

Although going public allows firms access to more financial capital that can fuel innovation, it also exposes them to a set of myopic incentives and disclosure requirements that constrain innovation. This tension is expected to produce a unique pattern of innovation strategies among firms going public, causing such firms to increase their innovation levels but reduce their innovation riskiness. Specifically, the authors predict that after going public, firms innovate at higher levels and introduce higher levels of variety with each innovation; however, these innovations are less risky, characterized by fewer breakthrough innovations and fewer innovations in new-to-the-firm categories. The authors compare 40,000 product introductions in the period 1980–2011 from a sample of consumer packaged goods firms that went public with a benchmark sample of firms that remained private, and the results support their predictions. Utilizing tests to resolve questions about endogeneity, including self-selection, reverse causality, and competing explanations, the authors demonstrate that initial public offering selection and dynamics do not drive this going-public effect. The authors also uncover a set of industry factors that mitigate the drop in breakthrough innovation by offering product-market incentives that counterbalance the documented effect of stock market incentives.

*Keywords:* innovation, stock market impact, initial public offering, marketing–finance interface, consumer packaged goods

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## Going Public: How Stock Market Listing Changes Firm Innovation Behavior

The process of bringing new products and services to the market is of high strategic relevance (e.g., Chandy and Tellis 2000; Hauser, Tellis, and Griffin 2006). A long tradition of research across disciplines has documented the positive stock market returns to research-and-development (R&D) expenditures and patents (e.g., Erickson and Jacobson 1992; Griliches 1981). Investors value these inputs because they

are expected to convert into innovations that will increase sales and profits (Bayus, Erickson, and Jacobson 2003; Pauwels et al. 2004) and, thus, firm value (Chaney, Devinney, and Winer 1991; Sood and Tellis 2009; Sorescu and Spanjol 2008).

Therefore, it is clear that firms have an incentive to invest in innovation. However, the high costs, uncertain payoffs, and difficulty of adequately measuring returns to innovation create challenges for firms (Sood and Tellis 2009). This particularly applies to publicly listed firms that are prone to suffer from agency conflicts and in which managers are exposed to stock market incentives. Although such firms have improved access to financial capital, their strategic choices are constrained because they have to meet short-term stock market expectations and disclosure requests. This tension translates into opposing impacts on firm innovation. On the one hand, the improved financing that results

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from going public should encourage innovation. On the other hand, disclosure requirements and short-term stock market incentives may have a detrimental effect on innovation. Scholarly work has not yet determined the net effect of going public on firm innovation activity.

Anecdotal evidence has illustrated how going public can reduce managerial discretion to innovate. Ingvar Kamprad, founder of IKEA, notes, “Keeping companies like IKEA in private hands would secure the freedom to have a long-term view on investments and in business development” (Kamprad 2011). Recently, Dell announced a leveraged buyout to reinvent its business strategy. Commentators suggest that as a private firm, Dell “can make decisions that aren’t just based on profits and revenues in the next quarter, but with a longer-term focus” (Devaney 2013, p. 8). Echoing this sentiment, business periodicals point out that successful privately held companies want to remain private to avoid “Wall Street’s obsession with quarterly earnings expectations” (Woo and Reifman 2003, p. 174) and to enjoy the “freedom from reduced obligations to Sarbanes-Oxley reporting requirements” (Murphy 2012). Tellis (2013, p. 239) refers to the negative effect of stock markets on managerial decisions as the “Wall Street curse” and specifies that “pressure from investors on Wall Street causes managers to cut investments in innovation to boost current earnings and stock prices, at the cost of future innovation, growth, and long-term market cap.”

Previous academic literature has explored how stock market incentives constrain public firms’ innovation investment decisions. Graham, Harvey, and Rajgopal (2005) find that

80% of managers are willing to decrease R&D spending and 55% are willing to delay starting a positive net present value project to meet current earnings projections. Referred to as “marketing myopia,” Mizik (2010) observes that firms cut marketing and R&D spending to improve short-term stock valuations despite the negative long-term firm value consequences of these cuts. Likewise, Chakravarty and Grewal (2011) find that previous stock return level and volatility increase the likelihood that managers will cut R&D budgets to avoid unexpected earnings shortfalls.

Other innovation research has explored stock market effects beyond earnings management. For example, Markovitch, Steckel, and Yeung (2005) find that firms alter the risk profiles of innovation projects conditional on their prior period’s industry-adjusted stock returns. Moorman et al. (2012) observe that stock market incentives drive firms to time their innovation strategies through a ratcheting strategy that sacrifices revenues in product markets but reaps benefits in financial markets. Research contemporaneous to our study shows that firm patent quality declines after firms access public stock markets (e.g., Bernstein 2015).

Table 1 summarizes extant empirical research examining how firms manage innovation in response to stock market incentives. We organize the research according to how innovation is operationalized—through R&D spending, patents, or new product introductions. The columns account for whether studies have focused on publicly listed firms or on how firms change their innovation actions after accessing public stock markets. The majority of the articles have two

Table 1  
THE STOCK MARKET AND INNOVATION OUTCOMES: A REVIEW OF EMPIRICAL LITERATURE

<i>Innovation-Related Activity</i>	<i>Firms in Public State</i>	<i>Firms Changing from Private to Public State</i>
<i>R&amp;D Spending</i>	<ul style="list-style-type: none"> <li>• Chief financial officers report a willingness to reduce R&amp;D spending or to delay starting a new project, even if such a delay led to a sacrifice in value to meet earnings targets (Graham, Harvey, and Rajgopal 2005).</li> <li>• Managers are less likely to cut R&amp;D to reverse an earnings decline when institutional ownership is high (Bushee 1998).</li> <li>• Cuts in R&amp;D spending temporarily inflate short-term earnings and valuations. However, firm value declines in the subsequent five years (Mizik 2010).</li> <li>• In response to past increases in stock returns and stock volatility, high-tech manufacturing firms cut R&amp;D budgets to avoid unexpected earnings shortfalls in the immediate future (Chakravarty and Grewal 2011).</li> <li>• An increase in the equity-to-bonus compensation ratio is positively related to R&amp;D expenditures (Currim, Lim, and Kim 2013).</li> </ul>	
<i>Patents</i>	<ul style="list-style-type: none"> <li>• High stock liquidity leads to lower patent output, especially with less entrenched management and lower profit levels (Fang, Tian, and Tice 2014).</li> <li>• High institutional ownership is positively related to patent output (Aghion, Van Reenen, and Zingales 2013).</li> <li>• Adoption of antitakeover provisions increases patent output (Chemmanur and Tian 2013).</li> <li>• High analyst coverage impedes firm patent productivity and investments in long-term innovative projects (He and Tian 2013).</li> <li>• Firms backed by more failure-tolerant venture capital investors produce a larger number of patents and patents with larger impact (Tian and Wang 2014).</li> </ul>	<ul style="list-style-type: none"> <li>• An IPO leads to a decline in patent levels and patent quality due to short-term performance pressures among biotech firms (Aggarwal and Hsu 2013).</li> <li>• The quality of internally generated patents declines following an IPO (Bernstein 2015).</li> <li>• After going public, medical device firms produce a larger number of patents, but a larger proportion of these patents rely on the firm’s prior patents (Wu 2012).</li> </ul>
<i>New Product Introduction</i>	<ul style="list-style-type: none"> <li>• Pharmaceutical firms with recent underperforming stock implement more high-risk innovation strategies than firms outperforming industry peers (Markovitch, Steckel, and Yeung 2005).</li> <li>• Consumer packaged goods firms time the introduction of new products to reap stock market benefits, though this comes at the expense of product market sales (Moorman et al. 2012).</li> </ul>	The current research

Notes: Research examines firm innovation across industries unless otherwise noted.

properties: a focus on public firms and a focus on R&D and patents.

Our research offers a unique view of how firms manipulate innovation in response to stock market incentives by studying the effect of stock market listing on new product introductions. In doing so, we offer the following contributions. First, new product introductions are a more valid measure of firm innovation. Research has found that R&D expenditures are not deterministically related to product introduction level or timing (e.g., Lerner, Sorensen, and Strömberg 2011) and that accounting rules make R&D expenditures a noisy measure of innovation (Hall and Lerner 2010). Likewise, patents are an unreliable indicator of innovation because many patents are not exploited commercially (Cohen and Levin 1989); firms do not patent all innovations given time delays, administrative costs, disclosure requirements, and the availability of alternative ways to protect innovation. Indeed, the consumer packaged goods (CPG) firms in our sample patent only 8.7% of new products. Contributing to this noisy measure, Lerner, Sorensen, and Strömberg (2011) observe that employees often file marginal patents unlikely to produce innovations or file bundled claims as separate patents to receive company rewards. Given these challenges, examining new product introductions should allow for stronger inferences about the effect of going public on firm innovation.

Second, using new product introductions offers an opportunity to examine an array of different dimensions of risk important to firm innovation strategy, including whether the innovation has breakthrough product features or whether it reflects the firm's market entry into new categories. The latter dimension enables us to examine the going-public effect on both product and market forms of innovation; previous literature, in contrast, has tended to focus on qualities of the offering as denoted in a patent. We also examine public firms' tendency to minimize risk by offering variations of the same product—a strategy known as stockkeeping unit (SKU) proliferation in the CPG industry.

Third, studying firms in the CPG sector offers broader insights into a sector of considerable economic significance, in which innovation plays an important role. Existing literature has focused on industries in general or on firms in the technology sector—a sector with more volatile and herd-like demand fluctuations, fragmented competitive environments, and contentious intellectual property conditions. Firms in the CPG sector face different regimes to appropriate value from innovations that may influence their innovation strategies after going public. Fourth, whereas the majority of articles have examined public firms, we use the quasi-experimental initial public offering (IPO) context to study stock market effects. Together with tests to rule out selection concerns, reverse causality, and firm dynamics, this enables us to observe a shift in innovation associated with being a publicly listed firm. A small set of recent articles has used similar empirical strategies. We add to the generalizability of the going-public effect by examining not only firms in the CPG sector but also firms across a longer time series—up to 30 years before and after the IPO. This prolonged observation period ensures that our results reflect a stock market regime shift and not only short-term dynamics around the IPO.

Using this approach, we observe that the net effect of a stock market listing on innovation is an increase in the level of innovations and a decrease in the riskiness of those innovations. Specifically, after going public, firms introduce a larger number of innovations and a larger variety of each innovation (e.g., different flavors, package sizes). At the same time, firms introduce fewer breakthrough innovations and fewer innovations into categories in which they do not have experience.

Given these results, we offer a final contribution to the literature: initial insights on the question of why some firms do not succumb to the going-public effect and continue to introduce risky innovations. Specifically, we offer preliminary ideas about a set of industry factors that offer product-market incentives that dominate stock market incentives.

The remainder of our article is organized as follows. We begin by surveying prior literature that provides the theory underlining our predictions. This is followed by a set of predictions about the effect of going public on firm innovation. We then describe our empirical strategy and results, followed by a set of exploratory analyses to enlarge our contribution and a set of robustness tests to resolve questions about endogeneity. We conclude with a discussion of our results with an emphasis on implications for theory and practice.

## GOING PUBLIC AND INNOVATION ACTIVITY

### *Going Public and Firm Investment Behavior*

Going public is a critical event that “forever transforms how a company goes about doing business” (PricewaterhouseCoopers 2012, p. 23). Surprisingly, despite improved financing conditions from accessing public stock markets, research has indicated that firms experience declines in operating performance, sales growth, and overall factor productivity post-IPO (e.g., Chemmanur, He, and Nandy 2010; Mikkelsen, Partch, and Shah 1997). Importantly, this post-IPO decline in performance is not an artifact of accounting choices but instead seems to be related to firms becoming less responsive to investment opportunities after they go public (Asker, Farre-Mensa, and Ljungqvist 2015).

### *Going Public and Firm Innovation Behavior*

A substantial part of investment in the CPG sector flows into product innovation. In an industry in which 22% of consumers are “always looking for new products” (Symphony IRI 2012, p. 1), innovation is a key driver of growth. In 2012 alone, this sector introduced more than 1,900 new products in the United States (Symphony IRI 2013).

Affordable financing is critical to developing and marketing these new products. However, our survey of existing work on the impact of stock market financing on innovation uncovers both positive and negative effects. On the one hand, going public may have a positive impact on innovation activity. The immediate cash inflow following an IPO relieves firm financial constraints that are widely accepted as a major bottleneck for innovation (e.g., Hall and Lerner 2010; Tellis, Prabhu, and Chandy 2009). Furthermore, public firms also benefit from lower-cost equity financing in the future (e.g., Maksimovic and Pichler 2001) and from improved access to nonfinancial resources that help them compete in product markets. For example, chief financial



officers report that public status enhances firm recognition and reputation (Brau and Fawcett 2006), which can be leveraged to attract employees, strengthen bargaining power with suppliers, and signal quality to customers, all of which should facilitate innovation.

On the other hand, going public may have a negative impact on innovation activity for two reasons. First, compared with privately held firms, public firms experience stronger disclosure incentives. This stems from both mandatory stock exchange disclosure rules and from investors demanding information to properly value the firm. Disclosures increase the spillover of sensitive information to competitors, thereby reducing the rents firms extract from innovation (Brau and Fawcett 2006; Spiegel and Tookes 2008). Given these spillovers, going public should dampen firm innovation, especially in industries with low protection mechanisms, such as the CPG sector. Consistent with this view, Guo, Lev, and Zhou (2004) show that firms are more willing to disclose information about innovative products if they are protected by patents or are in the late stage of a development cycle.

Second, going public imposes myopic performance incentives on the firm. Specifically, managers of public firms face incentives that lead to an overemphasis on current financial results and the current stock price (Stein 1989). High stock liquidity associated with a stock market listing accentuates this pressure because investors can penalize firms at the slightest sign of underperformance by selling the stock. As such, managers feel pressure to meet short-term earnings projections and to invest in projects with immediate and less risky payoffs that are easily valued (Ferreira, Manso, and Silva 2014). These pressures are compounded by the fact that investors lack information and thus have difficulty properly valuing innovation (e.g., Cohen, Diether, and Malloy 2013).

### PREDICTIONS

The tension arising between capital inflows versus stock market incentives raises the question of whether and how private firms change their innovation strategies after they go public. Consistent with our theory, we argue that improved access to resources will increase firm innovation levels, while stock market incentives will decrease the riskiness of innovation. In this section, we develop formal predictions about this trade-off.

#### *Does Going Public Change the Level of Innovation?*

*Does going public increase the overall number of innovations?* The overriding goal of going public is to ensure continued growth (Brau and Fawcett 2006); innovation, especially in the CPG sector, is a pivotal part of achieving that goal. As we have discussed, innovation is likely to be more sensitive to financing constraints than other forms of investments (e.g., Hall and Lerner 2010). Thus, an immediate inflow of financial capital and improved access to future capital should be positively related to overall number of innovations. We predict the following:

H<sub>1</sub>: After going public, firms introduce a larger number of innovations.

*Does going public increase innovation variety?* In general, CPG firms do not introduce a single version of a new product. Instead, they introduce innovation variety, defined as the range of versions of the same product that differ by package size, color, formulation, or taste. Offering a larger variety of the same innovation is a popular strategy to generate sales for several reasons. First, a greater assortment satisfies customer variety seeking within a segment and appeals to different customer segments. Second, more variety increases the firm's share of shelf space, which prevents competitive offerings from seizing the space. Third, the coordinated packaging and labeling across the different SKUs can achieve a sort of "billboard effect" on the store shelf (Quelch and Kenny 1994, p. 154), which increases brand awareness and brand reputation. The inflow of immediate cash and improved access to future capital should enable firms to scale up their innovation variety. We predict the following:

H<sub>2</sub>: After going public, firms introduce a higher level of variety per innovation.

#### *Does Going Public Change the Riskiness of Innovation?*

Although an increase in financial resources may lead to an increase in innovation levels, we predict that stock market incentives will have a dampening effect on the riskiness of innovation. We expect that managers become less willing to take the risks associated with bolder and more discontinuous innovations and instead focus more on incremental and familiar innovations that translate into profits more quickly.

*Does going public decrease the level of breakthrough innovations?* Breakthrough innovations offer substantially new consumer benefits to the market (Chandy and Tellis 1998; Sorescu and Spanjol 2008) compared with incremental innovations that offer only minor new consumer benefits. As discussed previously, stock market disclosure requirements and investors' informational demands can discourage firms from conducting breakthrough research because they prevent firms from appropriating monopolistic rents on breakthrough innovations. Myopic stock market incentives likewise dissuade managers from choosing long-term breakthrough research projects. Instead, managers are more likely to choose incremental projects with short-term and lower-risk payoffs. Incremental innovations are less complex for customers and are more compatible with complementary products currently used by customers. As a result, faster customer adoption is likely (Rogers 2003), which motivates retailers to designate more shelf space to such offerings and promises earlier firm revenue streams. Furthermore, choosing conventional projects helps managers communicate the project's prospects, which in turn will be more positively and instantaneously reflected in the current stock price from which managers derive utility (Cohen, Diether, and Malloy 2013). We predict the following:

H<sub>3</sub>: After going public, firms decrease the level of breakthrough innovations.

*Does going public decrease innovations in new-to-the-firm categories?* The high failure rate of new products introduced in the CPG industry has been well documented (Steenkamp and Gielens 2003). To reduce the likelihood of failure, managers may try to introduce innovations into

familiar categories as opposed to new-to-the-firm categories, defined as markets in which the firm does not have any existing brands. Innovating within familiar categories is a less risky strategy because the firm can exploit its category-specific knowledge and leverage integrated operations along the value chain. This strategy also enables the firm to leverage its brand equity as well as its existing customer and channel relationships to accelerate market penetration. Finally, staying in familiar terrain requires fewer explanatory firm disclosures and makes it easier for investors to interpret and value firm innovations. For these reasons, we predict the following:

H<sub>4</sub>: After going public, firms are less likely to introduce innovations into new-to-the-firm categories.

## METHOD

### Data Sources

The empirical setting for our study is the CPG sector—a key economic sector in the United States in terms of employment and gross domestic product contribution. The sector has demonstrated extraordinary stock market performance as evinced by an average annual increase in total returns to shareholders of 10% over the past 25 years, outperforming the S&P 500 index as well as high-growth industries such as information technology, telecommunication, and energy (McKinsey & Company 2011). Despite its economic importance, the sector has been underrepresented in empirical innovation research (e.g., Bayus, Erickson, and Jacobson 2003). Importantly for our study, the sector heavily relies on product innovation as a growth strategy (Sorescu and Spanjol 2008).

To test our predictions, we assemble a data set based on several archival sources: (1) Datamonitor's ProductLaunch Analytics for information about U.S. firm product introductions into U.S. food, drug, and mass retailers; (2) EDGAR and SDC Platinum for information on IPOs (Global New Issues Database) and mergers and acquisitions (Mergers & Acquisitions Database); (3) Compustat annual firm databases for financial and accounting data; (4) ReferenceUSA and the Center for Research in Security Prices (CRSP) database for firm public status and firm age; (5) Factiva newspaper database for firm press coverage; and (6) IRI's *Marketing Factbook* for industry-level (defined as category-level in these data) and firm-level controls.

### Sample

The sample begins with the population of U.S. firms tracked by ProductLaunch Analytics that introduce CPG products into the U.S. market ( $n = 215,668$ ). We eliminated firms for which we could not locate a company name or that have incomplete product data such as category or breakthrough rating ( $n = 434$ ). We dropped firms that introduced only one product during the observation period because it is unreliable to study changes in introductions for these firms ( $n = 28,709$ ). We then looked up each of the remaining firms in ReferenceUSA to determine whether they went public between 1980 and 2011. If so, we searched U.S. Securities and Exchange Commission Form S-1 filings to determine the exact date of the IPO. We deleted firms that were not incor-

porated in the United States, firms that we could not unambiguously locate in Compustat, firms that were all-private or all-public during the observation period, and firm-year observations after firms delisted from public stock markets (total  $n = 145,798$ ). Using the SDC Platinum Mergers & Acquisitions Database, we identified firms involved in mergers and acquisitions and ensured that product introductions were assigned to the correct firm.

These deletions resulted in a final sample of 40,724 new product introductions by 207 firms undergoing an IPO during the observation period. This sample, referred to as "changeover firms," involves 3,954 firm-year observations. It reflects an unbalanced number of years before and after the IPO to capture the widest time series possible. However, we have at least three years of data pre- and post-IPO.<sup>1</sup>

In the process of building the changeover sample, we also identified firms that remained private throughout the observation period as noted previously. We retained these firms and built a private benchmark sample, which comprises 158 firms that introduce 18,160 new product introductions between 1980 and 2011. We have 3,433 firm-year observations for this sample of private firms.

### Measures

Our predictions examine four dimensions of firm innovation activity—all derived from ProductLaunch Analytics, which is an established data source in CPG studies (Moorman et al. 2012; Sorescu and Spanjol 2008). ProductLaunch Analytics counts each new product introduction as an innovation. We measure the number of firm innovations by counting the firm's total new products introduced in a given year. Because the yearly number of innovations is highly skewed, we follow Chemmanur and Tian (2013) and use the natural logarithm of the count. To avoid losing firm-year observations in which no products were introduced, we add 1 to the actual number when calculating the natural logarithm. As the measure of firm innovation variety, we collect the number of SKUs associated with each firm innovation and use the natural logarithm of SKUs per firm innovation.

To capture firm breakthrough innovation, we follow Sorescu and Spanjol (2008) and count the number of new products that target a new market and/or offer a substantially new consumer benefit through product positioning, merchandising, packaging, formulation, or technology. These classifications are drawn from the ProductLaunch Analytics database, and we use the natural logarithm of the firm's breakthrough innovation count.

Finally, we measure innovation in a new-to-the-firm category as equal to 1 if the firm introduces an innovation into a category for which the firm has no experience in a given year, and 0 otherwise. We construct a binary variable instead of a count variable because firms rarely introduce new products into more than one new category in a given year (3% of the cases). To measure new-to-the-firm category, two research assistants used the product description in

<sup>1</sup>If the IPO was completed after March 2009, we excluded the firm to ensure that we have at least three years of post-IPO data. In unreported analyses, we repeat our models for firms including IPO years until 2010, and the results replicate.

ProductLaunch Analytics to classify each innovation into its corresponding IRI *Marketing Factbook* category. This was a straightforward task with 99% agreement (e.g., ProductLaunch's "shampoos" were classified into IRI's "shampoo and conditioner" category). We then compared the coded category of the firm's innovation with the firm's history of categories during the observation period to determine whether it represents a new category for the firm.

Our focal predictor is the binary post-IPO variable Public. This variable equals 1 if the firm-year observation occurs when the firm is in public state and 0 if the firm is in private state. We capture the going-public effect by comparing the post-IPO innovation outcomes with the same firm's pre-IPO innovation outcomes (i.e., a within-firm effect) and with firms that remain private throughout the observation period (i.e., a between-firm effect). This approach, which corresponds to the difference-in-difference identification strategy used by Chemmanur, He, and Nandy (2010), controls for firm-specific effects over time as well as cross-sectional effects stemming from unobserved time-specific variation.

Finally, we control for several variables. We include firm age to control for firm life-cycle effects. To measure firm age, we collect firm founding dates from the ReferenceUSA database. If no entry was found, we use the first entry in the CRSP database as the founding date. Previous research has suggested that firm size influences innovation efforts (e.g., Chandy and Tellis 2000). We lack time-series data to compute conventional measures of firm size, such as firm sales or number of employees, because such data are not available for private firms. Therefore, we resort to firm press coverage as a proxy for firm size, operationalized as yearly weighted number of articles found about the focal firm in the Factiva newspaper database. Previous literature has documented strong correlations between media coverage and traditional firm size metrics (Fang and Peress 2009). For our public-state observations, we find correlations of firm press coverage with firm sales ( $\rho = .51, p < .01$ ), firm total assets ( $\rho = .47, p < .01$ ), and firm number of employees ( $\rho = .32, p < .01$ ).<sup>2</sup> To control for the possibility that innovations might generate press coverage and thereby distort our size proxy, we regress press coverage on firm innovations (controlling for year and firm fixed effects) and use the residual as an alternative measure of firm size. We replicate our results.

We also include a variable to control for the demand frequency of firm innovation efforts, measured as industry purchasing frequency. Purchasing frequency is defined as the number of times the average buying household purchases

products in a given category over a year. We calculate purchasing frequency averages from the IRI *Marketing Factbook* for each IRI category and year and match them with firm data for the firm's dominant industry, as determined by Compustat. We also include industry concentration to control for the impact of a firm's competitive situation on its innovation strategies. Our measure is the Herfindahl–Hirschman index, which is the sum of squared market shares of firms in a firm's industry.

### Modeling and Estimation Approach

Next, we describe our four core models in detail. We begin by testing our predictions with these models. We then offer a set of tests to rule out questions related to endogeneity, including alternative explanations for our observed effects associated with IPO selection, reverse causality, and firm dynamics.

*Does going public increase the overall number of innovations?* We predict that the number of innovations will increase after the IPO, and we build the following model to test this prediction:

$$(1) \text{Innovations}_{i,t} = \beta_0 + \beta_1 \text{Public}_{i,t} + \beta_{2-5} \text{Controls}_{i,t} + \delta_t \text{Years}_t + \alpha_i + \varepsilon_{i,t},$$

where  $\text{Innovations}_{i,t}$  is the natural logarithm of the number of innovations introduced by firm  $i$  in year  $t$  and  $\text{Public}_{i,t}$  is a dummy variable that indicates whether firm  $i$  is public (1) or private (0) in year  $t$ .  $\text{Controls}_{i,t}$  captures the vector of control variables (i.e., firm age, purchasing frequency, industry concentration, and press coverage).  $\text{Years}_t$  is the vector of year dummies,  $\alpha_i$  are firm fixed effects to control for unobserved heterogeneity, and  $\varepsilon_{i,t}$  is an error term  $\sim N(0, \sigma)$ . We use cluster-robust standard errors to estimate Equations 1–4 to control for heteroskedasticity and serial correlation in the error terms.

Our focus is on  $\beta_1$ , which indicates whether a firm changes its overall innovation level after going public. In a semilogarithmic model, the percentage change in the level of the dependent variable is not equal to the coefficient of the binary variable multiplied by 100. We correct for this by transforming the coefficient ( $\beta_1$ ) (Halvorsen and Palmquist 1980) in Equations 1–3. A positive (negative) coefficient denotes that firms increase (decrease) the overall number of innovations post-IPO.

*Does going public increase innovation variety?* We examine how the number of different SKUs associated with an innovation changes after the firm's IPO with the following model:

$$(2) \text{InnovationVariety}_{j,i,t} = \beta_0 + \beta_1 \text{Public}_{i,t} + \beta_{2-6} \text{Controls}_{i,t} + \delta_t \text{Years}_t + \alpha_i + \varepsilon_{i,t},$$

where  $\text{InnovationVariety}_{j,i,t}$  is the natural logarithm of the number of SKUs of innovation  $j$  for firm  $i$  in year  $t$ . As before,  $\text{Public}_{i,t}$  indicates firm public status, and  $\text{Controls}_{i,t}$  measures the set of control variables firm age, industry purchasing frequency, industry concentration, firm press coverage, and firm total innovations.  $\text{Years}_t$ ,  $\alpha_i$ , and  $\varepsilon_{i,t}$  share the same interpretation as in Equation 1. A positive (negative)

<sup>2</sup>In an effort to circumvent these data limitations, we used the following strategy to collect firm revenue data. First, to gauge data availability, we looked up each firm in archived versions of Wards Business Directory and Dun & Bradstreet Million Dollar Directory in 5-year increments across the 30-year observation period (i.e., 1980, 1985, 1990, 1995, 2000, 2005, and 2010). We were able to locate each firm in at least one of these five-year intervals at the rate of 55% for private firms and 70% for changeover firms. Unfortunately, the time-series of firms was incomplete for many years, meaning that most firms do not appear in the majority of time periods in these volumes. In the end, we were only able to retrieve 24% of the firm-year observations, making it untenable to use this measure in our analysis. Despite this, we observe a correlation of  $\rho = .53$  ( $p < .01$ ) between the collected firm sales data and firm press coverage, thus increasing confidence in our current measure of firm size.



$\beta_1$  coefficient implies that firms introduce a larger (smaller) number of different SKUs per innovation after going public.

Does going public decrease the level of breakthrough innovations? To answer this question, we model the following:

$$(3) \text{Breakthrough}_{i,t} = \beta_0 + \beta_1 \text{Public}_{i,t} + \beta_{2-6} \text{Controls}_{i,t} + \delta_t \text{Years}_t + \alpha_i + \varepsilon_{i,t},$$

where  $\text{Breakthrough}_{i,t}$  is the natural logarithm of the number of breakthrough innovations by firm  $i$  in year  $t$ . The right-hand-side variables have the same interpretation as in Equation 2. A positive (negative)  $\beta_1$  coefficient implies that, after going public, firms introduce a larger (smaller) number of breakthrough innovations, controlling for overall innovation level.

*Does going public decrease innovations in new-to-the-firm categories?* Finally,  $H_4$  predicts that post-IPO firms are more likely to introduce their innovations into familiar categories instead of expanding into new-to-the-firm categories. We estimate the following probit model to test this prediction:

$$(4) \quad \Pr(\text{NewCat}_{i,t} = 1 | x_{i,t}, \beta) = \Phi(\beta_0 + \beta_1 \text{Public}_{i,t} + \beta_{2-6} \text{Controls}_{i,t} + \delta_t \text{Years}_t),$$

where  $\text{NewCat}_{i,t}$  is a binary variable equal to 1 if the firm introduces any of its innovation in year  $t$  into a new-to-the-firm category, and 0 otherwise.  $\text{Public}_{i,t}$ ,  $\text{Controls}_{i,t}$ , and  $\text{Years}_t$  share the same interpretation as in Equation 2;  $v_{i,t}$  is an error term  $\sim N(0, 1)$ ; and  $\Phi$  is the standard normal cumulative distribution function. We only retain firm-year observations in which firms introduce at least one innovation given that we are not able to determine category choices if no introductions are made. A positive (negative) coefficient provides evidence that firms are more (less) likely to introduce their innovations into new-to-the-firm categories after going public.

## RESULTS

Table 2 presents summary statistics for our sample. Firms introduce an average of 5.5 innovations per year. Most of these innovations are incremental (only .32 are breakthrough), which is in line with prior research on innovation in the CPG sector (e.g., Steenkamp and Gielens 2003). Firms introduce an average of 2.30 different SKUs per innovation and tend to innovate in familiar categories.

Figure 1 depicts the time series of IPO activity in our sample. Confirming previous literature, we observe a high number

of IPOs in the mid-1990s.<sup>3</sup> A clustering of IPOs in the midst of our time series fits well with our research setup and ensures a balanced number of pre- and post-IPO year observations.

### Does Going Public Increase the Overall Number of Firm Innovations?

Table 3 presents Equation 1 regression results. Results indicate that the overall model is significant ( $F(31) = 7.35$ ,  $p < .01$ ). In support of  $H_1$ , we find that that  $\beta_1$  is positive and significant ( $\beta_1 = .1167$ ,  $p < .01$ ), suggesting that going public is positively related to the number of innovations the firm generates subsequently. Specifically, compared with private firms and controlling for other firm characteristics, public firms introduce 12% more innovations, on average. Figure 2, Panel A, plots the actual number of innovations five years before and after the time of the IPO for the sample of changeover firms. The graph shows a stable level of innovations before going public followed by an increase in the years following the IPO.

<sup>3</sup>Firms go public in waves, and IPO climate conditions are a main driver of the decision to go public (e.g., Brau and Fawcett 2006). We compare our sample distribution of IPOs to the population distribution of all IPOs in the United States from Jay Ritter's IPO data (see <http://bear.warrington.ufl.edu/ritter/ipodata.htm>) and find an almost identical pattern.

Figure 1  
Time Series of Sample IPO Activity

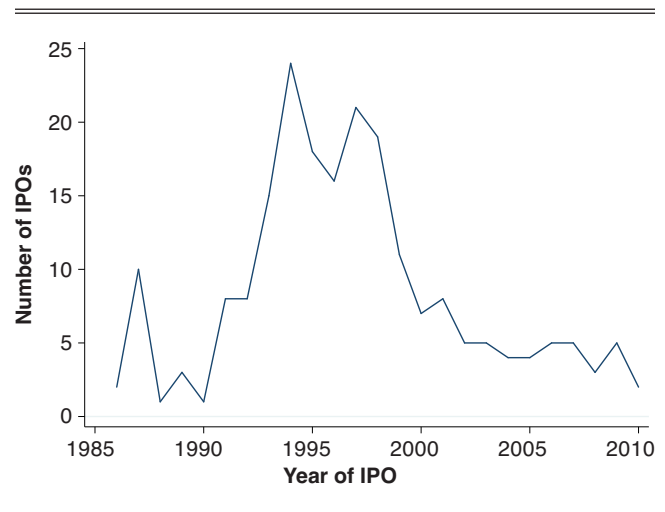


Table 2  
DESCRIPTIVES

Variable	M	SD	Min	Max
Firm innovations	5.513	19.668	0	295
Firm innovation variety	2.296	3.106	1	99
Firm breakthrough innovations	.324	1.343	0	28
Firm innovation in new-to-the-firm category	.078	.268	0	1
Firm public status	.282	.451	0	1
Firm age	41.040	41.038	2	205
Industry purchasing frequency	3.930	1.801	.917	15.873
Industry concentration	.249	.259	0	1
Firm press coverage	.003	.012	0	.189

Notes: All variables are reported in original units and before logarithmic transformation. Apart from innovation variety, all variables are measured on firm-year level; innovation variety is measured at the firm-innovation level.

Table 3  
FIRM INNOVATION OUTCOMES

	Equation 1 <i>Firm Innovations</i>	Equation 2 <i>Firm Innovation Variety</i>	Equation 3 <i>Firm Breakthrough Innovations</i>	Equation 4 <i>Firm Innovation in New-to-the-Firm Category<sup>a</sup></i>
Public ( $\beta_1$ )	.1167*** (.042)	.0353*** (.013)	-.0360** (.015)	-.4879*** (.098)
Firm age ( $\beta_2$ )	.0257*** (.003)	.0181*** (.001)	-.0012** (.001)	-.0032*** (.001)
Firm industry purchasing frequency ( $\beta_3$ )	.0087 (.009)	-.0105** (.005)	.0028 (.002)	-.0035 (.025)
Firm industry concentration ( $\beta_4$ )	-.0805 (.115)	-.0189 (.050)	-.0372 (.031)	.0909 (.177)
Firm press coverage ( $\beta_5$ )	4.6230* (2.617)	-7.6290 (9.003)	-.6703 (.978)	-.9353 (3.097)
Firm innovations ( $\beta_6$ )	—	-.0269*** (.008)	.1593*** (.013)	-.5886*** (.074)
Intercept ( $\beta_0$ )	-.8931*** (.165)	.0683* (.040)	.0147 (.021)	-1.0080** (.491)
Year fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	No
Observations	7,387	40,731	7,387	2,848
Adjusted R-square	.107	.090	.152	.165
F-statistic (d.f.)	7.35*** (31)	21.20*** (32)	8.56*** (32)	171.59*** (32)

\* $p < .10$ .

\*\* $p < .05$ .

\*\*\* $p < .01$ .

<sup>a</sup>Because Equation 4 is estimated as a nonlinear probit model, we report the pseudo R-square (instead of the adjusted R-square), as well as the Wald chi-square statistic (instead of the F-statistic). We omit the model log-likelihood, which is -651.

Notes: Robust standard errors clustered by firm appear in parentheses. Equations 1 and 3 are estimated at the firm-year level, Equation 2 is estimated at the firm-innovation level, and Equation 4 is estimated at the firm-year but only for firms that introduce at least one innovation.

We test the robustness of Equation 1 results by using untransformed innovation data instead of the logged innovation data. Because the untransformed innovation data take on only nonnegative and integer values, we follow traditional patent literature in economics and find that the results remain unchanged when estimated with a negative binomial model (Bernstein 2015).

#### *Does Going Public Increase Firm Innovation Variety?*

Figure 2, Panel B, depicts the actual number of SKUs per innovation for the changeover sample and shows that the number of SKUs increases at the time of the IPO and then levels off. Equation 2 in Table 3 reports our regression results. The overall model is significant ( $F(31) = 21.20$ ,  $p < .01$ ). Confirming  $H_2$ , going public increases the number of SKUs that firms launch for each innovation ( $\beta_1 = .0353$ ,  $p < .01$ ). As an aside, we also observe that an increase in the number of innovations is associated with a lower number of SKUs per innovation. We suspect that this finding reflects the financing constraints firms face when trading off the number of new products and the number of varieties for each new product.

#### *Does Going Public Decrease the Degree of Breakthrough Innovations?*

We plot the cross-sectional proportion of breakthrough innovations to total innovations for the changeover firms in Figure 2, Panel C. In line with theoretical models (see Spiegel

and Tookes 2008), we find a spike of breakthrough innovations in the year before the IPO and a gradual decrease following the IPO. We present a formal test of Equation 3 in Table 3.<sup>4</sup> The overall model is significant ( $F(32) = 8.56$ ,  $p < .01$ ), and consistent with  $H_3$ , going public decreases the number of breakthrough innovations ( $\beta_1 = -.0360$ ,  $p < .05$ ). Unreported robustness checks show that the number of incremental innovations (defined as firm total innovations minus breakthrough innovations in a given year) increases after going public. That is, while introducing an overall larger number of innovations, firms introduce more incremental innovations and fewer breakthrough innovations.

#### *Does Going Public Decrease Innovations in New-to-the-Firm Categories?*

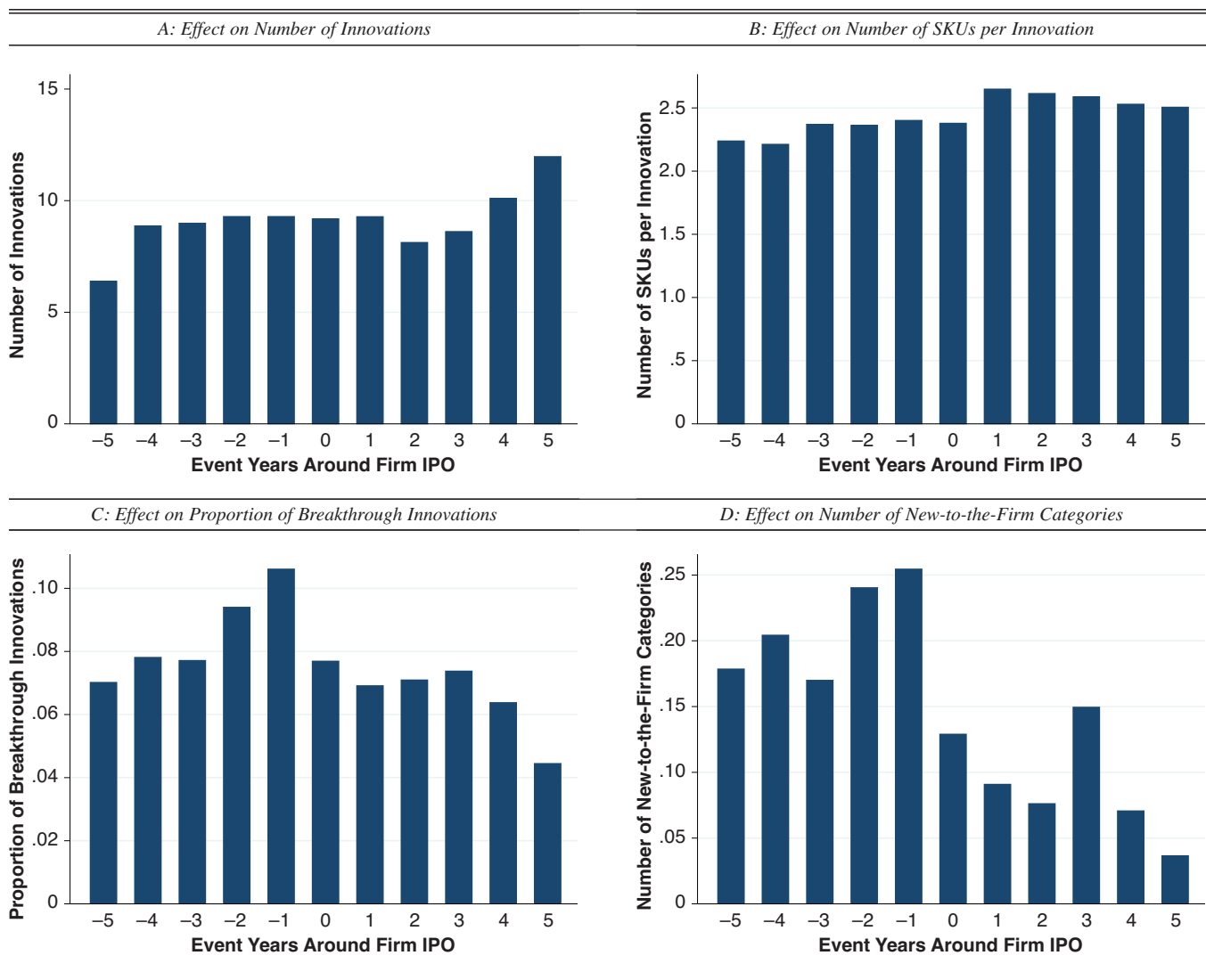
As we depict in Figure 2, Panel D, the number of new-to-the-firm categories drops rapidly after the IPO. This is supported by the binary regression results of Equation 4 in Table 3. The model is statistically significant ( $\chi^2(32) = 171.59$ ,  $p < .01$ ). After going public, firms are less likely to expand into new-to-the-firm categories ( $\beta_1 = -.4879$ ,  $p < .01$ ), controlling for the total number of innovations. This finding supports  $H_4$ .<sup>5</sup>

<sup>4</sup>To mitigate concerns that Equation 3 becomes endogenous when we control for the number of innovations, we follow Sorescu and Spanjol (2008), who instrument the number of innovations in year  $t$  by the number of innovations in year  $t - 1$ . Our results replicate.

<sup>5</sup>We reestimate Equation 4 including firm-year observations with zero innovations and find that our results replicate.



Figure 2  
INNOVATION OUTCOMES FOR FIRMS UNDERGOING AN IPO



In unreported tests, we also control for the cumulative number of categories in which the firm has introduced products and find the going-public effect to be even stronger ( $\beta_1 = -.5205, p < .01$ ).

#### Summary

Our findings indicate that when a CPG firm goes public, it increases the number and variety of innovations it introduces but reduces the riskiness of those innovations (measured as number of breakthrough innovations and new-to-the-firm categories). Given the importance of our findings, the following two sections offer follow-up analyses and a set of endogeneity checks. The next section begins by offering an exploratory examination of whether firms can beat the going-public effect. This is followed by two corroborating analyses. Specifically, if the stock market has the effect of influencing innovations for firms that go public, does going private have the opposite effect and does the degree of exposure to the stock market strengthen the effect? The

second section examines questions related to endogeneity, including alternative explanations for our observed effects associated with IPO selection, reverse causality, and firm dynamics.

#### FOLLOW-UP AND CORROBORATING ANALYSES

##### Can Firms Beat the Going-Public Effect?

Our results demonstrate that going public reduces the riskiness of firm innovations, including breakthrough innovations and innovations in new-to-firm categories. Given these effects, we next consider whether some firms continue to introduce risky innovations despite going public and, if so, what factors differentiate these firms. We focus our attention on whether firms continue to introduce breakthrough innovations given that breakthrough innovations have a clear positive effect on firm performance (e.g., Sorescu and Spanjol 2008). The choice to introduce products in new categories has a more equivocal effect, and

some research has observed a negative effect on firm performance due to the costs of diversification (e.g., Campa and Kedia 2002; Wernerfelt and Montgomery 1988) and other research pointing to a positive effect due to risk diversification (e.g., Villalonga 2004).

Given our focus on stock market incentives, we examine two types of countervailing product-market incentives that should tip the public firm's calculus toward continuing to introduce breakthrough innovations. First, there must be demand-side opportunity, meaning a strong likelihood that customers will purchase the firm's breakthrough innovation. Second, there must be appropriability opportunities that protect the firm's ability to extract profits from its breakthrough innovation.

We examine these moderating forces at the industry level because they are product-market variables. This industry-level view offers two additional empirical advantages. We are able to retain the same empirical approach used in our hypothesis testing because we can measure these industry factors when the firm is in a private and a public state. A focus on industry factors also minimizes endogeneity concerns because these factors are independent of firm strategy.

Beginning with demand-side opportunities in product markets, we theorize that public firms operating in industries with higher industry sales growth will make higher investments in risky innovation given the expectation of an increasing pie and potentially a larger piece of that pie (McDougall et al. 1994). Similarly, we expect that industry demand instability will weaken firm incentives to engage in risky innovation because it jeopardizes innovation returns, which puts public firms at risk of underdelivering against investors' earnings projections.

Public firms are more likely to invest in risky innovation when they also have an increased opportunity to extract or appropriate the returns from doing so (Cohen and Levin 1989). Given this, we focus on two industry factors that should heighten this opportunity. First, we expect that higher industry value appropriation emphasis will increase this opportunity. Firms may appropriate value from innovation by protecting returns with patents or by advertising (which builds brands and customer relationships), both of which may protect the firm from imitators. Given its low patent rate, the CPG sector appears to use advertising for this purpose. If, as Mizik and Jacobson (2003, p. 66) argue, company "resources end up concentrated in the areas of the greatest perceived importance," it follows that an industry emphasis on value appropriation will support firms investing in breakthrough innovations. Although conceptualized as a firm trait, we argue that industries also vary on this emphasis.<sup>6</sup> Second, we expect that greater industry concentration will increase opportunities to extract value from innovation. This is the case because higher levels of industry concentration typically reduce the entry of new competitors and the intensity of competition among existing firms in the industry.

To test these predictions, we construct interaction terms with each product-market contingency and the public state

dummy and add them to our breakthrough innovation model (Equation 3):

$$\begin{aligned} (5) \text{ Breakthrough}_{i,t} = & \beta_0 + \beta_1 \text{Public}_{i,t} + \beta_{2-5} \text{Controls}_{i,t} \\ & + \beta_{6-9} \text{ProductMarketFactors}_{i,k,t} \\ & + \beta_{10-13} \text{Public}_{i,t} \times \text{ProductMarketFactors}_{i,k,t} + \\ & \delta_t \text{Years}_t + \alpha_i + \epsilon_{i,t}, \end{aligned}$$

where  $\text{Breakthrough}_{i,t}$ ,  $\text{Public}_{i,t}$ ,  $\text{Years}_t$ , and  $\alpha_i$  share the same interpretation as in Equation 3, and  $\text{Controls}_{i,t}$  is the same vector of control variables except for firm industry concentration, which is now in the  $\text{ProductMarketFactors}_{i,k,t}$  vector.  $\text{ProductMarketFactors}_{i,k,t}$  is the vector of product-market contingencies for firm  $i$  in industry  $k$ . We mean-center all continuous variables to facilitate interpretation of the public main effect. As before, we use cluster-robust standard errors to estimate Equation 5, and  $\epsilon_{i,t}$  is an error term  $\sim N(0, \sigma)$ .

We measure industry sales growth as the compounded annual sales growth rate over the previous three years (Luo and Donthu 2006) and industry demand instability as the standard deviation of the industry sales growth (Gruca and Rego 2005). Following Mizik and Jacobson (2003), we measure industry appropriation emphasis as firm advertising expenditures minus firm R&D expenditures, scaled by total assets, averaged over all firms per year in a given industry.<sup>7</sup> As before, industry concentration is measured by the Herfindahl-Hirschman index. Web Appendix A contains a correlation matrix of all variables in this model.

The overall model is significant ( $F(39) = 6.03, p < .01$ ), and our public main effect remains negative and significant ( $\beta_1 = -.0310, p < .05$ ). Industry sales growth positively moderates the going-public effect ( $\beta_{10} = .3146, p < .05$ ), while industry demand instability does not have a significant impact, though the sign is in the expected direction ( $\beta_{11} = -.0139, n.s.$ ). Industry strategic emphasis ( $\beta_{12} = 1.1167, p < .01$ ) and industry concentration ( $\beta_{13} = .1421, p < .05$ ) positively moderate the going-public effect. Web Appendix B provides a complete set of model results. We conclude from these results that the industry in which a public firm operates can offer product-market incentives that counterbalance stock market pressures. In particular, both demand opportunities and innovation-appropriability opportunities can counteract stock market pressures faced by public firms.

#### *Does Going Private Influence Level and Riskiness of Innovations?*

If our theory holds, we should observe the reverse of the going-public effect when firms delist from public stock markets. Specifically, after going private, there should be a drop in innovation level and an increase in the riskiness of innovations. To examine this question, we identify a new sample of 90 public CPG firms from Compustat that delisted from public stock markets within our observation period. Excluding firms that lack data for at least three years

<sup>6</sup>Mizik and Jacobson (2003) also highlight industry differences in these emphases in their article.

<sup>7</sup>Although three of our four moderators can only be measured at the industry level, value appropriation emphasis can also be measured at the firm level. We remain at the industry level for theoretical reasons and so we can observe the firm in both its public and private states—a feature that is important to our quasi-experimental design.

before and after the delisting (Lerner, Sorensen, and Strömberg 2011) reduces the sample size to 77 firms.<sup>8</sup> Block (2004) observes that the ratio of firms going private to going public is in the 20%–30% range, which compares well with our sample ratio of 36%. We then test Equations 1–4 and capture the going-private effect by the reversed sign of the public variable.

Confirming the counterfactual implied in  $H_1$  and  $H_2$ , firms significantly decrease their level of innovations ( $\beta_1 = -.2256, p < .05$ ) and marginally decrease their innovation variety ( $\beta_1 = -.6688, p < .10$ ) after going private. We also find that firms are more likely to introduce products into new-to-the-firm categories ( $\beta_1 = .4515, p < .05$ ) after delisting ( $H_4$ ). Our results do not, however, provide evidence that firms increase their number of breakthrough innovations after going private ( $\beta_1 = -.0066, n.s.; H_3$ ).

#### *How Do Seasoned Equity Offerings Influence Firm Innovation?*

Another follow-up question involves whether firms that are more exposed to the stock market experience similar changes in innovation. Specifically, we analyze the innovation strategies of firms that offer seasoned equity after the initial IPO. We collect information on seasoned equity offerings (SEOs) of the changeover firms from the SDC Platinum Global New Issues database and create a variable that cumulatively counts the number of SEOs for each firm. The maximum number of SEOs observed per firm in our sample is 9 ( $M = .61, SD = 1.40$ ). Interacting the SEO count variable with the public state dummy and including it in our earlier models has a significant effect only for the number of breakthrough innovations ( $\beta_1 = -.030, p < .05$ ). Thus, offering more equity to public firms increases their exposure to stock market incentives and leads firms to reduce breakthrough innovation levels.

#### ENDOGENEITY ANALYSES

Our empirical identification strategy lacks randomized assignment into the going-public or staying-private firm conditions. Thus, we cannot rule out the possibility that the going-public decision is correlated with the firm's innovation activity. We address this potential endogeneity problem in part by using a fixed-effects estimator, which rules out time-invariant unobservable firm characteristics that may be confounded with both the decision to go public and firm innovation strategies (e.g., Chemmanur, He, and Nandy 2010; Mikkelsen, Partch, and Shah 1997). In this section, we describe three additional strategies to mitigate endogeneity concerns, including self-selection, reverse causality, and alternative explanations involving firm dynamics.

#### *Ruling Out Self-Selection*

**Heckman self-selection correction.** To perform the Heckman two-step estimation, we begin by estimating a first-stage binary regression to predict the probability of being a publicly listed firm using a latent index function  $IPO^* = \beta'X + u$ , with  $IPO = 1$  if  $IPO^* > 0$  and  $IPO = 0$  if  $IPO^* < 0$ . We fol-

low Xiong and Bharadwaj (2011) and include a measure of firm size (press coverage proxy), firm location (state of firm headquarter), firm age, and industry dummies as predictors of the going-public decision.<sup>9</sup> The dependent variable—going public—is equal to 0 for all private firms. For public firms, it is 0 in all years before the IPO, 1 in the year of the IPO, and set to missing in the years when the firm is public.<sup>10</sup> The results indicate that the overall model is significant (likelihood-ratio  $\chi^2(54) = 93.82, p < .01$ ), with firm size predicting the decision to go public ( $\beta = 8.42, p < .01$ ), but not firm age ( $\beta = -.001, n.s.$ ). We then compute the inverse Mills ratio derived from the probit model as  $\lambda = \varphi(\beta'X)/\Phi(\beta'X)$ —where  $\varphi$  and  $\Phi$  are the probability density function and cumulative density function of the normal distribution, respectively—and add it as a predictor to correct for self-selection in Equations 1–4. We bootstrap the standard errors and observe that the inverse Mills ratio is not significant in any of the models and that our results replicate.

**Magnitude measure self-selection correction.** Li and Prabhala (2007) propose an alternative technique to address the endogenous selection problem. Specifically, they suggest using a variable that indicates the magnitude of the selection, conditional on the selection itself, as a correction term. Consistent with this idea, we can observe the firm going public and the size of its equity offering. Retrieving these data from SDC Platinum for 104 of the 207 changeover firms, we reestimate Equations 1–4 and include an additional regressor—the size of the equity offer—to correct for selection. Results indicate that this magnitude variable does not have a significant effect on our innovation outcomes, and our results hold.

**Entropy balancing and matching self-selection correction.** To eliminate bias arising from having qualitatively different treatment (changeover) and control (private) groups, we control for observable differences between public and private firms by employing both balancing and matching corrections. First, we use a probability-weighting procedure to complement traditional ordinary least squares estimation by confining estimation to a balanced sample of firm observations with similar covariate propensities. Weighting prevents sample loss that might occur in matching procedures—an attractive feature when using continuous covariates. Following Hainmueller (2012), we use entropy balancing, a generalized propensity score weighting technique, to determine the influence of the going-public decision on firm innovation. Our predictors for selection into the changeover group (treatment) that goes public are the firm covariates from our earlier model. Following balancing, the descriptives for the sample do not differ between treatment and control groups. Weighting on these variables, we replicate our results. Second, we also match observables on propensity scores associated with these same covariates and replicate our results (Rosenbaum and Rubin 1983).

<sup>9</sup>We tested the sensitivity of the two-stage estimation by including different sets of predictors in the first-stage regression. Following recent work in finance, we also included the annual return on the S&P 500 index, number of firms listed in CRSP, standard deviation of analyst forecasts, and number of analysts (Chemmanur, He, and Nandy 2010). Our second-stage results replicate under these specifications.

<sup>10</sup>If we instead retain the years when the firm is public and set these years to a value of 1, our results replicate.

<sup>8</sup>Lerner, Sorensen, and Strömberg (2011) use three years before and five years after the delisting. To maximize our sample size, we adopt the three-year frame before and after.



### *Ruling Out Reverse Causality*

Another endogeneity concern is that the innovation pattern we observe is not a function of the IPO; instead, the IPO is a function of the firm's past innovation and future innovation expectations. To resolve this concern, first, we use the prediction model we applied in our earlier Heckman selection specification to forecast the probability that a firm will go public. We then identify firms that only have a low probability of going public in a particular year but still pursue an IPO.<sup>11</sup> We build a dummy variable UIPO—unanticipated IPO—that is equal to 1 if firm *i* unexpectedly goes public in year *t*, and 0 otherwise. We regress the lagged number of innovations and breakthrough innovations on UIPO. Neither is significant, suggesting that prior levels of innovation do not induce firms to pursue an IPO. This is consistent with prior literature suggesting that market conditions motivate if and when firms go public (Braun and Fawcett 2006).

As a second step, we explore managers' expectations of future firm performance. As a proxy for managerial confidence in future firm competitiveness, we study insider trading behavior after the firm goes public. We collect insider transaction data from Thomson Reuters Insider Filing Data Feed for all firms in our changeover sample and add a randomly drawn sample of 223 public CPG firms for which insider transaction data are available. Summing the number of transactions among firm executives for each firm-year, we do not find a significant difference in share purchasing ( $t = -1.01$ , n.s.), share selling ( $t = .74$ , n.s.), or net share purchasing selling ( $t = -.59$ , n.s.) between the newly public changeover firms and the randomly drawn public firms. This finding suggests that managers of the changeover firms were not pessimistic about firm prospects and supports the view that our results are not driven by reverse causality.

### *Ruling Out Alternative Firm Dynamics*

*Ruling out IPO dynamics.* One alternative explanation is that our results are a short-term effect resulting from pre-IPO window dressing and not a persistent transformation in firm strategy. Although our 30-year time series before and after the IPO is an important reason to doubt this concern, we offer three additional tests to rule it out. First, we exclude the IPO year, as well as one or two years before and after the IPO, and replicate our results. We also build a binary variable equal to 1 if the observation comes from one or two years before the IPO and 0 if it comes from any other firm-year. Regressing this variable on our innovation outcomes yields no significant effects, indicating that the years around the IPO do not drive our findings. Second, we remove the public dummy predictor and use a continuous variable that counts firm-event years (where firm IPO year = 0). We find that the predictor is significant and in the same direction as the public dummy, indicating that the more years after the IPO, the more firms increase innovation levels and reduce risky innovation. Third, we control for a potential over-time trend toward less innovative products by

including a within-firm trend variable in our earlier models. We replicate our public effect in all four models.

*Ruling out firm life-cycle dynamics.* A second alternative explanation is that the firm's own life cycle produces the observed innovation outcomes (Bernstein 2015). Specifically, as the firm evolves over time, it exhibits different strategies. We control for age, which partials out substantial life-cycle effects. In an additional robustness check, we test our models on a new sample of firms that planned but did not complete an IPO and are at the same stage in their life cycle as the firms in our sample. We were able to identify 36 firms that registered with the Securities and Exchange Commission to go public but withdrew their filings. We collected information on the planned IPO date from SDC Platinum Global New Issues Database. Comparing the pre-planned-IPO observations with the post-planned-IPO observations, we do not find a change over the planned IPO date for any of our four innovation outcomes. Although instructive, the small sample makes it challenging to detect significant patterns, and therefore we interpret these results with caution.

*Ruling out management-team dynamics.* A third alternative explanation for our findings is that firms change their management teams when going public and that this change leads to the observed innovation strategy changes. We do not expect this reasoning to explain our results for three reasons. First, prior literature has found that going public does not lead to high management turnover (Mikkelsen, Partch, and Shah 1993). Second, even if turnover does occur at the IPO, to explain our results, firms would systematically have to choose managers who adopt the innovation pattern we uncover. Although we cannot exclude this possibility, it seems unlikely. Third, we collect evidence from ExecuComp to study chief executive officer (CEO) tenure for a sample of our changeover firms for which data are available. For a total of 247 CEOs ( $n = 90$  firms) from 1992–2011, a new CEO was appointed when the firm went public in only 15 cases (16.6%).

## DISCUSSION

### *Summary of Key Contributions*

Our findings contribute to the literature in the following ways. First, by examining new product introductions instead of R&D spending and patents, we offer the first investigation of the going-public effect that relies on actual innovations introduced to the market. As such, we argue that our empirical approach offers a more valid test of the going-public effect. Second, the use of actual new product introductions enables us to include new market entry as a type of innovation that might be influenced by firms going public. Specifically, we demonstrate that both product-level and market-level forms of risky innovation are influenced by stock market incentives.

Third, whereas existing literature using a quasi-experimental approach has focused on technology sectors, we focus on firms in the CPG sector, which face unique regimes to appropriate value from innovations. By showing that the going-public effect does occur in this sector and that it does so over a 30-year period, we add to the generalizability of the going-public effect. Examining this industry also enables us to offer the risk-reduction prong of the going-public effect as a reason CPG firms may use an SKU-proliferation

<sup>11</sup>We define these firms as those that have a probability of .4 or lower of going public in year *t* but still pursue an IPO in year *t*, *t* – 1, or *t* + 1. The results replicate with cutoff points of .5, .3, and .2, respectively.



strategy. This extends literature that has viewed SKU proliferation as a strategy to deter entry (Kekre and Srinivasan 1990) or to signal quality (Draganska and Jain 2005).

Fourth, our empirical strategy examining firms before and after stock market listing is among a small number of studies adopting this quasi-experimental setup. With a range of tests to rule out endogeneity concerns, reverse causality, and competing explanations, we increase confidence in the going-public effect by demonstrating that IPO selection and IPO dynamics do not drive its operation.

Finally, we attempt to understand whether firms can defy the going-public effect and continue to introduce breakthrough innovations after going public. We identified a set of industry factors that might shift the public firm's calculus away from stock market incentives and toward product-market incentives. Industry factors can also be measured before and after the IPO, which is consistent with our quasi-experimental approach, and they suffer from fewer endogeneity concerns. We outline directions for further research on this topic in the next subsection.

#### *Influencing the Firm's Post-IPO Innovation Behavior*

Future research examining other industry factors might consider the strategic flexibility of competitors and how firm marketing spending compares with industry averages given that research has identified both as factors influencing the stock market's response to the firm (Kurt and Hulland 2013). Future studies should also consider a broader array of firm and policy variables that facilitate resistance to the going-public effect. To that end, we offer an initial research agenda.

*The role of firm factors in the going-public effect.* First, firms with a stronger history of breakthrough innovation before the IPO may exhibit a smaller drop-off after they go public because their capabilities may continue to operate to the post-IPO period (Argote 1999). Second, the presence of a chief marketing officer or a CEO with a marketing background may facilitate a stronger focus on product-market incentives, given the documented relationship between presence of a chief marketing officer and firm innovation investments (Nath and Mahajan 2008).

Third, research has shown that family firms are more likely to invest in value appropriation (Kashmiri and Mahajan 2010) and less likely to decrease their new product introductions during recessions (Kashmiri and Mahajan 2014). Thus, family-name presence in the firm name and family ownership both may influence whether firms resist the going-public effect. Research arguing that entrepreneurs are signaling confidence in firm quality when they include their own name in the firm name (Belenzon, Chatterji, and Daley 2014) supports the view that family name is likely to be related to investments in breakthrough innovation.

Fourth, company incentive systems may encourage post-IPO innovation, including performance control systems that reward risk taking, corporate governance structures that include risk-seeking compensation schemes (Currim, Lim, and Kim 2013), and the use of nonfinancial controls in management performance evaluation. Fifth, organizational culture and structure bolster radical innovation levels. We recommend examining whether (1) willingness to cannibalize successful products (Chandy and Tellis 1998), (2) focus on

the future (Yadav, Prabhu, and Chandy 2007), and (3) risk tolerance and product champions (Tellis, Prabhu, and Chandy 2009) also attenuate the going-public effect.

Sixth, given external partnerships influence firm access to novel information and resources (Rindfleisch and Moorman 2001), these relationships may support the newly public firm's breakthrough innovation. Furthermore, contractual arrangements with partners for new products may buffer some of the risk and make it difficult to alter strategies after the IPO.

Whether alone or in combination, it is important to note that most firm factors cannot be modified quickly and are in place before the firm offers its shares to the public. Thus, researchers will need to resolve concerns about endogeneity, including whether the aforementioned firm factors attract certain types of investor clientele that reward innovation (see Homburg et al. 2014; Saboo and Grewal 2013). Separating out such selection effects will be important in future research on this topic.

*The role of policy in the going-public effect.* If our underlying theory about the role of stock market disclosures is correct, the passage of the Sarbanes-Oxley Act should worsen the going-public effect because the law increases the amount of information companies must disclose to shareholders. Research should also examine whether regulation that protects managers from stock market pressures, such as antitakeover laws, weakens the going-public effect.

#### *Post-IPO Innovation Behavior and Firm Performance*

Breakthrough innovations generate stock returns seven times larger than those to incremental innovations (Srinivasan et al. 2009) and have a higher impact on Tobin's  $q$  and abnormal stock returns than incremental innovations (Sorescu and Spanjol 2008). Breakthrough innovations are also more likely to grow markets and to create loyal customers. Given this evidence, our documented shift in innovation behavior may have important consequences for the long-term performance of public firms. As Tellis, Prabhu, and Chandy (2009) observe, capital availability is not sufficient to ensure returns to innovation. Instead, firm performance is conditional on managers making the right kinds of innovation investments.

Examining the effect of innovation strategies on performance is important because breakthrough and new-to-firm category innovations have risks, often fail, and are associated with a higher cash flow discount rate than incremental innovations (Sorescu and Spanjol 2008). Thus, unlike investments in customer satisfaction that exhibit lower risk while generating higher cash flows (Fornell et al. 2006), investments in innovation have substantial downside risk when it comes to financial performance. Thus, investors are likely to demand a price premium to compensate for this increased risk, especially in the immediate period after the IPO when newly listed firms lack prior public performance history. Investments into complementary assets (e.g., marketing) around the IPO can help firms mitigate such risks (Kurt and Hulland 2013).

#### *Limitations and Additional Future Research*

This study represents an early inquiry into the stock market's impact on firm innovation. Thus, we acknowledge sev-

eral limitations that we hope will form the basis of future research. We focus on how the going-public effect influences one aspect of firm marketing strategy—its innovation strategy. Future studies should consider how stock market incentives influence other strategic behaviors, such as a firm's channel or communications strategy. Does a public firm's channel strategy reflect less risk, such as the use of more indirect channels or the use of more channel partners? Furthermore, will public firms shift to the use of promotion over advertising given that it offers shorter-term payoffs (e.g., Pauwels et al. 2004)?

Stock markets offer the firm more resources while also imposing shorter-term incentives and disclosure requirements. Our study does not separate the stock market incentive mechanism from the financing mechanism. To do so, future research should build a sample of firms that went public but only offered existing shares (i.e., conducted a secondary IPO). Although these firms do not raise new capital, they do experience stock market incentives. Unfortunately, we were only able to identify two such firms with complete data for our variables of interest.

### CONCLUSION

This article investigates how the stock market affects firm innovation behavior. In a quasi-experimental research design around firm IPO, we document that going public affects both the level and riskiness of firm innovation. First, after going public, firms innovate at higher levels and introduce more variety with each innovation. This result seems to be driven by increased access to financial and strategic resources after the IPO. Second, firms introduce less risky innovations after the IPO, characterized by fewer breakthrough innovations and fewer innovations into unfamiliar categories. We attribute this finding to the effect of stock market incentives on the public firm. Third, a set of industry factors associated with a strong focus on appropriability and sales growth weaken the negative effect of going public on firm breakthrough innovation. Taken together, results suggest that the stock market not only absorbs information but also generates an incentive structure that affects managerial decision making regarding innovation.

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# GOING PUBLIC: HOW STOCK MARKET LISTING CHANGES FIRM INNOVATION BEHAVIOR

Simone Wies and Christine Moorman

## WEB APPENDIX A

### *CORRELATION MATRIX OF INTERACTION MODEL VARIABLES (EQUATION 5)*

	1	2	3	4	5	6	7	8	9	10
1 Firm breakthrough innovations	1									
2 Public	.1237	1								
3 Firm age	.2999	.1327	1							
4 Firm industry purchasing frequency	.0362	.0069	.0083	1						
5 Firm industry concentration	-.1370	-.0800	-.1675	.0402	1					
6 Firm press coverage	.3374	.1719	.2917	.0170	.0656	1				
7 Firm innovations	.7173	.2531	.3404	.0254	-.1883	.3351	1			
8 Industry strategic emphasis	-.0790	-.1573	-.1359	-.1481	.1516	-.0300	-.1319	1		
9 Industry demand instability	-.0983	-.0364	-.1190	-.0687	.6341	.0761	-.1191	.0938	1	
10 Industry sales growth	.0500	.0475	-.0120	.1945	-.1045	.0224	.0385	.0790	.0508	1

*Note:* All continuous variables are mean centered.

## WEB APPENDIX B

### *INTERACTION MODELS PREDICTING FIRM BREAKTHROUGH INNOVATIONS (EQUATION 5 RESULTS)*

	(1) <sup>a</sup>	(2)	(3)
Public ( $\beta_1$ )	-.1343*** (.031)	-.0384** (.016)	-.0310** (.015)
Firm age ( $\beta_2$ )	-.0060*** (.001)	-.0060*** (.001)	-.0060*** (.0014)
Firm industry purchasing frequency ( $\beta_3$ )	.0006 (.002)	.0016 (.002)	.0006 (.002)
Firm press coverage ( $\beta_4$ )	-.3130 (1.058)	-.2760 (1.051)	-.3130 (1.058)
Firm innovations ( $\beta_5$ )	.1440*** (.012)	.1430*** (.012)	.1440*** (.012)
Industry concentration ( $\beta_6$ )	-.0121 (.035)	.0041 (.032)	-.0121 (.035)
Industry strategic emphasis ( $\beta_7$ )	-.6090*** (.169)	-.4020*** (.145)	-.6090*** (.169)
Industry demand instability ( $\beta_8$ )	-.0116** (.006)	-.0154** (.007)	-.0116** (.006)
Industry sales growth ( $\beta_9$ )	-.1430* (.083)	-.0615 (.086)	-.1430* (.083)
Public*Industry sales growth ( $\beta_{10}$ )	.3146** (.132)		.3146** (.132)
Public*Industry demand instability ( $\beta_{11}$ )	-.0139 (.012)		-.0139 (.012)
Public*Industry strategic emphasis ( $\beta_{12}$ )	1.1167*** (.362)		1.1167*** (.362)
Public*Industry concentration ( $\beta_{13}$ )	.1421** (.062)		.1421** (.062)
Intercept ( $\beta_0$ )	.3320*** (.070)	.1230*** (.015)	.1270*** (.015)
Year fixed effects	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes
Observations	7,173	7,173	7,173
Adjusted R-square	.122	.119	.122
F-statistic (d.f.)	6.09*** (39)	6.26*** (35)	6.09*** (39)

\*\*\* $p < .01$ , \*\* $p < .05$ , \* $p < .10$ .

<sup>a</sup>Estimation using data that are not mean centered.

*Notes:* The dependent variable for all models is firm breakthrough innovations. Robust standard errors clustered by firm in parentheses. The interaction models use a sample of 7,173 observations given data is missing for 214 observations for these variables in Compustat. Column 1 contains our interaction model using data that are not mean-centered. Column 2 contains the main effect model and Column 3 contains the full interaction model using the mean-centered data.

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