2013; Gnyawali, He and Madhavan, 2006; Miller and Chen, 1994, 1996a; Young, Smith and Grimm, 1996). We used the log of the firm's total assets to measure firm size, and the number of years elapsed since firm founding as our measure of firm age.

Zhang and Gimeno's (2010) study of earnings pressure and strategy suggested that financial constraints could impact the ability to carry out competitive actions. Thus, we controlled for the firm's budgetary allocations across key functional domains. These were measured as R&D intensity, capital intensity and advertising intensity. In particular, R&D intensity was measured as the firm's R&D spending to total sales, capital intensity as the firm's net fixed assets to total book assets, and advertising intensity as the firm's advertising spending to total sales.

Diamond and Verrecchia (1987) argued that introducing option contracts on a stock could impact the level of short selling because option strategies allow traders to mimic short-selling strategies. To control for options arbitrage, we constructed a dummy variable to indicate whether the stock has traded options.

Because of the volatility of the market and the probability that market indices impact short selling, we included year dummies in our analysis.

Analysis

The sample means, standard deviations and correlations for all variables are reported in Table 1. Over time and across firms, our data reveal significant between- and within-firm variation in short interest pressure and the three attributes of the competitive action repertoires. To account for this, as well as any unobserved factors that influence our variables of interest, we ran a fixed-effects regression analysis that accounts for both firm and month fixed effects. Although our arguments and hypotheses do not imply direct causality, we nonetheless include the lagged values of short interest pressure (along with past performance) in our analyses to account for the possibility of reverse causality and endogeneity.

Table 1. Descriptive statistics and correlations

Control	Mean	Standard deviation	1	2	3	4	5	6	7	8	9	10	11
1.													

$^{*}p < 0.05$; $^{**}p < 0.01$.

Control	Mean	Standard deviation	1	2	3	4	5	6	7	8	9	10	11
1. Optioned stock	0.45	0.50											
2. Firm size	2.96	1.20	0.276**										
3. Firm age	32.56	15.72	0.199**	0.396**									
4. Past performance	5.96	27.92	0.126**	0.172**	−0.044**								
5. Organizational slack	0.23	0.19	0.013	0.040*	−0.019	−0.014							
6. Capital intensity	0.17	0.13	−0.070**	0.036**	0.348**	−0.127**	−0.005						
7. R&D intensity	2.72	17.89	−0.039**	−0.018	−0.095**	−0.027*	−0.230**	−0.022					
8. Advertising intensity	0.09	0.09	0.024	−0.199**	−0.067**	−0.125**	0.032*	−0.093**	−0.031*				
Independent													
9. Short interest pressure	0.09	0.01	−0.008	0.057**	0.026	−0.049**	−0.010	−0.024	0.083*	−0.054**			
Dependent													
10. Action repertoire intensity	0.10	0.86	−0.130**	0.028*	−0.002	−0.094**	−0.004	−0.074**	−0.014	0.076**	0.040**		
11. Action repertoire complexity	0.06	0.22	0.104**	0.166**	0.085**	0.014	0.013	0.047*	0.003	−0.060**	0.031*	0.024*	
12. Action repertoire non-conformity	00.07	00.78	−0.023*	0.014	0.005	−0.049**	0.008	−0.019	−0.007	0.010	0.030**	0.118**	0.046**

Results

Hypothesis 1 predicted that higher levels of short interest pressure will be positively related to action repertoire intensity. As reported in Table 2, this hypothesis is supported ($b = 0.001$; $p < 0.01$). This suggests that when faced with short interest pressure the firm carries out a high number of competitive actions in the ensuing time period.

Table 2. Fixed-effects regression of short interest pressure on action repertoire attributes 2009−2014

	Action repertoire intensity	Action repertoire complexity	Action repertoire non-conformity
1. $^*p < 0.05; ^{**}p < 0.01; ^{***}p < 0.001.$			
2. †Results for year dummies omitted.			
Optioned stock	0.001	−0.001	−0.001
Firm size	0.010***	−0.001*	0.003*
Firm age	−0.001*	−0.001	−0.023
Past performance	0.001	0.001*	−0.016**
Organizational slack	0.008	0.001	0.004
Capital intensity	0.040*	−0.004**	0.004**
R&D intensity	0.007*	0.001*	0.001
Advertising intensity	0.006	−0.003	−0.003
Short interest pressure	0.001**	0.036	0.010**
−2 log likelihood	799.4	3657.7	3121.4
Model significance	$p < 0.001$	$p < 0.001$	$p < 0.001$

Hypothesis 2 predicted that short interest pressure will be positively related to the complexity of a firm's action repertoire. This hypothesis is not supported. Apparently, short interest pressure has little effect on the firm's choice to carry out a broad range (or narrow set) of competitive actions.

Hypothesis 3 is also supported ($b = 0.010$; $p < 0.01$). Here, we predicted that higher levels of short interest are positively related to action repertoire non-conformity. This suggests that, when faced with a signal of future poor performance, firms are likely to carry out a competitive action repertoire that is dissimilar from that of rivals.

Discussion and conclusions

Our study's simple aim was to introduce short interest pressure as a particular form of capital market pressure and explore how it predicts competitive behaviour in ensuing time periods. Holding past performance constant, we found that higher levels of short interest pressure were associated with both a higher number of competitive actions being carried out by the focal firm and a competitive action repertoire that deviated from the industry norm. We reason that short interest pressure serves as a signal that foreshadows poor future stock returns, thereby motivating managers to take corrective action. Short interest pressure is similar in effect to other forms of competitive pressure that ultimately give rise to increased competitive aggressiveness. Indeed, prior research has found that other forms of 'pressure' experienced by managers that

stem from topics such as identity domain commonality (Livengood and Reger, 2010), highly salient rivalries (Kilduff, Elfenbein and Staw, 2010), perceived competitive tension (Chen, Su and Tsai, 2007) and performance distress (Ferrier *et al.*, 2002) are associated with observed competitive behaviour. However, the source of the signal is unique to a particular portion of the investment community, namely investors that sell the focal firm's stock short. Thus, our findings enhance our understanding of what motivates competitive action.

Whereas Zhang and Gimeno's (2010) study examined how capital market pressure influenced only one type of competitive action — the restriction of output — we found that it influences two core attributes of the firm's entire repertoire of competitive actions of different types. This further enriches and broadens our understanding about the role of capital market signals on managerial choice associated with a more comprehensive range of potential competitive actions carried out in response to capital market pressure. Future research could fruitfully explore how various forms of capital market pressure influence other conceptualizations of competitive action, like action—reaction response time (Chen and MacMillan, 1992; Hambrick, Cho and Chen, 1996), action—response order (Lee *et al.*, 2000) or the unfolding of the firm's sequence of competitive actions carried out over time (Ferrier, 2001; Rindova, Ferrier and Wiltbank, 2010).

We also introduce short interest pressure to the strategic management lexicon of salient constructs and their corresponding measures that are associated with firm performance. Like earnings pressure or performance distress, short interest pressure serves as an interpretable financial signal that we believe to be salient to managers and stimulates managerial response. Using a qualitative approach or a laboratory design, future research could explore how managers differentially notice and respond to various forms of capital market pressures. This would help establish the distinctive validity of short interest pressure as a useful variable in future research. Further, whereas we measured short interest pressure using stock market data, future research could adopt the approach used by Chen, Su and Tsai (2007) to capture the subjective managerial interpretations and feelings of pressure associated with various levels of short interest and other cognitively linked forms of pressure or tension.

We tested the relationship between short interest pressure and competitive action in the pharmaceutical industry that, in terms of participating firms' competitive strategies, may overemphasize competitive actions related to the development and launch of new products. Although rival pharmaceutical companies carry out other types of competitive actions designed to steal market share from rivals, like new advertising campaigns, price discounts and new tactics used by sales representatives, future research could explore how capital market pressure

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influences competitive behaviour in hypercompetitive industries, nascent markets and those that are less technology driven.

Our study may also yield new insights for managers. As we noted above, a high level short interest in a firm's outstanding shares exerts downward pressure on its future stock price. To the extent that they strive to avoid short interest, managers would do well to credibly signal to would-be short investors, and the broader investment community, that the firm's competitive strategy is sufficiently aggressive, novel and surprising, complex, and tuned to meet the competitive challenges posed by rivals (D'Aveni, 1994).

Post hoc and exploratory analysis

In an effort to tease out a more nuanced relationship between short interest pressure and competitive action, we engaged in a series of *post hoc* and exploratory analyses. Our results suggest a strong relationship between short interest pressure and two attributes of the firm's competitive action repertoire (intensity and non-conformity) in the recent 2009−2014 period of time. During this time frame, the NASDAQ index grew sharply from under 1400 to over 4000. So, our results are representative of the relationship between short interest pressure and competitive behaviour in a strong upward market environment. To explore whether our findings were robust with respect to other market environments, we ran our direct-effects model on data drawn from the 1998−2004 time period. Here, the NASDAQ grew from about 1600 in early 1998, peaked at about 4700 in year 2000, then declined to a period low of about 1300 in year 2002 before rebounding to about 2000 at the period's end. As reported in Table 3, we found that the relationship between lagged short interest pressure and competitive action repertoire non-conformity was significant ($b = 0.012$; $p < 0.05$). However, while action repertoire intensity fell out of statistical significance in the earlier time period, we found a new significant relationship between short interest pressure and action repertoire complexity ($b = 0.34$; $p < 0.01$). Together with our core findings, these *post hoc* results generally suggest that short interest pressure influences competitive behaviour across all market conditions. However, in an oscillating market environment the level of short interest tends to be related to competitive action breadth and differences as opposed to the sheer number of actions carried out, thereby suggesting a quality-over-quantity sort of relationship.

Table 3. Fixed-effects regression of short interest pressure on action repertoire attributes 1998−2004

	Action repertoire intensity	Action repertoire complexity	Action repertoire non-conformity
Optioned stock	0.001	−0.012*	−0.006
Firm size	0.010	−0.001	0.003*
Firm age	−0.002	−0.001	−0.053*
Past performance	−0.001	0.001	−0.029**
Organizational slack	0.006	0.001	0.002
Capital intensity	0.020*	−0.003*	0.003*
R&D intensity	0.002*	0.001*	0.001
Advertising intensity	0.006	−0.001	−0.002
Short interest pressure	−0.001	0.034**	0.012*
−2 log likelihood	723.3	3712.7	2915.8
Model significance	$p < 0.001$	$p < 0.001$	$p < 0.001$

1. $^*p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.
2. †Results for year dummies omitted.

Acknowledging the non-linear relationships between, for example, action complexity and performance (Ferrier, 2001) and action non-conformity and performance (Deephouse, 1999), we also tested for the possibility of a non-linear relationship between short interest pressure and each of the three competitive action repertoire attributes included in our study. In each model, the regression coefficient corresponding to the squared term for short interest pressure was not significant. This supports the idea that the general relationship between short interest pressure and competitive action is linear.

We also explored whether the relationship between short interest pressure and competitive action was attenuated by varying levels of past performance. To accomplish this, we included an interaction term (short interest pressure × past performance) using centred variables in an alternative set of regression models predicting action repertoire intensity, complexity and non-conformity.

Although the coefficient for this interaction term reported in Table 4 was not significant in the action repertoire intensity model, we did find support for the possibility that, for firms that had experienced high levels of past performance, the effect of short interest pressure on action repertoire complexity and non-conformity was reduced relative to those with low levels of past performance. For poor performing firms, the effect of short interest pressure appears to have amplified observed levels of action repertoire complexity and non-conformity. In other words, high performing firms appear to discount capital market signals of poor future performance

relative to those with poorer performance, who carry out competitive action repertoires in subsequent time periods that are more complex and differ more from the industry norm than their higher performing brethren. Yet, as noted above, extreme levels of short interest pressure in concert with poor past performance could motivate higher levels of action repertoire non-conformity which are likely to give rise to a deterioration of future firm performance (Deephouse, 1999).

Table 4. Fixed-effects regression of short interest pressure × performance on action repertoire attributes

1. SIP, short interest pressure.
2. $^*p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.
3. †Results for year dummies omitted.

	Action repertoire intensity	Action repertoire complexity	Action repertoire non-conformity
Optioned stock	−0.274***	0.010**	−0.002*
Firm size	0.027***	0.020**	0.008*
Firm age	0.001*	0.020***	0.001
Past performance	−0.001**	−0.001*	−0.001*
Organizational slack	−0.011	0.020	0.019
Capital intensity	−0.388***	−0.080***	−0.041
R&D intensity	−0.001	0.001	−0.001
Advertising intensity	−0.105	−0.156***	−0.001
Short interest pressure	0.975	−0.352	−0.147
SIP × past performance	0.073	−0.037**	−0.061*
−2 log likelihood (base)	799.4	3657.7	3121.4
−2 log likelihood	687.2	4039.1	2201.3

Limitations and future directions

Despite our inclusion of lagged short interest pressure in our models and numerous controls, our study cannot completely rule out reverse causality, namely that the properties of the firm's competitive action repertoire — few actions, simple and conforming repertoires — may give rise to higher levels of short interest pressure in ensuing time periods. So, we urge future research to extend work on the relationship between competitive behaviour and firm performance to also include specific aspects of stock market reactions as an indicator of future firm performance. Similarly, we cannot rule out the potential for overestimation due to endogeneity. We hope that our inclusion of a composite measure of past performance (Altman's *Z*), which contains both accounting and market-based elements among our many control variables, helps to minimize the potential for endogeneity.

Our study is agnostic as to the reasons that investors decide to sell a particular firm's stock short. On one hand, we reason that it is probably the result of the investor's analysis and conjectures associated with the future value of the firm's past and current competitive behaviour. On the other hand, however, the level of short interest pressure experienced by the firm could also be the result of investors' estimation of whether the stock is overvalued or not. Future research could tease apart instances — and the resultant effects — of short interest pressure that comes about for fundamentally different reasons.

Further, it is widely known that the investment community is composed of different types of investors. For example, some buy and hold for the long term, whereas others seek to cash in on very short term gains. Each group seeks, analyses and reacts to different market signals and information. Recent research has explored whether short sellers have long versus short time horizons. For example, Engelberg, Reed and Ringgenberg (2012) contend that short sellers have short investment horizons that do not extend beyond two calendar weeks. Yet, other scholars argue that short sellers have much longer time horizons (Akbas *et al.*, 2015; Desai, Krishnamurthy and Venkataraman, 2006; Karpoff and Lou, 2010). Owing to our focus on aggregate, firm and time period specific short interest, our study cannot determine whether short sellers acted upon short versus longer term information. Future research could explore whether short sellers attend to information that signals financial or strategic trouble for the firm far in advance of the decision to short the firm's stock or information that is more temporally proximate to the short sell decision.

In addition, our theory and results rest on the assumption that managers make strategic and tactical decisions based on a combination of past information about strategy, competitive rivalry, and performance and conjectures (their own or those signalled by short sellers) about future performance. That is, the decisions are endogenous to their expected performance outcomes (Hamilton and Nickerson, 2003). In conducting our analyses, we have taken strides to account for the potential for endogeneity. However, an enduring limitation of our study is that some endogeneity probably persists. There may be omitted or unobserved factors that are responsible for the relationships between short interest pressure and competitive action that we reported above. Future research could first validate our findings — perhaps in different research settings or different levels of analysis (like action—response speed) — and extend the scope of the line of inquiry related to the effect of capital market pressure.

In sum, we hope that our study stimulates scholarly interest not only among competitive dynamics scholars who seek to explore new antecedents of competitive behaviour, but also among scholars who prospect for the meaningful relationships between phenomena along the interstices of strategic management, behavioural finance and other areas of inquiry.

1. For example, Gnywali, He and Madhavan (2006) developed categories of actions in the global steel industry. Likewise, Yu and Cannella (2007) developed categories of actions in the global auto industry.
2. Indeed, the focus on short-term results by investors is so prevalent that a 2005 survey of more than 400 financial executives found that 80% of the respondents said they would decrease discretionary spending on such areas as research and development, advertising, maintenance and hiring to meet short-term earnings targets (Graham, Harvey and Rajgopal, 2005). Thus, because both investors and managers are focused on the short term, our departure from the annual level of analysis is appropriate to our research question.
3. See Andrevski, Brass and Ferrier, 2013; Andrevski *et al.*, 2014; Audia, Locke and Smith, 2000; Chen, Su and Tsai, 2007; Chi, Ravichandran and Andrevski, 2010; Derfus *et al.*, 2008; Ferrier *et al.*, 2002; Gnyawali, He and Madhavan, 2006; Miller and Chen, 1994, 1996a, 1996b; Young, Smith and Grimm, 1996.

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