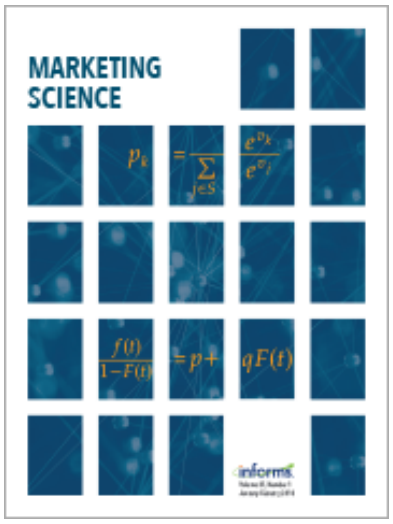

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Firm Innovation and the Ratchet Effect Among Consumer Packaged Goods Firms

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We consider how public firms influence their stock market valuations by timing the introduction of innovative new products. Our focus is on *innovation ratchet strategy*—firms timing the introduction of innovations in order to demonstrate an improvement in the number of introductions over time. We document that public firms use an innovation ratchet strategy more often than do private firms and that the stock market rewards public firms for doing so. These rewards from the stock market, however, come at the expense of performance in product markets. Specifically, because firms using an innovation ratchet strategy delay some product introductions, they have significantly lower sales growth in the year they ratchet. Finally, we identify firm and market characteristics that influence the likelihood that a public firm will engage in an innovation ratchet strategy.

Key words: innovation; timing; stock market; ratchet; revenue
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1. Introduction

A long tradition in accounting research shows that firms manage earnings to influence stock market valuation (e.g., Matsumoto 2002). This work has focused primarily on managing accruals, or when revenues and expenses are recognized. More recent research shows that managers are also willing to manipulate real activities, such as discretionary spending, to manage earnings (Roychowdhury 2006). Graham et al. (2005, p. 33), for example, asked chief financial officers to respond to the question, "Near the end of the quarter, it looks like your company might come in below the desired earnings target. Within what is permitted by GAAP [Generally Accepted Accounting Principles], which of the following choices might your company make?" Eighty percent agreed that their firms would "decrease discretionary spending (e.g., research and development (R&D), advertising)," 55% agreed that their firms would "delay starting a new project even if this entails a small sacrifice in value," and 40% agreed that their firms would "provide incentives for customers to buy more product this quarter."

Research in marketing has also examined the management of real activities. Mizik and Jacobson (2007), for example, identified a set of myopic firms that inflate short-term earnings by cutting marketing spending at a time of seasoned equity offerings (see also Mizik 2010). Chapman and Steenburgh (2010) found that firms increase marketing promotions for nonperishable products (but not for perishables) at the end of the fiscal period. They suggested that the intent of this strategy is to promote forward buying of nonperishables to increase revenues attributable to the current fiscal period. Finally, research shows that managers change the firm's product portfolio (Markovitch et al. 2005) and modify R&D and marketing budgets (Chakravarty and Grewal 2011) in response to stock market returns.

In this paper, we consider another strategy managers use in response to stock market incentives. We begin with the well-accepted idea from the efficient market hypothesis that for a firm to achieve positive abnormal returns, it must surprise the market by exceeding the market's expectations (e.g., Fama 1976). Therefore, firm actions have information content to

the stock market only if these actions are not anticipated. One way for the firm to do this is to exceed its prior performance.

This type of incentive structure is similar to the well-known idea of a ratchet (Berliner 1956). Milgrom and Roberts (1992, p. 233) described a ratchet as a "tendency for performance standards to increase after a period of good performance." Likewise, Weitzman (1980, p. 303) stated that a ratchet occurs any time that "current performance acts like a notched gear wheel in fixing the point of departure for next period's target." Given these incentives, we argue that managers will be tempted to engage in a ratcheting strategy and withhold performance in one period so that they are more likely to exceed it in the next period.

We investigate ratcheting in the context of a firm's innovation strategy—in particular, the timing of innovative product introductions. Specifically, driven by a desire to (positively) surprise the market, firms have an incentive not to introduce all innovations when they are available for launch. Instead, managers have an incentive to introduce innovations in a pattern that demonstrates improvement (i.e., acceleration) over time. For example, a firm may introduce one product in period 1 and two products in period 2, instead of introducing all three innovations in period 1 or spreading them across three periods.

We argue that some firms will be able to accelerate the introduction of their innovations over time and surprise the market because they have improved capabilities. However, firms without such capabilities will try to mimic this accelerating pattern by using a ratchet strategy. We rely on economic theory to argue that these firms do so in order to signal to the stock market that they too have improved capabilities (e.g., Bebchuk and Stole 1993).

We hypothesize and find that, relative to private firms, public firms are more likely to ratchet the introduction of their innovations. We document the stock market and the revenue implications of this strategy by showing that firms using an innovation ratchet strategy improve their stock price performance in capital markets but experience lower revenue growth in product markets. We then investigate a set of firm and market factors that influence the likelihood that managers will choose to engage in an innovation ratchet strategy. We test our ideas in a multiyear study of innovative new product introductions in the consumer packaged goods industry.

2. The Innovation Ratchet, Firm Strategy, and Firm Value

2.1. Why Firms Use an Innovation Ratchet Strategy

Ratcheting is a robust phenomenon observed across a variety of disciplines. Its operation is best understood within the framework of economics research on the dynamics of incentives in principal–agent relationships in private information settings (Laffont and Tirole 1988, Weitzman 1980). Berliner (1956) first used the term "ratchet principle" to explain why Soviet firms do not develop innovations as fast as they are capable of doing. He suggested that because firms anticipate central planners will ratchet up standards to recent performance, firms reduce output to avoid extra effort.

In contrast to a planned economies setting, the stock market creates incentives for managers of public firms to consistently exceed their prior performance and positively surprise the stock market. Some firms will naturally exhibit this accelerating pattern of introducing innovations to the market because they have improved capabilities (knowledge and skill) in developing and introducing innovations. These capabilities involve the ability to sense market trends, identify customer needs, develop creative and useful new products with significant customer benefits, prototype and manufacture new products, and bring those products to market through existing or new channels. Given this, an accelerating introduction pattern becomes a signal of unobservable firm capabilities in managing innovations.

However, the challenge is that firm capabilities are not directly observable by the stock market. Capabilities constitute private information that cannot be credibly revealed. Given this, some managers will try to improve their firm valuations by mimicking (through intentional delays of completed innovations) the accelerating innovation introduction patterns of firms with improved capabilities. We refer to a strategy in which a firm artificially times the introduction of innovations to demonstrate improvement over time as an *innovation ratchet strategy*.[1]

Incentives to demonstrate an accelerating pattern in hidden information settings (the agent has information unavailable to the principal) and in hidden action settings (the agent can take actions unobservable by the principal) can induce firms to use an innovation ratchet strategy. Consistent with this idea, Bebchuk and Stole (1993), Bizjak et al. (1993), and Trueman (1986) offered analytical models in which observable firm actions are used by the stock market to infer unobservable good or bad firm "types." Specifically, because the market cannot observe the state of a firm's capabilities (its quality type), the stock market uses innovation timing patterns to infer it. Managers realize this fact and may manipulate their firms' observable activities (i.e., timing of innovation introductions) to signal that they have improved capabilities. When the expected benefits exceed the costs of

[1] We use the terms "innovation ratchet strategy" and "ratchet strategy" interchangeably in the paper.

manipulation, the bad-type firms have an incentive to mimic the good-type firms, which results in a break of the separating equilibrium.

The operation of such signaling in a stock market setting is also consistent with models of information neglect. Brandenburger and Polak (1996) demonstrated that when managers care about their stock prices, some will choose to ignore their (better) private information to make optimal firm decisions and instead use strategies rewarded by the stock market. In our paper, this means managers do not introduce innovations when it is optimal, given firm or market conditions. Instead, managers use an innovation ratchet strategy and artificially manipulate the timing of innovation introductions to demonstrate an accelerating pattern over time.

Not all firms are equally likely to engage in an innovation ratchet strategy. For example, managers in private firms do not face the pressures from the stock market and do not engage in these signaling games. They introduce products as soon as they are available for launch, all else being equal (i.e., given seasonality and demand conditions). We will therefore begin by examining the patterns of innovation introductions exhibited by public versus private firms. Among public firms, some firms may be unable to enact an innovation ratchet strategy because they face fierce competition and view delays in product markets as too costly. Still other firms face marketing budget constraints that force them to roll out their innovations at a steady rate to avoid overloading their operating budgets.

2.2. Why an Innovation Ratchet Strategy Improves Firm Value

Past research offers evidence that investors interpret marketing actions (see Srinivasan and Hanssens 2009 for a review) and that innovation has a significant positive effect on firm value (Pauwels et al. 2004, Sood and Tellis 2009, Sorescu et al. 2003, Sorescu and Spanjol 2008). Table 1 presents an overview of past research that examines how innovation strategies affect firm value. As shown there, this literature has not examined how the timing of innovation strategies affects firm value. We add to this literature by investigating whether one innovation timing strategy—an innovation ratchet strategy—impacts firm value.

We argue that because firm capabilities are not directly observable by the stock market, the stock market uses an accelerating introduction pattern as a signal of unobservable firm capabilities. Why does the stock market reward firms with stronger new product capabilities? We offer two related reasons. First, the stock market views a firm that has more frequently exceeded its prior innovation levels as more likely to innovate in the future. Second, the stock market views a firm that has more frequently exceeded its prior innovation levels as more likely to introduce successful follow-up non-innovative products in the future. Specifically, given that the firm has invested in innovation and shown improvement over time, the

Table 1 Product Innovation and Stock Market Performance

Innovation feature	Findings from literature
Innovation level	—Introduction of a new product improves firm abnormal returns (Chaney et al. 1991). —The short-term firm value impact of new product introductions is very low (0.02) compared to the long-term firm value impact (1.14) (Pauwels et al. 2004).
Innovation type	—The firm value effects of innovation depend on the innovation level. The most innovative products have the greatest long-term impact on firm value (Pauwels et al. 2004). —Breakthrough innovations increase economic stock market performance, but incremental innovations do not (Sorescu and Spanjol 2008). —Pioneering innovations have an impact on stock returns that is seven times greater than new products with minor updates (Srinivasan et al. 2009). —High-quality innovations have a positive effect on stock market performance (Srinivasan et al. 2009).
Innovation preannouncement	—Firms receive stock market benefits from preannouncing new products but only when firms offer specific information about the preannounced product (Sorescu et al. 2007).
Innovation process	—Investors gradually adjust their reactions as emerging consumer acceptance information helps them update their expectations (Pauwels et al. 2004). —The firm accrues stock market benefits across the entire innovation project. Some stages offer systematically higher returns than others; returns to development are the highest and returns to new product launch are the lowest (Sood and Tellis 2009). —Firms continue to receive stock market benefits after preannouncement if firms continue to update the market on the progress of their new products (Sorescu et al. 2007).
Innovation spending	—R&D spending positively affects firm value (Erickson and Jacobson 1992). —R&D spending is not properly valued by the stock market (Eberhart et al. 2004). —R&D spending cuts can be used to temporarily inflate earnings and firm valuation. The value of firms undertaking R&D cuts with the intent to inflate current earnings significantly declines in the subsequent five years (Mizik 2010).
Innovation timing	—No literature found.

stock market expects the firm to leverage these investments and related knowledge to introduce a range of follow-up non-innovations in the future. This argument is especially applicable for consumer packaged goods companies because customers are often willing to purchase a range of new products related to the innovation (e.g., different flavors or complementary products).

Given this powerful signal, other firms not endowed with the capabilities to ratchet naturally may attempt to mimic these patterns through intentional delays of innovations that are ready for introduction. However, we argue that the stock market is not able to distinguish such artificial delays from natural introduction patterns. The key reason for this inability is that the stock market does not have a clear idea of how many innovations a firm *can* introduce in a given time period. This occurs for several reasons. First, R&D spending does not have a deterministic impact on the timing of innovative new product introductions.[2] Many firms invest in the development of innovations only to fail (e.g., Hauser et al. 2006). Second (and related), early signals of innovations in a firm's pipeline are not present in all industries. For example, in the consumer packaged goods industry we study, most innovations are not patented and therefore cannot be researched by analysts. Third, firms can introduce available innovations at whatever rate they choose given that product strategy is not governed by GAAP or other accounting standards. All these reasons make it difficult for the stock market to form accurate expectations about the timing of innovative introductions.

If the stock market recognizes post-factum that a firm strategically timed its introductions for ratcheting purposes, we would expect to observe a negative future response from the stock market. We do not observe such a pattern in our data in the subsequent year. Instead, as we will show, we find that the market rewards firms that demonstrate an accelerating introduction pattern.

3. Predictions

3.1. Does Stock Market Participation Increase Firm Use of an Innovation Ratchet Strategy?

If the stock market creates the incentive for public firms to ratchet, it is imperative that we begin by demonstrating that, compared to private firms, public firms have a greater propensity to use an innovation ratchet strategy. Private firms will, on the other hand, time the introduction of innovations without regard to stock market incentives. This might mean introducing innovations to meet seasonality demands, to respond to competitor moves or consumer demand, or to meet budgetary constraints. As such, we predict the following.

Hypothesis 1 (H1). *Public firms will be more likely to ratchet the introduction of innovations compared to private firms.*

3.2. Does the Stock Market Reward Firm Use of an Innovation Ratchet Strategy?

An innovation ratchet strategy is one of several innovation timing patterns firms can select. For example, the firm can also introduce all of its innovations at once to maximize its revenues in any period that it determines is best for the firm. Alternatively, the firm can introduce innovations consistently and meet, but not exceed, its prior introduction level. This approach is similar to strategies that "smooth" earnings (Lambert 1984). We have suggested that the primary reason managers would engage in an innovation ratchet strategy is to reap stock market rewards. Given the ratcheting incentive built into the stock market (as described earlier) and the capability signal inherent in accelerating innovation levels, we expect that the stock market will reward firms exhibiting this pattern. This leads to our next hypothesis.

Hypothesis 2 (H2). *Firms using an innovation ratchet strategy will exhibit higher abnormal returns compared to firms using other innovation timing strategies.*

3.3. Do Firms Using an Innovation Ratchet Strategy Sacrifice Revenue?

An innovation ratchet strategy involves a firm artificially delaying the introductions of its innovations. These delays, however, sacrifice revenues in product markets. That is, in an attempt to signal the presence of improved firm capabilities to capital markets, the firm intentionally delays the launch of innovations and forgoes revenue in product markets. We hypothesize as follows.

Hypothesis 3 (H3). *Firms using an innovation ratchet strategy will exhibit lower revenue growth compared to firms using other innovation timing strategies.*

3.4. What Factors Increase Firm Use of an Innovation Ratchet Strategy?

Research has documented that several firm-specific factors tend to increase the likelihood that a firm will engage in real activities manipulation (e.g., Chakravarty and Grewal 2011, Chapman and

[2] This type of uncertainty is indicated by the following quote from 3M (2001, p. 30): "The company's growth objectives are largely dependent on the timing and market acceptance of its new product offerings, including its ability to renew its pipeline of new products and to bring those products to market. This ability may be adversely affected by difficulties or delays in product development, such as the inability to: identify viable new products; successfully complete clinical trials and obtain regulatory approvals; obtain adequate intellectual property protection; or gain market acceptance of new products."

Steenburgh 2010, Roychowdhury 2006). Likewise, a long line of marketing strategy research examines the impact of different market conditions on firm choices (e.g., Vorhies and Morgan 2005). Following this tradition, we examine firm and market factors that might increase the likelihood of a firm utilizing an innovation ratchet strategy.

Our first antecedent is the amount of attention the firm receives from the stock market. Brokerage houses regularly assign analysts to study firm behavior and issue buy and sell recommendations. However, not all firms receive the same amount of attention. *Firm stock market scrutiny* refers to the amount of attention a firm receives from stock market analysts. Consistent with this, managers are likely to experience greater pressure to satisfy and exceed expectations when more analysts follow their firm. At lower levels of scrutiny, the firm may reason that its strategies are less likely to be noticed, which lowers incentives to ratchet. We predict the following.

Hypothesis 4 (H4). *Public firms experiencing greater stock market scrutiny will be more likely to adopt an innovation ratchet strategy.*

Market concentration refers to the degree of competition in a product market. Higher levels of concentration mean less competitive rivalry. We argue that firms have a greater incentive to ratchet when market concentration is high. This is the case because firms in more concentrated markets (i.e., less competitive markets) have less risk that competitors will enter with new products. Therefore, although a ratcheting firm in a concentrated market does delay revenues in such markets, it does not stand to lose revenues at the level of a ratcheting firm in a more competitive market. Therefore, market concentration increases the incentive to ratchet. We hypothesize as follows.

Hypothesis 5 (H5). *Public firms operating in more concentrated* (*i.e., less competitive*) *industries will be more likely to adopt an innovation ratchet strategy.*

Using a similar logic, the potential income lost from a delay is mitigated when the firm introduces patented innovations, which are protected from imitation. We use the term *patent intensity level* to refer to the use of patents in a firm's innovation strategy. When the firm has a higher patent intensity level, revenue is less threatened because the patent restricts competitor entry of the same product. Competitors can enter with alternative formulations and designs; thus they can remain a threat, especially if they target a similar benefit. However, patent protection would reduce potential revenue losses to firms using an innovation ratchet strategy. As such, firms with greater patent protection may delay introductions because they still have a significant period to derive revenue until patent expiration. This leads to our final hypothesis.

Hypothesis 6 (H6). *Public firms with a higher patent intensity level will be more likely to adopt an innovation ratchet strategy.*

4. Method

4.1. Data Sources

We created a data set from secondary sources: (i) Datamonitor's Product Launch Analytics for information about products introduced into food, drug, and mass retailers; (ii) Compustat for sales revenue and profits; (iii) the Center for Research in Securities Prices (CRSP) for monthly stock returns; (iv) Kenneth French's data library (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html) for the Fama–French/Carhart risk factors and the risk-free return; (v) Delphion for product patent information; (vi) the Institutional Brokers' Estimate System (I/B/E/S) database for the number of analysts following the firm; and (vii) IRI's InfoScan and *Marketing Factbook* for product-level revenues.

4.2. Samples

We used two different samples in our tests. The *private firm* sample is the set of privately owned firms and the *public firm sample* is the set of publicly traded firms in our observation period. H1 examines whether the stock market provides firms an incentive to ratchet. We tested this hypothesis by examining the prevalence of an innovation ratchet strategy and the timing of innovation introductions in the private versus public samples. Having demonstrated that public firms use a ratchet strategy more than private firms, and given that stock market and sales data are only available for public firms, the rest of our predictions are tested among public firms. H2 examines whether public firms that use an innovation ratchet strategy experience higher stock market returns compared to firms using other strategies. H3 tests whether public firms using an innovation ratchet strategy experience revenue losses compared to firms using other strategies. H4–H6 examine the antecedents of an innovation ratchet strategy among public firms.

The public and private samples begin with the population of 25,687 firms listed as "parents" in the 2000–2006 IRI InfoScan data. This is a comprehensive list of all firms and their brands sold in U.S. food, drug, and mass retailers. To generate our *public firm sample*, we observed that 9,582 of the 25,687 firms (37%) participated in more than one product category. We reasoned that if a firm competes in only one category, there is a low likelihood that it is publicly held. This decision was supported by a random draw ($n = 50$) of the 16,105 single-category firms. None were publicly held. We looked up each of the 9,582 multicategory firms in Hoover's, Goliath,

ReferenceUSA, and Manta and found that 385 (4%) were publicly held. We eliminated 67 of these 385 firms not listed in Compustat or CRSP, leaving 318 public firms. Finally, we cross-checked this list with Product Launch Analytics and found that 262 firms had introduced at least one new product during the 1995–2007 observation period.

For our *private firm sample*, we randomly selected firms from the remaining 9,197 multicategory private firms (9,582 − 385 public firms = 9,197 private firms) and checked whether any firm went public during the observation period. This process involved checking each firm-year to determine whether the firm's ownership status changed. We included the firm in our private sample if it remained private throughout the observation period. Following our procedure for the public sample, we checked Product Launch Analytics to ensure that the firm introduced at least one new product during the study period. We continued until we had a sample of 285 private firms. In this process of building the private and public firm samples, we uncovered a set of firms ($n = 211$) that experienced a change in ownership during the observation period. We retained these firms and sorted them into our private or public samples according to their ownership status in each year.

We took the following steps to determine the representativeness of our samples. For the public firm sample, given that we started with a population of public firms from IRI's InfoScan data, our confidence was high that our sample is representative of firms selling in U.S. food, drug, and mass merchandisers. However, we lost 56 firms when we went from those public firms listed in financial databases ($n = 318$) to those that also appeared in Product Launch Analytics ($n = 262$). Therefore, as a precaution, we compared our final sample of 262 public firms to those public firms ($n = 56$) that did not make it into our final sample on number of employees, assets, market value, net income, and revenues. There are no differences between the two groups. Further, we also compared the number of new products and innovations introduced by both sets of firms and found no difference between the two groups. For the private firm sample, given that this sample is randomly drawn from the population of private firms, we are confident that it is representative.

4.3. Independent Variable Measures

4.3.1. Firm Innovative Product Introductions. Product Launch Analytics tracks and records all product introductions worldwide (see Sorescu and Spanjol 2008 for an overview of the benefits of this data set). Field personnel regularly visit local markets to observe and document new product introductions. The company collects extensive data about each new product, including when it was introduced, whether it is an innovation, and, if so, what type of innovation it is. Product Launch Analytics codes whether or not the product is a packaging innovation, merchandising innovation, formulation innovation, positioning innovation, market innovation, and/or technological innovation. Products can be classified into multiple categories. When a new product has been coded as fitting into any of the innovation categories, we count it as an "innovative" new product introduction; otherwise, we count it as a "non-innovative" introduction.[3]

Across our samples, we observed 30,223 product introductions during the 13-year period. Of these, 6.97% ($n = 2,107$) were innovations. Firms introduce, on average, 0.61 innovations (SD = 1.31) and 7.45 non-innovations (SD = 20.45) per year. However, if a firm did not introduce an innovation in a year, the firm-year observation was dropped from the study. This is important because a firm cannot strategically time the introduction of innovations if it does not introduce innovations. As expected, the number of introductions is higher in this final sample, with firms introducing an average of 2.16 innovations (SD = 1.92) and 23.05 non-innovations (SD = 36.51). The final firm-year observations in our samples are 2,458 for public firms and 698 for private firms.

4.3.2. Firm and Market Antecedents. *Firm stock market scrutiny* is measured using the average number of analysts covering firm i during year t drawn from I/B/E/S. As this number increases, the level of attention the firm receives from the stock market increases. We used the average because the number of analysts changes over the course of the year.

Industry market concentration is measured as the market share of the four largest firms (C4) in a firm's dominant industry in year t. C4 is a commonly used measure of industry concentration and is highly correlated with the Herfindahl index (Tirole 1988). Obtained from the economic census, it is based on the first two digits of each firm's primary North American Industry Classification System code in Compustat.

Firm patent intensity is measured as the ratio of a firm's patented innovations introduced relative to the total number of innovations introduced by that firm. We use the ratio to ensure that our measure is not confounded with the total number of innovations introduced by the firm. To determine whether an innovation is patented, independent coders retrieved patent information from Delphion for each public

[3] Sorescu and Spanjol (2008) classified products that do not fit into any of the innovation categories as "incremental" innovations as opposed to "breakthrough." We focus only on breakthrough innovations as Sorescu and Spanjol showed that incremental innovations in this industry do not generate abnormal stock returns.

firm for five years before the introduction of each innovation. Each patent was reviewed to determine whether it applied to a given innovation. If so, the innovation was counted as being patented. The number of patented innovations was aggregated across the year to generate a firm patent level for that year. This was divided by the number of total innovations introduced to produce our patent intensity measure.

4.4. Characterizing the Firm Innovation Timing Strategy

We selected the calendar year as our unit of analysis. Hence, we examine firm behavior over the four quarters in a given year for evidence that the firm is using an innovation ratchet strategy. We used the following approach to classify firms.

We began by subtracting the number of innovations introduced by firm i in quarter k in year t from the number of innovations introduced by firm i in quarter $k-1$. Specifically, we examined four sets of differences within the year ($Innovations_{t,q1} - Innovations_{t-1,q4}$, $Innovations_{t,q2} - Innovations_{t,q1}$, $Innovations_{t,q3} - Innovations_{t,q2}$, $Innovations_{t,q4} - Innovations_{t,q3}$). We used this differencing approach because our focus is not on the *number* of innovations introduced by a firm in a quarter, but rather on the *change in the number* of innovations introduced from the prior quarter. This appears to be an appropriate benchmark for our setting for several reasons. First, we offered several reasons why the stock market has difficulty forming expectations for the introduction of innovations (see §2). Second, Demirakos et al. (2004) found that analysts are more likely to use single-period valuation techniques than multiperiod valuation techniques in beverage companies, which are among the fast-moving consumer goods companies we study.[4]

Using the change in the number of innovations introduced, we counted how many times a firm exceeds its prior innovation level across the four quarters in a year. Our unit of analysis is therefore firm i in year t. We observed the following frequency of firms exceeding their prior innovation levels across all our samples: zero times (7.59% of firms), one time (72.97% of firms), two times (18.66% of firms), and three times (0.77% of firms). We characterize a firm's strategy as a *ratchet strategy* when it exceeds its prior introduction rates two or more times in a given year for two reasons. First, given the frequency of different ratcheting levels, we think a two-period requirement is a stronger indicator of a ratchet strategy than a single-period requirement, which the majority of firms achieve (78.06%), or the three-period requirement, which very few firms achieve (0.67%). Second, given that the calendar-time portfolio analysis used to assess stock market effects requires a discrete measure of a ratchet strategy, we adopt this discrete measure of a ratchet strategy for all our models to be consistent.

We contrast a ratchet strategy to three other strategies from theory or past empirical evidence. Specifically, we examined two strategies in which firms introduce all of their innovations at once, which is an important alternative strategy to ratcheting. An *early all-at-once strategy* occurs when firms only exceed their prior innovation rates one time and in either quarter 1 or quarter 2. In this strategy, firms seek income as early as possible in the year. A *late all-at-once strategy* occurs when firms only exceed their prior innovation rates one time and in either quarter 3 or quarter 4. These firms also do not spread out their innovations. Instead, following Axarloglou (2003), these firms might introduce their innovations to meet seasonality demands.[5] The third strategy, a *consistent strategy*, occurs when firms introduce their innovations in a consistent pattern throughout the year, presumably to smooth demand or costs or to meet expectations.[6]

Among the four innovation timing strategies, we observed the following frequency of firm-year observations across all our samples: 19.43% for a ratchet strategy, 29.24% for an early all-at-once strategy, 36.68% for a late all-at-once strategy, and 14.65% for a consistent strategy. In line with our classification, the average day of innovation introduction for the late all-at-once strategy is the latest in the year (average day = 321), followed by the ratchet strategy (average day = 202), consistent strategy (average day = 200), and the early all-at-once strategy (average day = 70).

Finally, consistent with our expectations, firms do not exhibit these patterns in perpetuity. Instead, firms use different strategies across years depending on firm and market factors (such as those we predict in H4–H6) and whether they have any innovations to introduce in the year. In fact, the most common switching pattern we observe is for the firm to go from one of the four timing strategies to not innovating at all. This occurs 55% of the time for firms using a ratchet strategy and 68% of the time across all strategies. However, considering those firms that

[4] The other two industries studied in Demirakos et al. (2004)—electronics and pharmaceutical companies—tend to use multiperiod techniques. We tested the robustness of our findings using alternative expectation models in §8, point 2.

[5] Axarloglou (2003) observed that nondurables companies, such as a food and kindred products (Standard Industrial Classification 20), tend to introduce the majority of their new products in September and October in anticipation of strong holiday sales.

[6] Although we focus on these three strategies in our main analysis, we compare a ratchet strategy to two other potential strategies in our robustness checks (see point 4 in §8).

innovate and can therefore switch from or retain the same strategy from year t to $t+1$, we observe that firms tend to retain the same strategy at the following rates: 16.98% for a ratchet strategy, 9.06% for an early all-at-once strategy, 9.66% for a late all-at-once strategy, and 7.95% for a consistent strategy.

4.5. Modeling and Estimation Approach

4.5.1. Does Stock Market Participation Increase Firm Use of an Innovation Ratchet Strategy? A key premise of our paper is that the stock market creates an incentive leading to an innovation ratchet strategy. As such, we should observe that public and private firms differ in their use of a ratchet strategy (H1) and in the introduction timing of their innovations more generally. We examined these ideas with two sets of tests.

First, we tested H1 by estimating the likelihood of firm i adopting a ratchet strategy in year t. Based on the group membership outlined in §4.4, we estimated the following panel probit model for firm i in year t:

$$\begin{aligned}\Pr(y_{it}=1 \mid \mathbf{x}_{it}, \boldsymbol{\beta}, \upsilon_i) &= \Phi(\beta_0+\beta_1 x_{1it}+\beta_2 x_{2it}+\beta_3 x_{3i}+\cdots \\ &\quad +\beta_{11}x_{11i}+\beta_{12}x_{12t}+\cdots+\beta_{23}x_{23t}+\upsilon_i), \quad (1)\end{aligned}$$

where y_{it} is the binary variable of firm i adopting a ratchet strategy (1) or not (0) in year t, x_{1it} is a dummy variable for the firm's ownership status that is equal to 1 if the firm is public in year t and 0 if the firm is private in year t, and x_{2it} is the total number of innovations the firm introduces in year t. Finally, x_{4i} to x_{23t} are the set of industry (x_{4i}–x_{11i}) and year (x_{12t}–x_{23t}) dummy variables; $\upsilon_i \sim \mathrm{N}(0, \sigma^2)$ is a random, firm-specific effect; and Φ is the standard normal cumulative distribution function. In line with our discussion about firms changing their innovation strategy across the years, we observe a low first-order autocorrelation coefficient of 0.16 and conclude that autocorrelation is not a significant problem in our sample. The more positive (negative) the coefficient on the public variable (β_1), the more (less) likely a firm is to use a ratchet strategy.

Second, we offer an exploratory investigation of how public and private firms differ in the introduction timing of their innovations over the course of a year. One benefit of this analysis is that seasonal, strategic, and general economic considerations outside of the stock market affect public and private firms equally throughout the year. Therefore, private firms serve as an effective benchmark for public firms to discern the effect of introduction timing behavior across the year. Based on our theory that ratcheting involves artificial delays of innovations in order to exceed prior period performance, we expect that private (public) firms will introduce more of their products earlier (later) in the year. As the majority of our public firms have a December fiscal year end, we align our tests by calendar year. This alignment allows us to control for seasonality and other common effects across the public and private firms.[7]

To perform this analysis, we calculate the proportion of innovations introduced by each firm in each quarter within a given year (i.e., quarterly number of innovations/yearly number of innovations). Given that public firms introduce more innovations than private firms in a year, using the *percentage innovations introduced in a given quarter* enables us to more accurately compare the timing of innovation introductions between private and public firms across the year. We used private firms as a benchmark; that is, we computed the average percentage of annual innovation introductions for each quarter across all private firms. We tested the difference between the quarterly proportion of innovation introductions by public firms versus the private benchmark firms for each of the four quarters across all years.

4.5.2. Does the Stock Market Reward Firm Use of an Innovation Ratchet Strategy? We used the calendar-time portfolio approach to investigate the stock market effects of public firms following the different innovation timing strategies (e.g., Brav and Gompers 1997, Jaffe 1974). This approach is standard in finance and has received attention in the marketing literature (see Markovitch and Golder 2008, Sorescu et al. 2007).

After observing firm innovation behavior across the four quarters of each year (i.e., the portfolio formation period), we assigned the firms into one of four strategy portfolios for the year (i.e., ratchet, early all-at-once, late all-at-once, and consistent). We reassign firms to portfolios at the end of every portfolio formation period. For each portfolio, we computed the value-weighted monthly returns and estimate abnormal returns for the subsequent 12 months using the Fama–French three-factor model augmented with momentum:

$$\begin{aligned}R_{pt}-R_{ft} &= \alpha_p+\beta_p(R_{mt}-R_{ft})+s_p SMB_t+h_p HML_t \\ &\quad +m_p MOM_t+\varepsilon_{pt}, \quad (2)\end{aligned}$$

where portfolio return (R_{pt}) is calculated as the value-weighted return for firms in portfolio p during the month t. R_{ft} is the return on a 30-day U.S. Treasury bill; R_{mt} is the return on a value-weighted portfolio of all NYSE, AMEX, and/or NASDAQ stocks; SMB_t is the return difference between a small and large capitalization stock portfolio; HML_t is the return difference between a high and low

[7] In our sensitivity tests, we excluded firms with a non-December fiscal year end and replicated our results.

book-to-market stock portfolio; MOM_t is the return difference between a stock portfolio with high past returns and a stock portfolio with low past returns (Carhart 1997); and ε_{pt} is an error term $\sim N(0, \sigma^2)$ (all in month t).

The variable of interest is the regression intercept, α_p. If it is significantly different from 0, we can conclude that the portfolio earned abnormal returns relative to its expected returns as predicted by the four-factor model.[8] To test H2, we then tested for differences in the abnormal returns to the ratchet strategy portfolio versus each of the other groups. We excluded firms that preannounced the majority of the innovations they introduced in the current year in the calendar-time portfolio analysis. We do so because Sood and Tellis (2009) documented that preannouncing shifts some of the rewards from an innovation into an earlier period. To determine whether innovations were preannounced, we searched for the innovation in Factiva, a database that archives information published across media sources. We repeat the analysis without excluding those preannouncing firms and compare the results in §5.2.

4.5.3. Do Firms Using an Innovation Ratchet Strategy Sacrifice Revenue? H3 predicts that firms using a ratchet strategy will experience revenue losses because they sacrifice income by delaying the introduction of innovations. Given this, we examined whether firms using a ratchet strategy experience lower than expected sales growth[9] during the year they used the strategy. To test our prediction, we examined sales growth patterns between firms using a ratchet strategy and firms not using a ratchet strategy. Specifically, we examined whether sales growth across our innovation timing strategy groups deviates systematically from the firm-specific "normal" sales growth level.

To perform our test, we retrieved yearly firm sales revenue data from Compustat and calculated sales growth as a percentage change in sales revenue from $t-1$ to t, where t is the year in which the innovation timing strategy is observed. We ran the following model:

$$Y_{it} = \alpha_i + \varphi Y_{it-1} + \beta_1 x_{1it} + \beta_2 x_{2t} + \cdots + \beta_{13} x_{13t} + \varepsilon_{it}, \quad (3)$$

where Y_{it} is sales growth and x_{1it} is the number of innovations introduced in year t for firm i, respectively; x_{2t} to x_{13t} are a vector of year dummy variables; α_i is the firm-specific fixed effect; and ε_{it} is an error term $\sim N(0, \sigma^2)$. We estimate this autoregressive fixed-effects model with the procedure outlined by Arellano and Bond (1991). This estimator takes the first difference of the data to remove unobserved firm heterogeneity and uses the two-period lagged dependent variable as an instrumental variable for the one-period lagged difference. As such, the correlation between the lagged dependent variable and the error term is mitigated, and consistent parameter estimates are produced. We compute the residuals from this model and run a two-group mean comparison test that examines the differences in the unanticipated sales growth for firms using a ratchet strategy versus firms not using a ratchet strategy. This two-step procedure is similar to the approach utilized in Schoar (2002). As a follow-up, we also conducted pairwise tests comparing firms using a ratchet strategy versus each of the three innovation timing groups.

4.5.4. What Factors Increase Firm Use of an Innovation Ratchet Strategy? We next examined what predisposes a public firm to adopt an innovation ratchet strategy. We tested H4–H6 by estimating the likelihood of firm i adopting a ratchet strategy in year t. We estimated the following panel probit model for firm i in year t:

$$\begin{aligned}\Pr(y_{it} = 1 \mid \mathbf{x}_{it}, \boldsymbol{\beta}, \upsilon_i) &= \Phi(\beta_0 + \beta_1 x_{1it} + \beta_2 x_{2it} + \beta_3 x_{3it} + \beta_4 x_{4i} + \cdots \\ &\quad + \beta_{12} x_{12i} + \beta_{13} x_{13t} + \cdots + \beta_{24} x_{24t} + \upsilon_i), \quad (4)\end{aligned}$$

where y_{it} is the binary variable of firm i adopting a ratchet strategy (1) or not (0) in year t, x_{1it} is firm stock market scrutiny, x_{2it} is industry market concentration, and x_{3it} is the firm patent intensity. Finally, x_{4i} to x_{24t} are the set of industry (x_{4i}–x_{12i}) and year (x_{13t}–x_{24t}) dummy variables, $\upsilon_i \sim N(0, \sigma^2)$ is a random firm-specific effect,[10] and Φ is the standard normal cumulative distribution function. In line with our discussion on firms changing their innovation strategy across the years (see §4.4), we observe a low first-order autocorrelation coefficient of 0.12 and conclude that autocorrelation does not influence our results. The more positive (negative) the coefficient on our variables of interest, the more (less) likely a firm is to use a ratchet strategy.

5. Results

5.1. Does Stock Market Participation Increase Firm Use of an Innovation Ratchet Strategy?

Table 2 presents the results of our test of Model 1. We observe a significant positive effect of stock market

[8] We also estimate the Fama–French three-factor model (Fama and French 1993) and the single-factor capital asset pricing model (Jensen 1968). Our results replicate.

[9] We thank an anonymous reviewer for suggesting this operationalization.

[10] We quantify the relative impact of *within* and *between* variation in the independent variables and conclude that most of the variation is *between* variation. A formal Hausman test of both sets of estimates (i.e., random- and fixed-effect versions) of the corresponding logit model reveals no systematic differences in the estimates, and hence we choose a random-effects model specification.

Table 2 How the Stock Market Induces a Ratchet Strategy

	Dependent variable: *Membership in ratchet strategy group*
Intercept (β_0)	−3.089 (0.211)***
H1: *Public firm status* (β_1)	0.497 (0.226)**
Control variables	
Number of innovations (β_2)	0.571 (0.442)***
Industry 1 (β_3)	0.634 (0.283)
Industry 2 (β_4)	0.324 (0.295)
Industry 3 (β_5)	0.803 (0.379)
Industry 4 (β_6)	0.655 (0.575)
Industry 5 (β_7)	0.382 (0.520)
Industry 6 (β_8)	0.503 (0.396)
Industry 7 (β_9)	0.407 (0.523)
Industry 8 (β_{10})	−0.365 (0.738)
Industry 9 (β_{11})	0.361 (0.292)
Year 1 (β_{12})	0.464 (0.395)
Year 2 (β_{13})	0.379 (0.349)
Year 3 (β_{14})	0.231 (0.333)
Year 4 (β_{15})	0.231 (0.314)
Year 5 (β_{16})	0.384 (0.348)
Year 6 (β_{17})	0.462 (0.394)
Year 7 (β_{18})	−0.176 (0.369)
Year 8 (β_{19})	0.300 (0.372)
Year 9 (β_{20})	0.428 (0.369)
Year 10 (β_{21})	−0.005 (0.337)
Year 11 (β_{22})	0.293 (0.326)
Year 12 (β_{23})	0.379 (0.475)
No. of observations	3,125
Log likelihood	−211.282
χ^2 (df)	212.472*** (24)

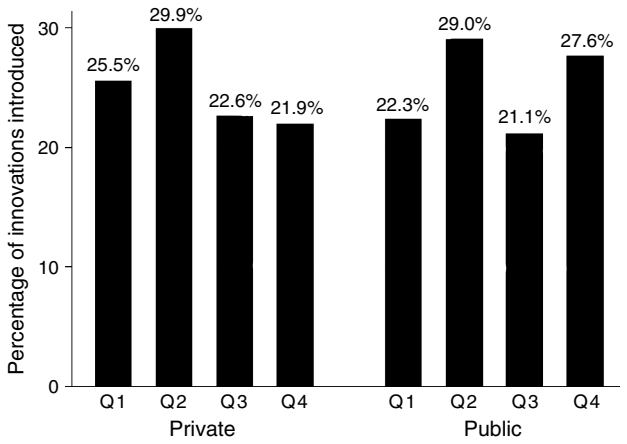
Notes. Parameters reflect the effect of the variable on the probability (or log odds) the firm uses a ratchet strategy in year t. A positive parameter indicates an increase in the probability. The model includes a random firm effect. Standard errors are in parentheses.

***$p < 0.01$; **$p < 0.05$.

participation on the propensity to use a ratchet strategy. Our results indicate that public firms are more likely to follow a ratchet strategy ($\beta_1 = 0.497, p < 0.05$) than are private firms.

To further explore this phenomenon, we compare the percentage of innovative introductions in each quarter by public firms relative to the private-firm benchmark. Based on our theory that ratcheting involves the artificial delay of innovations in order to exceed prior period performance, we expect that private (public) firms will introduce more of their innovations earlier (later) in the year. Figure 1 displays the observed pattern of innovation introductions across quarters for public and private firms. As expected, we observe a spike in innovations toward the end of the year for the public firms, whereas private firms cluster their innovations toward the beginning of the year. Consistent with our expectations, we find that the difference between the two groups of firms is significant: private firms introduce a greater proportion of their innovations in the first quarter ($\text{Mean}_{\text{private, Q1}} = 25.5\%$) compared to public firms ($\text{Mean}_{\text{public, Q1}} = 22.3\%, p < 0.05$). Furthermore, we observe that public firms introduce more of their innovations in the fourth quarter ($\text{Mean}_{\text{public, Q4}} = 27.6\%$) compared to private firms ($\text{Mean}_{\text{private, Q4}} = 21.9\%, p < 0.001$). There are no differences between the two sets of firms in the second quarter ($\text{Mean}_{\text{private, Q2}} = 29.9\%$ versus $\text{Mean}_{\text{public, Q2}} = 29.0\%$, n.s.), and there is only a marginal difference in the third quarter ($\text{Mean}_{\text{private, Q3}} = 22.6\%$ versus $\text{Mean}_{\text{public, Q2}} = 21.1\%, p < 0.10$).

Figure 1 Innovation Timing Patterns Across Private and Public Firms



5.2. Does the Stock Market Reward Firm Use of an Innovation Ratchet Strategy?

We now consider the stock market reaction to our four innovation timing strategies. Results indicate that the stock market does positively adjust the valuation of ratcheting firms. Table 3 reports our tests of the calendar-time portfolio analyses from Model 2. We examined the alphas for each of the portfolios and find that firms using a ratchet strategy ($\alpha_p = 1.020, p < 0.05$) experience significant positive abnormal returns relative to the market. Portfolios based on firms using an early all-at-once strategy ($\alpha_p = 0.263$, n.s.), a late all-at-once strategy ($\alpha_p = 0.142$, n.s.), and a consistent strategy ($\alpha_p = 0.467$, n.s.) do not generate significant abnormal returns.

We test for the differences in the abnormal returns to the ratchet strategy portfolio versus each of the other groups. Results are reported in the final row of Table 3. We find significant differences between a ratchet strategy and an early all-at-once strategy ($p < 0.01$), as well as a ratchet strategy and a late all-at-once strategy ($p < 0.05$). We find a marginally significant difference between a ratchet strategy and a consistent strategy ($p < 0.10$).

As a robustness check, we repeated our analyses without excluding those firms that preannounced more than half of their innovative introductions. As

Table 3 How the Stock Market Rewards Innovation Timing Strategies

Variables	(1) Ratchet strategy	(2) Early all-at-once strategy	(3) Late all-at-once strategy	(4) Consistent strategy
Intercept (α_p)	1.020 (0.415)**	0.263 (0.235)	0.142 (0.423)	0.467 (0.593)
RMRF (β_p)	0.556 (0.115)***	0.831 (0.064)***	0.648 (0.113)***	0.797 (0.147)***
SMB (s_p)	−0.499 (0.121)***	−0.418 (0.064)***	−0.428 (0.114)***	−0.262 (0.146)*
HML (h_p)	0.176 (0.146)	0.124 (−0.082)	0.344 (0.144)**	0.625 (0.187)***
MOM (u_p)	0.004 (0.078)	−0.031 (0.045)	0.144 (0.079)*	−0.088 (0.099)
No. of observations	144	156	145	108
R-squared	0.234	0.625	0.261	0.311
Difference in alpha compared to ratchet strategy		(1)–(2) 0.717 (0.253)***	(1)–(3) 0.870 (0.342)**	(1)–(4) 0.540 (0.311)*

Notes. Standard errors are in parentheses. The number of observations refers to the number of months of observation in which the maximum is 156 (13 years × 12 months).

***$p < 0.01$; **$p < 0.05$; *$p < 0.10$.

before, only the ratchet strategy portfolio earns significant abnormal returns. The differences between the ratchet strategy portfolio's alpha and the alphas for early all-at-once, late all-at-once, and consistent portfolios are weaker but remain significant at the 10% level. These results are consistent with Sood and Tellis (2009), who observed that preannouncing shifts some stock market rewards from the launch to the time of the preannouncement. This finding is also consistent with the benefits of disclosure noted in the literature—more information about innovative products reduces the uncertainty of their potential and allows the market to price them more precisely early on (i.e., reduces the magnitude of the subsequent adjustment).

We also test whether our results are driven by the choices we make regarding our methodology. To do so, we relaxed the assumption of time-invariant risk (Jacobson and Mizik 2009). We allowed the four risk factors (R_{mt}, SMB_t, HML_t, and MOM_t) to vary for each year, our rebalancing period. This alternative method generates results in close correspondence to those reported in Table 3. We also repeated our analysis using holding periods of 18 and 24 months and replicated our results.

5.3. Do Firms Using an Innovation Ratchet Strategy Sacrifice Revenue?

The autoregressive fixed-effects panel (Model 3) is overall significant ($F(14) = 5.16, p < 0.001$) and indicates that sales growth exhibits significant persistence but with slowing growth in its first-order lag ($\varphi = -0.0678, p < 0.001$). We tested for second-order effects but find that second-order lags are insignificant ($\beta = -0.0163$, n.s.). The augmented Dickey–Fuller test rules out unit root in the sales growth series.

Consistent with our expectations, we find that the deviation from expected sales growth is negative and significant for firms using a ratchet strategy ($\varepsilon_{it} = -0.167, p < 0.01$) and not significantly different from 0 for firms using other innovation timing strategies ($\varepsilon_{it} = 0.013$, n.s.). The difference in unanticipated sales growth between those firms using and not using a ratchet strategy is significant ($p < 0.01$).[11]

To further explore this finding, we ran a multivariate regression analysis of our unanticipated sales growth estimates using dummy variables coded to reflect the remaining three innovation timing groups (i.e., early all-at-once, late all-at-once, and consistent), letting the ratchet strategy group serve as the baseline. We find that firms using an early all-at-once strategy ($\beta_{\text{Early}} = 0.1137, p < 0.01$) and consistent strategy ($\beta_{\text{Consistent}} = 0.1360, p < 0.05$) experience higher sales growth compared to firms using a ratchet strategy. The differential in unanticipated sales growth between firms using a late all-at-once strategy and ratchet strategy is also positive but not significant ($\beta_{\text{Late}} = 0.0746$, n.s.).

5.4. What Factors Increase Firm Use of an Innovation Ratchet Strategy?

Table 4 contains our results for H4–H6. The overall Model 4 fit is significant ($\chi^2(24) = 51.22, p < 0.01$). H4 predicted that firms under greater stock market scrutiny are more likely to adopt a ratchet strategy. Our results support this prediction ($\beta_1 = 0.034$, $p < 0.01$). We check whether these results are sensitive to the variable construction and proxy stock market scrutiny with the maximum number of analysts per year (as opposed to the average number of analysts), and our results replicate.

Turning to H5, we had theorized that higher market concentration levels would protect a firm from losing revenue because of reduced risk that competitors

[11] We used a two-group *t*-test with unequal variances to examine sales growth deviation from expected levels across the ratchet and non-ratchet groups. Given unequal variances, the degrees of freedom are Satterthwaite's.

Table 4 Factors Influencing the Likelihood of Using an Innovation Ratchet Strategy

	Dependent variable: *Membership in ratchet strategy group*
Intercept (β_0)	−1.258 (1.043)
H4: *Firm stock market scrutiny level* (β_1)	0.034 (0.009)***
H5: *Firm market concentration level* (β_2)	−7.716 (4.438)*
H6: *Firm patent intensity level* (β_3)	0.528 (0.241)**
Control variables	
Industry 1 (β_4)	−0.687 (9.130)
Industry 2 (β_5)	1.640 (0.558)***
Industry 3 (β_6)	0.792 (0.528)
Industry 4 (β_7)	−0.041 (0.650)
Industry 5 (β_8)	1.253 (1.007)
Industry 6 (β_9)	−2.561 (5.775)
Industry 7 (β_{10})	−4.686 (10.444)
Industry 8 (β_{11})	−4.780 (8.175)
Industry 9 (β_{12})	−2.884 (11.326)
Year 1 (β_{13})	0.302 (0.548)
Year 2 (β_{14})	0.265 (0.528)
Year 3 (β_{15})	−0.058 (0.532)
Year 4 (β_{16})	0.281 (0.517)
Year 5 (β_{17})	0.245 (0.513)
Year 6 (β_{18})	0.579 (0.514)
Year 7 (β_{19})	0.252 (0.539)
Year 8 (β_{20})	0.531 (0.529)
Year 9 (β_{21})	0.620 (0.537)
Year 10 (β_{22})	0.175 (0.552)
Year 11 (β_{23})	0.101 (0.550)
Year 12 (β_{24})	0.102 (0.554)
No. of observations	769
Log likelihood	−246.921
χ^2 (DF)	51.218*** (24)

Notes. Parameters reflect the effect of the variable on the probability (or log odds) the firm uses a ratchet strategy in year t. A positive parameter indicates an increase in the probability. The model includes a random firm effect. Standard errors are in parentheses.

***$p < 0.01$; **$p < 0.05$; *$p < 0.10$.

would enter with substitute offerings. Instead, our results indicate that increases in industry concentration marginally decrease the likelihood of a firm using a ratchet strategy ($\beta_2 = -7.72, p < 0.10$). We speculate that this happens for several reasons. First, higher concentration means that profits will also be concentrated among a select set of firms. If a firm is among those with market power, it may have a weaker incentive to ratchet because it stands to lose more income by delaying introductions. Second, higher market concentration levels may signal to the stock market that firm performance will change very little. If so, the rewards from ratcheting may be diminished.[12]

Finally, consistent with H6, we observe that firms with higher patent intensity levels have a greater likelihood of adopting a ratchet strategy ($\beta_3 = 0.528, p < 0.05$). This result points to the conclusion that patents are a preemption tool that may protect firms using a ratchet strategy.

As a sensitivity check, we also ran Model 4 for each of the three other innovation timing groups. Results support the view that our predictors uniquely influence firm adoption of a ratchet strategy. Specifically, we find that the overall model results for the late all-at-once strategy ($\chi^2(21) = 26.09$, n.s.) and consistent strategy ($\chi^2(24) = 25.90$, n.s.) are not significant and neither are any of the individual predictors in the model. Interestingly, we find an overall significant model for the early all-at-once strategy ($\chi^2(24) = 71.46, p < 0.01$). However, in each case, the three predictors are significant but in the opposite direction from those in the model for the ratchet strategy. Specifically, the early all-at-once strategy has a negative and significant relationship with the firm stock market scrutiny ($\beta_1 = -0.0620, p < 0.01$), a positive and significant relationship with industry concentration ($\beta_2 = 9.323, p < 0.05$), and a negative and significant relationship with firm patent intensity ($\beta_3 = -0.588, p < 0.05$). This finding indicates that the incentives that propel a firm to introduce early and ceteris paribus maximize revenues in the product market are the exact opposite of those that induce the firm to behave strategically and engage in an innovation ratchet strategy.

6. Discussion

6.1. Innovation Ratcheting and Managerial Manipulation

Our findings point to the conclusion that some managers do artificially delay their firm's introduction of innovations in order to demonstrate improvement over time. Specifically, we observe that public firms ratchet more than private firms (H1). Private firms introduce a greater proportion of their innovations earlier in the year, whereas public firms introduce a greater proportion of their innovations later in the year. In addition, the public firms that use a ratchet strategy enjoy stronger returns from the stock market (H2) while sacrificing sales growth in product markets (H3).

To further investigate the premise of managerial manipulation, we undertook primary data collection from top marketing managers. To do so, we inserted a small number of questions into The CMO Survey™ (http://www.cmosurvey.org). The survey asks marketing leaders questions about firm strategy, spending, performance, and organization; 574 responses were collected (13.86% response rate).[13] We used the

[12] We thank an anonymous reviewer for this explanation.

[13] The sample was drawn from 4,141 top marketers from Fortune's Top 100 and the Forbes Top 200 companies, CMO Club members, American Marketing Association members, and university alumni.

lead-in from Graham et al. (2005) ("It's near the end of the quarter and it looks like your company might come in below its desired earnings target. Within what is permitted by GAAP, which of the following choices might your company make?") and asked managers whether they would or would not take the following actions: (i) decrease discretionary marketing spending (68% responded yes) and (ii) delay introducing a new product or service (27% responded yes). Although new product manipulation is less common than revenue manipulation, both indicators point to a willingness to change strategies to improve firm performance in the stock market.

We offer several ideas about other ways managers might manipulate innovation to influence stock market outcomes. First, we think it is theoretically possible that firms might bring products to market *earlier* than planned to show a ratcheting pattern. Although these "rushed" introductions may help a firm exceed its prior introduction level, they will also cost the firm if product quality or aspects of the launch are sacrificed so that the firm can move fast. Future research should attempt to document the interplay and the prevalence of "delay" and "rush" strategies to achieve a ratcheting pattern and their relative costs. Second, firms may also use a ratcheting strategy to manage the quality of innovations.[14] This would imply that companies have an incentive to hold back some quality improvements so that an increasing level of quality can occur over time. We encourage future research to examine this issue. Doing so is likely to be more fruitful in industries such as electronics, where quality improvements are more frequent and substantial than in the consumer packed goods industry we examine.

6.2. Innovation Ratcheting and Stock Market Rewards

We contribute to the long-standing literature on the timing of new product introductions in marketing. This literature has examined the optimal timing of new product introductions to minimize cannibalization (Moorthy and Png 1992, Putsis 1993) and to balance the risks of premature entry against the missed opportunity of late entry (Lilien and Yoon 1990). We offer new insights to this literature by examining how innovation timing affects stock market rewards.

Specifically, we argued that because firm capabilities are not directly observable by the stock market, the stock market uses an accelerating pattern of innovative introductions as a signal of unobservable firm capabilities. We suggested that the stock market rewards firms that accelerate innovations because it expects these firms to be more likely to introduce more innovations and follow-up non-innovations in the future.

[14] We thank the editor for this interesting idea.

We perform an exploratory test for the presence of these mechanisms using a two-step procedure. First, we used an autoregressive, fixed-effects, time-adjusted forecast model to estimate the number of new products introduced in each year: $(Introductions_{it} - \overline{Introductions_t}) = \alpha_i + \varphi_1 \cdot (Introductions_{it-1} - \overline{Introductions_{t-1}}) + \varepsilon_{it}$, where $Introductions_{it}$ is either the number of innovations or non-innovations introduced by firm i in year t. We control for time-specific effects by time demeaning our data. $\overline{Introductions_t}$ is the cross-sectional mean number of introductions occurring in year t across all firms in our sample. The firm-specific intercept α_i measures time-invariant firm heterogeneity, and the residuals $\varepsilon_{it} \sim N(0, \sigma^2)$ in the equation are the number of unanticipated introductions by firm i in year t. We estimated this equation using an instrumental variable approach. We removed the fixed effects by first differencing the data and use higher-order lagged levels of the dependent variable as instruments for the $\Delta(Introductions_{it-1} - \overline{Introductions_{t-1}})$ (Arellano and Bond 1991).

Second, we ran the following model on our sample of public firms: $Unanticipated\_Introductions_{it} = \alpha_0 + \beta_1 Ratchet\_Strategy_{it-1} + \beta_2 EBITDA_{it-1} + \varepsilon_{it}$, where $Unanticipated\_Introductions_{it}$ is either the number of unanticipated innovations or unanticipated non-innovations for firm i in year t, $Ratchet\_Strategy_{it-1}$ is a dummy variable indicating whether the firm follows a ratchet strategy (1) or not (0), and $EBITDA_{it-1}$ is the natural logarithm of earnings before interest, tax, depreciation, and amortization for firm i in year $t-1$. We included lagged $EBITDA_{it-1}$ as a control because a firm's prior performance might have an effect on the financial resources available and hence the number of innovations and non-innovations that can possibly follow.

Results indicate that firms using a ratchet strategy introduce significantly more innovations ($\beta_1 = 1.27$, $p < 0.01$) and non-innovations ($\beta_1 = 17.11$, $p < 0.01$) in the following year. As a robustness check, we also estimated equations using dummy variables for each of the three other innovation timing strategies (i.e., early all-at-once, late all-at-once, and consistent) and find that none have a significant effect on innovative or non-innovative introductions. These results offer exploratory support for *why* the stock market rewards an innovation ratchet strategy.[15]

[15] There are other potential mechanisms that could be vetted in future research as well. For example, the stock market could reward firms for accelerating introductions because the stock market expects that the firm will be able to generate a stronger return on R&D investments. Specifically, firms with stronger capabilities should be able to generate greater return on investment for introduced innovations in the future. We thank the editor for suggesting this idea.

6.3. The Strategic Costs of Innovation Ratcheting

What are the longer-term marketing implications of a firm's use of an innovation ratchet strategy? First, if the products are delayed as a result of ratcheting, this may influence a firm's likelihood of acquiring new customers, especially early adopters and innovators who enter the purchase cycle early. Likewise, if current customers are likely to switch to competitors who enter early, adopting a ratchet strategy not only hurts revenues in a given year but may also threaten customer retention. Finally, if a strategic delay hurts customer perceptions of a firm's innovativeness, a ratchet strategy could also damage the firm's reputation. Managers should consider these customer effects when deciding whether or not their firms should engage in innovation ratcheting.

To ensure a healthy debate about these trade-offs, we advise managers to focus equally on customer assets and financial assets. This is important given that past research has demonstrated customer relationships are important to value creation in financial markets (Gupta et al. 2004, Rust et al. 2004, Srivastava et al. 1998). To this end, because the stock market pressures on public firms are so great, shareholders should insist on a clear role for the marketing function (Moorman and Rust 1999), a strong market orientation (Kohli and Jaworski 1990), and a strong customer-oriented culture (Deshpandé et al. 1993). These actions will ensure that managers account for how firm strategies designed to impact financial markets also impact customer relationships.

6.4. Innovation Ratcheting and the Firm Value Trade-off

Finally, we observed that ratcheting firms trade off rewards from financial markets with revenue sacrifices from product markets. How do these revenue losses compare to stock market gains? To get the most accurate assessment of this trade-off, it is important to focus on the exact products delayed during ratcheting. Unfortunately, our current test of Model 3 uses overall firm sales. Furthermore, our previous models do not account for the fact that the on-time introduction of innovations would have produced earnings for a firm that are not realized and that on-time introductions would likely cannibalize the sales of existing products. Therefore, to more accurately quantify the trade-off that firms are making between performance in the stock market and in product markets, it is necessary to determine the firm market value lost as a result of unrealized potential income from a ratchet strategy and then compare this to the market value gains from a ratchet strategy. The Web appendix (available at http://dx.doi.org/10.1287/mksc.1120.0737) describes our approach to calculating this trade-off.

Stock market effects from Model 2 indicate that firms using a ratchet strategy realized an abnormal annual stock return of 12.24% (1.02% per month $\times$ 12 months; see Table 3). In calculating the unrealized earnings from the delayed introduction of innovations to the market, our results indicate that firms using a ratchet strategy gave up an average of between 2.22% of annual stock returns (using the assumption that innovations were delayed by one quarter) and 2.51% of annual stock returns (using the assumption that all innovations were ready for introduction at the beginning of the year). This range of losses (2.22% to 2.51%) is smaller than the 12.24% of wealth generated by ratcheting in the following year. The results of these exploratory analyses should be viewed with caution because many assumptions enter into our calculations (see the Web appendix). Some of these assumptions exaggerate the potential losses (e.g., the omission of launch costs) and some understate them (e.g., considering only the lost revenue in the first few quarters). Despite these caveats, however, the firm appears to have a clear financial incentive to ratchet.

6.5. Limitations and Additional Future Research Opportunities

Given the novelty of this research area and our findings, we have undertaken robustness checks for many measurement and model choices in our paper (see §8 for details). Our findings hold up well to these additional tests. Our study, however, is not without its limitations, many of which offer important directions for future research. First, our study was performed within the context of one industry—consumer packaged goods. Future research should consider the degree to which our findings generalize to other contexts.

Second, our research relies exclusively on secondary data to establish the innovation ratchet and to identify firm responses and outcomes. That is, we have no primary evidence that managers *deliberately* engage in ratcheting (i.e., firms had products available for introduction and managers chose to delay). It would be interesting to explore directly the managerial decision processes involved in the product introduction decisions. As a step in this direction, we examined transcripts of the quarterly earnings conference calls and other U.S. Securities and Exchange Commission (SEC) filings (e.g., 10-Ks) for a number of firms in our sample and observed that managers discuss innovation as a driver of firm profits. Therefore, we know that managers try to signal the presence of innovation to analysts. Future research can examine these managerial activities more comprehensively for direct evidence of ratcheting.

Further, we only examine a subset of variables that may encourage or discourage firms from adopting a

ratchet strategy. Several additional firm factors could be examined in future research. For example, firms operating in a larger number of industries or categories may have greater capacity to adopt a ratchet strategy (in one category) given their ability to offset the revenue losses with revenues in other categories. Likewise, firms with high levels of existing revenues in a category may be more likely to use a ratchet strategy given that existing products will be cannibalized less as a result of the strategic delay. Other firm financial antecedents could include a firm's recent stock market performance in the prior quarter or whether the firm had a negative earnings surprise in the prior quarter (Chakravarty and Grewal 2011). We expect both of these factors to increase the likelihood of an innovation ratchet strategy.

Considering industry factors, firms that participate in categories where innovation is relatively less important may be more likely to pursue a ratchet strategy given the lower likelihood of competitor innovation. Likewise, firms in growth industries or in growth periods in any industry may be less likely to use a ratchet strategy because a delay could allow competitors to gain early footholds as the market is taking off. Additionally, as Gielens and Steenkamp (2007) showed, consumer acceptance of new products is higher in less heavily promoted, less heavily advertised categories and in categories with more intense competition on innovation. As a result, all of these factors may tempt firms to use a ratchet strategy because they assume that faster acceptance will counterbalance the decision to delay. Furthermore, following Lilien and Yoon (1990), R&D competition and entry competition are also likely to play a role in the decision to use an innovation ratchet strategy.

In investigating these and other antecedents to the use of a ratchet strategy, research may benefit from modeling a firm's *capacity* to use a ratchet strategy. The idea is to capture the factors that limit the firm's ability to ratchet, even though managers have the intent to use a ratchet strategy. A hidden Markov modeling framework is a useful approach to capture the firm's latent capacity to use a ratchet strategy whether or not the firm is successful in realizing this intent. Such models might allow for building better forecasts about future managerial behavior.[16] We did not adopt this approach in this paper given our focus on how observed firm behavior influences stock market outcomes.

Finally, although our sample is similar to those in innovation studies, it is relatively small. If and when innovation and revenue data become more easily available, future research might be able to examine these relationships using more advanced dynamic modeling frameworks (see Pauwels et al. 2005). Unfortunately, such modeling is not feasible given our sample size.

[16] We thank an anonymous reviewer for this idea.

7. Conclusion

Research examining the stock market implications of firm innovation has not examined the impact of innovation timing strategies. We examine firm use of one timing strategy—an innovation ratchet strategy—in which the firm artificially times the introduction of innovations in order to show improvement over time. We theorize that firms use an innovation ratchet strategy to mimic the natural acceleration of innovations from high capability firms. As expected, the stock market rewards these ratcheting firms with greater returns. However, the introduction delay inherent in an innovation ratchet strategy causes these firms to sacrifice revenue growth in product markets. Offering evidence that the stock market provides an incentive to ratchet, we observe that public firms use an innovation ratchet strategy more than private firms do and that public firms are more likely to ratchet as the level of stock market scrutiny increases. These observations offer important implications for theory and practice at the interface of innovation and stock market outcomes as well as directions for future research.

8. Additional Robustness Checks

We performed a series of checks to ensure the robustness of our results. We discuss each as follows.

1. *Changeover sample replication.* We also tested H1 in the sample of firms that change from private to public during our observation period. This change in status is verified by checking SEC filings for an S-1 form, which is submitted by a firm changing its legal status. We identified 229 firms that changed legal status from private to public during the observation period. Eighteen firms changed status several times during this period. We deleted these firms, resulting in a final changeover sample of 211 firms. Using this sample, we tested Model 1 using our two-quarter operationalization of the ratchet strategy and find that our model does not converge because so few newly public firms follow a ratchet strategy defined in this way. Given this, we instead used the number of times ratcheting occurs within a year (ranging from 0 to 4). To do so, we used an ordered probit model, which is an extension of the univariate probit model estimated in Model 1, and cluster-robust standard errors to mitigate potential intrafirm correlation of the error term. This model is significant ($\chi^2(24) = 134.80, p < 0.001$). Results indicate that when a firm is public, it has a significantly higher likelihood of ratcheting than when a firm is private ($\beta = 0.536, p < 0.001$). As a further test, we estimated the same continuous model for the public versus private firm sample used to test H1 and confirm our former results that

public firms have a higher likelihood of ratcheting than do private firms ($\beta = 0.677, p < 0.001$). Finally, extending the analysis in Figure 1, we performed the mean comparison test of the innovations introduced in each quarter in our changeover sample. Results confirm that in the first quarter, firms in a public state ($\text{Mean}_{\text{public, Q1}} = 27.3\%$) introduce a significantly lower proportion of innovations compared to firms in a private state ($\text{Mean}_{\text{private, Q1}} = 40.9\%, p < 0.01$). Conversely, in the fourth quarter, firms in a public state ($\text{Mean}_{\text{public, Q4}} = 32.1\%$) introduce a significantly higher proportion of innovations compared to firms in a private state ($\text{Mean}_{\text{private, Q4}} = 13.6\%, p < 0.01$).

2. *Alternative assumptions of stock market expectations.* We used a firm's $k-1$ quarter as the base for the stock market's expectation. We explored whether our results are robust to different ways of modeling the stock market's expectation. First, the marketing and finance literatures have used the $t-1$ year, k quarter as the basis for the stock market's expectation (Graham et al. 2005, Mizik 2010). To test the effect of using this different expectation model, we followed the same approach in our main analyses, but instead of subtracting the number of innovations introduced in the prior quarter, we subtracted the number of innovations introduced in quarter k in year $t-1$ from the number of innovations introduced in quarter k in year t. Although we find that firms using a ratchet strategy earn significant abnormal returns and none of the other timing portfolios do, we do not find a significant difference between the alpha for the ratchet strategy portfolio and the other three strategy portfolios. Second, we follow Mizik and Jacobson (2009) and used a forecasting model to estimate the expected number of innovations introduced in quarter k. Specifically, we built the following fixed-effects autoregressive time-adjusted forecast model:

$$\begin{aligned}(Innovations_{ik} - \overline{Innovations_k}) &= \alpha_i + \varphi_1(Innovations_{ik-1} - \overline{Innovations_{k-1}}) \\ &\quad + \varphi_2(Innovations_{ik-2} - \overline{Innovations_{k-2}}) \\ &\quad + \varphi_3(Innovations_{ik-3} - \overline{Innovations_{k-3}}) \\ &\quad + \varphi_4(Innovations_{ik-4} - \overline{Innovations_{k-4}}) + \varepsilon_{ik},\end{aligned}$$

where $Innovations_{ik}$ is the number of innovations introduced by firm i in quarter k. We control for time-specific effects and time demean our data where $\overline{Innovations}_{k-j}$ is the cross-sectional mean number of innovations occurring in quarter $k-j$. The firm-specific intercept α_i measures time-invariant firm heterogeneity, and the residuals ε_{ik} retrieved from our model are the number of unanticipated innovations of firm i in quarter k. If the number of unanticipated innovations is larger than 0 in quarter k, the firm is ratcheting in this quarter. We summed the number of ratchets across the year and characterized a firm as using a ratchet strategy in year t if it had at least two quarterly ratchets. Results indicate that firms using a ratchet strategy are the only group to earn significant abnormal returns. Compared to the three other timing groups, firms adopting a ratchet strategy perform marginally better in terms of the alpha in the calendar-time portfolio analyses.

3. *Alternative innovation-level portfolios.* As another robustness check, we classified the firms into portfolios based on (i) their innovation timing strategy (i.e., ratchet, early all-at-once, late all-at-once, or consistent) and (ii) whether they introduce two or more innovations in the same year. This ensures that all firms are innovating at the same levels. Consistent with our former results, we observe significant abnormal returns for only the ratchet strategy group. The alpha of the ratchet strategy portfolio remains significantly different from the alphas of the early all-at-once and consistent portfolios. However, we find no difference between the portfolios of firms using the ratchet strategy and those using the late all-at-once strategy. These results should be viewed with caution given the reduced sample size.

4. *Alternative innovation timing portfolios.* We focused our portfolios on four innovation timing strategies. As a robustness check, we examined the performance of two additional innovation timing strategies. Firms using a middle all-at-once strategy introduce all innovations at once and do so in either quarter 2 or quarter 3. Firms using a random strategy do not use any of the other five innovation timing strategies (ratchet, early all-at-once, late all-at-once, consistent, or middle all-at-once). Results indicate that α_p is not significant for these two portfolios: middle all-at-once ($\alpha_p = 0.475$, SE $= 0.455$, n.s.) and random ($\alpha_p = 0.305$, SE $= 0.236$, n.s.). Furthermore, we tested for differences in the alpha between the ratchet strategy portfolio and each of the new strategy groups, and we find that the ratchet strategy significantly outperforms both alternative timing strategies.

5. *Future sales growth replication.* We ran an equivalent of Model 3 to examine the sales growth in the year following the use of the ratchet strategy and find that sales growth in the following year ($t+1$) is also significantly lower than normal for those firms which used a ratchet strategy in year t ($p < 0.01$). We find no difference in the normal and the observed sales growths for firms not using a ratchet strategy. This finding further highlights the long-term negative product market consequences of ratcheting.

Electronic Companion

An electronic companion to this paper is available as part of the online version at http://dx.doi.org/10.1287/mksc.1120.0737.

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