Innovation Imprinting: Why Some Firms Beat the Post-IPO Innovation Slump

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Abstract

Growth and innovation are primary arguments for firms seeking to go public and access resources from the stock market. So it is poignant that going public is, for a majority of firms, associated with a pronounced slump in breakthrough innovation. This paper proposes an actionable, marketing-related explanation for why some firms that go public manage to beat the post-IPO innovation slump: innovation imprinting. The paper argues and demonstrates that those firms that engage in innovation imprinting before they go public attract a segment of concordant investors whose risk preferences are more supportive of breakthrough innovation than investors at large. These investors, in turn, reward the firms' continued introduction of breakthrough innovations after they have gone public. By analyzing the innovation patterns of 207 firms in the consumer-packaged goods sector before and after an IPO, we observe that one-third of firms are able to maintain or beat their pre-IPO levels of breakthrough innovations after going public. By studying their actions, the investors they attract, and their financial performance and survival rates, we provide empirical evidence for the importance of innovation imprinting and concordant investors in helping firms beat the post-IPO innovation slump.

Keywords: breakthrough innovation, IPO, marketing-finance interface, investors

Introduction

Business commentators repeatedly warn that "… once companies go public… [they] have pretty much started the inevitable death of innovation" (Deeb 2014). Those who manage public companies lament that when striving to meet Wall Street's quarterly demands, it is "… not always possible to focus on innovating for customers" (Dell 2014). A growing body of academic research reinforces these concerns by finding that once companies go public, they reduce their R&D and marketing spending (Mizik and Jacobson 2007; Chakravarty and Grewal 2011), take less risk in innovating (Markovitch, Steckel, and Yeung 2005), and time the introduction of new products to maximize stock market, not product market, impact (Graham, Harvey, and Rajgopal 2005; Moorman et al. 2012). Other studies document declines in patent innovativeness (Bernstein 2015; Aggarwal and Hsu 2013) and in the introduction of risky innovations (Wies and Moorman 2015) after companies undergo an initial public offering (IPO). Overall, these studies suggest that going public is associated with a pronounced reduction in breakthrough innovation; a phenomenon we refer to as the *post-IPO innovation slump*.

The post-IPO innovation slump is especially striking since the purported logic for accessing public markets is often one that involves growth and innovation (Kim and Weisbach 2008). As Bodnaruk et al. (2008, p. 2818) note, an IPO allows the firm to "raise funds to finance new growth opportunities," and investors buy shares in newly public companies in part to reap the benefits of this growth. If a substantial slump in innovation is "inevitable" among firms that go public, then the implications for these firms—and their investors—are discouraging.

However, there are reasons to believe that not all firms that go public are doomed to experience a post-IPO innovation slump. Empirically, the literature largely focuses on average effects across firms and industries to reach pessimistic conclusions about the slump. But averages might conceal much variance and exceptions can be insightful (Gould 1991). Although

many firms succumb to this slump, others do not. It could be instructive to understand what differentiates the latter from the former. The existing literature emphasizes the role of stock market pressures to explain why managers reduce innovation investments after they go public and thus cause harm to their firms in the long run (e.g., Mizik 2010). Though pressures from stock markets could indeed play a role in discouraging innovation, research shows that these same markets also reward innovation by publicly listed firms (Sorescu and Spanjol 2008; Tellis, Prabhu, and Chandy 2008). The literature offers few explanations for this apparent paradox.

Remarkably, no prior research has so far examined actions that managers can take to beat the post-IPO innovation slump (see Table 1). Existing research has offered insights into industry-level factors that explain why some firms beat the post-IPO innovation slump. For example, Chakravarty and Grewal (2011) find that industry concentration reduces the slump, while Wies and Moorman (2015) observe that industry incentives such as strong sales growth weaken it. Other research, mostly in finance, has identified firm-level factors that are not under the direct control of managers including, stock liquidity (Fang, Tian, and Tice 2014), institutional ownership level (Bushee 1998), and anti-takeover provisions (Chemmanur and Tian 2018).

We adopt a distinctive approach in this paper, which is to focus on firm-level, marketing-relevant actions[1] that are externally visible and managers can take to beat the post-IPO innovation slump. In particular, we examine the marketing actions that managers can take *before* they go public to ensure their firms continue to innovate even *after* the IPO. Consistent with this approach, we study firms as they transition from private to public—an approach that remains rare in this literature (see Table 1)—which allows us to account for the long reach of each firm's early history. We focus on *breakthrough innovations*, defined as new products that incorporate

[1] By marketing-relevant, we mean that marketing either directly controls or has input into these actions.

new technologies and/or fulfil key customer needs substantially better than existing products (Chandy and Tellis 2000), which have been shown to drop off after the IPO.

[Insert Table 1 here]

We seek to make three contributions to the literature in marketing, innovation, and the marketing-finance interface. First, we propose a managerially actionable explanation for why some firms that go public beat the post-IPO innovation slump: innovation imprinting. In our context, *innovation imprinting* refers to marketing-relevant actions by firms that establish product priorities and build market capabilities associated with breakthrough innovation before they go public. We argue that innovation imprinting establishes aspirations and routines within the company that support its ability to resist potential stock market pressure to shift priorities and capabilities away from breakthrough innovation after going public.

Second, we offer an explanation for the apparent contradiction in the effect of the stock market in encouraging or discouraging innovation in public firms. We argue that it is important to consider investors not as a homogenous whole—as the marketing literature tends to do—but as segments that have varying preferences (see Bushee 1998). Specifically, we propose that firms that engage in innovation imprinting attract a segment of investors whose risk preferences are more supportive of innovation than investors at large. We refer to these investors as *concordant investors*. Innovation imprinting—which happens before a firm goes public and is visible to potential investors—signals the firm's product priorities and market capabilities. We propose that firms with histories of innovation imprinting, in turn, disproportionately attract these risk-tolerant investors who tend to value innovation and are more forgiving of short-term fluctuations in performance. By contrast, firms that do not engage in innovation imprinting draw more investors who pressure these firms in a manner that reduces post-IPO innovation.

Third, we document that the innovation slump is by no means inevitable among firms that go public. By analyzing the innovation patterns of 207 firms in the consumer-packaged goods sector before and after an IPO, we observe that almost one-third of firms are able to maintain or beat their pre-IPO levels of breakthrough innovations after going public. To explain this effect, we present a theoretically driven measure of innovation imprinting that capitalizes on publicly available data on private firms—thereby overcoming one of the key challenges of empirical research on this topic. We show that this metric helps predict whether firms are likely to beat the post-IPO innovation slump after they go public. Moreover, we provide evidence for the mechanism we propose to explain why this occurs—innovation imprinting attracts concordant investors, who reward firms for persisting at breakthrough innovation. Our findings challenge the idea that the stock market causes an inevitable adoption of a risk averse view that discourages breakthrough innovation. Instead, results suggest that managers can help their firms remain innovative by planting the seeds of innovation before they go public.

Conceptual Framework

Why do some firms remain innovative after they go public? We argue that the answer might lie in the innovation activities that they engage in *before* they go public. Following a long tradition of research on the origins of firm strategy (see Simsek, Fox, and Heavey 2015), we propose that these early activities—formally referred to as innovation imprinting—help establish innovation priorities and capabilities that support a firm's ability to resist potential stock market pressure to shift toward more incremental innovation *after* it goes public (see Figure 1). This view extends prior literature which has tended to focus on how firms maintain or adapt its early identity over time. In addition, we further extend the literature by advocating for a novel mechanism by which the firm maintains the activities and outcomes of its past. Specifically, we

suggest that the firm's pre-IPO innovation imprinting signals to and ultimately attracts a set of investors that are less risk averse and that will support the firm's focus on breakthrough innovation. Once attracted, these investors buffer the firm from the short-term focus of the stock market and allow it to continue to innovate at pre-IPO levels. This is shown in Figure 1 by the mediating role that these investors play in beating the post-IPO innovation slump. Beating the slump, we predict, leads to positive and consequential outcomes—both for investors and for firms that yield higher financial returns as well as lower odds of bankruptcy.

[Insert Figure 1 here]

This section outlines the core tenets of our proposed framework by linking the three constructs depicted in Figure 1: (1) the post-IPO innovation slump; (2) pre-IPO innovation imprinting; and (3) the role of concordant investors. We discuss each construct in turn, and then present a series of hypotheses arising from the associated framework.

Beating the Post-IPO Innovation Slump

As we noted in the introduction, the post-IPO innovation slump—a reduction in the introduction of breakthrough innovations among firms that go public—is well-documented. A key reason for this slump is that after firms go public, managers perceive pressure from the stock market that reduces their incentives to invest in breakthrough innovation. This is the case because breakthrough innovation is an inherently risky activity and investments may fail to pay off or to do so within a predictable timeline. These aspects of breakthrough innovation are at odds with expectations from many stock market investors, who impose strict quarterly earnings targets and judge firms by their short-term performance. These expectations from investors create incentives that prompt managers to optimize investments for the short-term (Mizik 2010). One way to secure short-term performance is to reduce their firms' focus on breakthrough innovation, and to instead fund more incremental innovation activities, which are less risky and

more predictable in their outcomes. A theory of how firms beat the post-IPO innovation slump should therefore offer a mechanism that weakens this short-term stock market pressure. We introduce innovation imprinting and the attraction of concordant investors as this mechanism.

Imprinting and Breakthrough Innovation

Imprinting is a concept with a long history in the organizational sciences (Stinchcombe 1965).[2] This literature has broadly examined three types of questions. First, what are the sources of imprinting? Scholars in this area have pointed to the many different early influences—environmental, organizational, or individual—that can have a formative effect on how companies develop (Marquis and Tilcsik 2013). For example, Snihur and Zott (2020) find that founders' tendency to engage in search outside their industry for novel stimuli leads to imprinting that facilitates business model innovation later in the firm's life. Second, what are the consequences of imprinting on strategy choice and firm performance? Simsek, Fox, and Heavey (2014) suggest these effects can be wide-ranging (also see Marquis and Tilcsik 2013). The most common consequences at the firm level are growth, survival, and strategic change or new market entry (Simsek et al. 2015. Third, what are the organizational processes and dynamics that maintain or weaken the effects of imprinting? For example, Suddaby et al. (2020) describe how imprinting facilitates the sensing of opportunities and the seizing of opportunities, while Erdogan, Rondi, and De Massis (2020) highlight how firms adopt both forward- and backward-looking approaches to balance the dual goals of maintaining tradition and achieving innovation.

We draw from and extend the literature on imprinting to develop and test marketing-related explanations for why some firms beat the post-IPO innovation slump in several ways.

[2] Our theoretical arguments about innovation imprinting are also closely aligned with Miller and Friesen's (1980) idea of strategic momentum. Indeed, strategic momentum, defined as the propensity to persist with previous strategic actions, is often used to explain the lasting power of imprinting. In the context of innovation imprinting to beat the post-IPO innovation slump, strategic momentum implies that managers remain focused on developing and commercializing breakthrough innovations even after the firm goes public.

First, we introduce to the literature the construct of innovation imprinting, which (as we noted earlier) refers to activities by firms that establish product priorities and build market capabilities associated with breakthrough innovation before they go public. In focusing on and delving deeply into innovation-specific aspects of the phenomenon of imprinting, we seek to go beyond the existing literature, which has largely addressed generic aspects of imprinting (e.g., recombination; Gioia et al. 2010) or imprinting on dimensions that are distinct from innovation (e.g., employment models; Baron, Hannan, and Burton 1999).

Second, we introduce the important role of external actors (in our case, the stock market) to explain the dynamics of imprinting. Importantly, we suggest that the external actors are a key reason why the effects of imprinting are maintained over time. Specifically, we argue that innovation imprinting attracts a segment of risk-tolerant investors who give the firm license to maintain its breakthrough innovation even after it goes public. This view is distinctive from the focus of the great majority of imprinting research, which ignores the impact of imprinting on external entities such as investors (Kimberly 1975).

Third, we highlight the role of marketing activities in imprinting. In our review of the imprinting literature, we were hard pressed to find examples of how marketing-relevant imprints have played an influential role in the firm's evolution; indeed, the literature is currently devoid of a marketing focus. We present arguments for why marketing-relevant imprints, as manifested in a firm's pre-IPO product priorities and market capabilities, can help the firm sustain its innovation outcomes. We build on these points of contribution in the sections that follow.

Imprinting and product priorities. We first consider the imprinting role of the firm's strategy, which establishes its priorities and seeks to build a consensus around goals and appropriate actions (Boeker 1989). Given this role, past strategic choices can frame the mental model that influences how managers perceive the firm and its environment going forward,

including what is aspirational and achievable (Marquis and Huang 2010). Consistent with this view, Boeker's (1989) study of the semiconductor producers in Silicon Valley observes that priorities established at company founding tend to be maintained over time.

In the same way, we expect that a firm's priorities regarding the development and introduction of breakthrough innovations before it goes public will have a formative effect on its post-IPO actions. Although they may manifest themselves in a number of ways, we focus on two product priorities that are under the manager's control, are marketing-relevant, and are transparent to the stock market. The first priority is the level of emphasis placed on the development and introduction of breakthrough innovations relative to more incremental innovations (see Sorescu, Chandy, and Prabhu 2003). The prioritization of breakthrough over incremental innovations establishes the firm's acceptance of the risk associated with this focus.

A second priority is around the pacing of breakthrough innovations, which reflects the degree to which the development and introduction of breakthrough innovations is a consistent instead of a more sporadic feature of the firm's strategy (Brown and Eisenhardt 1997; Sharma, Saboo, and Kumar 2018). A consistent pacing of breakthrough introductions pre-IPO is a strong indicator of a company's strategy to prioritize risky innovation.

Imprinting and market capabilities. Capabilities reflect bundles of skills, accumulated knowledge, and resources that enable a firm to carry out its activities (Moorman and Day 2016). Capabilities are developed over time and form powerful routines that are deeply institutionalized in the organization's processes. As such, they are difficult to disrupt. For example, Marquis and Huang (2010) observe the persistence of acquisition capabilities from actions taken during the founding of U.S. commercial banks. Following our focus on capabilities that are under the control of managers, are externally visible, and are marketing-relevant, we focus on two market

capabilities that meet these criteria. In both cases, the focus is on capabilities related to commercializing breakthrough innovation (Sorescu, Chandy, and Prabhu 2007).

The first capability is a firm's bundling capability (Sirmon, Hitt, and Ireland 2008), through which it combines breakthrough innovations with related incremental innovations to create platforms for future growth. For example, Home Bake extended its breakthrough product "Scoop & Bake Cookie Dough"—the first shelf-stable, non-refrigerated cookie dough—by creating a line of related products including brownies and fudge. By building a platform for future growth, a bundling capability increases the firm's ability to manage the commercial risks associated with breakthrough innovation.

The second capability is the firm's leveraging capability which involves applying its own resources and those owned by other firms to extract value from its breakthrough innovations. Specifically, engaging in marketing alliances allows firms to leverage others' resources to introduce breakthrough innovations across markets (see Sirmon, Hitt, and Ireland 2007; Sirmon, Gove, and Hitt 2008). A leveraging capability increases the firm's ability to reach customers across markets and to use partnerships to do so efficiently.

Summary. These arguments describe how innovation imprinting—as manifested in pre-IPO product priorities and market capabilities—can help firms manage the risks involved in developing and commercializing breakthrough innovations. This innovation imprinting increases the likelihood firms will beat the post-IPO innovation slump.

H1: Firms engaging in more innovation imprinting before they go public will be more likely to beat the post-IPO innovation slump.

The Role of Concordant Investors in Beating the Post-IPO Innovation Slump

Our discussion thus far has offered an internal account of imprinting that is consistent with the literature. In this section, we add to this view by describing an *external signaling*

mechanism that contributes to this effect. Specifically, we predict that the firm's pre-IPO innovation imprinting actions send important signals to the investor community regarding the firm's future—including its product priorities and market capabilities that are likely to persist over time (Bebchuk and Stole 1993; Moorman et al. 2012). Because investors can observe these amassed aspects of a firm's breakthrough innovation efforts, they interpret these as indicators of the firm's future innovation potential, including the ability to manage risks.

The idea of signals utilized by investors to gauge a firm's future economic value has a long research tradition in finance (e.g., Carter and Manaster 1990; Leland and Pyle 1977). Because of information asymmetries between firm owners and investors, and because owners might have incentives to misrepresent the firm to investors, research has suggested that investors will tend to ignore unsupported claims released by owners (Cohen and Dean 2005). Instead, the firm must use *actions* to transmit credible information about its strategy important to forming expectations for the future of the venture (Downes and Heinkel 1982), including innovation activities (e.g., Audretsch, Bönte, and Mahagaonkar 2012; Hellman and Puri 2000).

However, investors are not a homogenous group. Some have a greater affinity for risky innovation than others. We propose that the signals inherent in innovation imprinting attract a segment of concordant investors, meaning they share the firms' tolerance for risk. They value the potentially high returns to breakthrough innovation and are commensurately more forgiving of the risk associated with these innovations relative to other investors. These characteristics make them highly compatible with the risk-taking associated with breakthrough innovations. We refer to these concordant investors as *risk-tolerant investor*s for the remainder of the paper.

Recent work in finance points to the advantages of matching firms and investors with compatible risk profiles. Kaplan et al. (2009), for instance, describe how investors make their IPO investment decisions based on the IPO firm's prior business strategy, which they expect to

persist in the post-IPO state. Pointing to a two-sided matching mechanism, Sørensen (2007) highlights that young firms advertise to and pick those VC investors that have the best strategic fit, even if it is not the best financial offer at the time of matching. Lungeanu and Zajac (2016) document the positive long-term effects of firm-investor fit on firm performance.

As risk-tolerant investors assess IPO firms, they look for credible signals that the firms align with their own innovation preferences and will persist in breakthrough innovation in the long term. The logic we have articulated above suggests that firms that have engaged in innovation imprinting will be more likely to offer such signals. This increases the likelihood that they will attract risk-tolerant investors once they go public.

H2: Firms engaging in more innovation imprinting before they go public will attract more risk-tolerant investors in the post-IPO period.

Together, H1 and H2 imply that the attraction of risk-tolerant investors is an important mechanism by which innovation imprinting increases the likelihood that firms will beat the post-IPO innovation slump. We predict:

H3: Firms engaging in more innovation imprinting before they go public will attract more risk-tolerant investors in the post-IPO period, which, in turn, increases the likelihood that they will beat the post-IPO innovation slump.

Long-Term Effects of Beating the Post-IPO Innovation Slump

What is the impact of beating the post-IPO innovation slump on long-term performance outcomes of the firms in question? Does it help the firms improve their financial performance and survive over the long run? We examine both outcomes next.

Financial performance. A significant literature has examined the returns to innovation (Sorescu et al. 2003; Srinivasan et al. 2009; Sorescu and Spanjol 2008). This literature indicates that persistent breakthrough innovation by firms is rewarded by the stock market. The stock

market values breakthrough innovations because they offer new customer benefits that grow markets and form barriers to entry for competitors.

Important to our paper, this literature has not considered the performance impact of breakthrough innovation in the context of IPO firms. Further, our question is not whether breakthrough innovation is per se a predictor of financial performance. Instead, we focus here on whether maintaining or exceeding pre-IPO breakthrough innovation levels after going public is noticed and rewarded by investors. We think the answer is yes for two reasons. First, firms that beat the post-IPO innovation slump are likely to have attracted risk-tolerant investors who will disproportionally reward the introduction of breakthrough innovations. Second, consistent with our signaling story, maintaining or exceeding the level of breakthrough innovation relative to pre-IPO levels represents a strong signal of firm strategy, confidence, and competitive viability that should be rewarded by these risk-tolerant investors.

H4: Firms that beat the post-IPO innovation slump will have better post-IPO financial performance than firms that do not.

Survival. The aforementioned financial returns provide the resources to innovative firms to further develop their innovation pipelines, thus setting the stage for a potential virtuous cycle of innovation and returns. Such a cycle should also bode well for firm survival. Because breakthrough innovations generate larger revenues and profits (Pauwels et al. 2004), beating the post-IPO innovation slump in breakthrough innovation should help firms compete more effectively, leading to better odds of survival in competitive markets. We predict:

H5: Firms that beat the post-IPO innovation slump will have better post-IPO survival likelihood than firms that do not.

Data and Measures

Empirical Context and Data Sources

An ideal empirical context to test our hypotheses would fulfill three criteria. First, IPOs and breakthrough innovations should be widely prevalent in the context, thus ensuring an adequate sample size for rigorous tests of our hypotheses. Second, objective and reliable information should be available on each of the constructs of interest. Importantly, information on the imprinting factors should be available when firms are privately held (and not required to disclose information) and over a period of time that is long enough to assess the impact on long-term outcomes. Third, the context should be economically significant, and yet it should not be constrained by unique regulations (such as in pharmaceuticals) that might limit generalizability.

The U.S. consumer-packaged goods (CPG) sector meets each of these criteria. First, the CPG sector is one of the largest sectors in the U.S. and it is economically significant, supporting 1 in 10 U.S. jobs, and contributing over $2 trillion to the U.S. GDP (PwC 2019). Second, CPG firms have traditionally sought to innovate as a source of growth and data sources are available over time (e.g., through ProductLaunch Analytics).[3]

To test our predictions, we assemble a data set using several secondary sources: (i) Datamonitor's ProductLaunch Analytics for new products; (ii) EDGAR and SDC Platinum for IPOs (Global New Issues Database) and alliances (Mergers, Acquisitions and Alliances Database); (iii) Compustat for financial data; (iv) Thomson Reuters Institutional 13f Holdings for

[3] Note that it is not easy to access objective information on breakthrough innovations in most sectors. Further, patent data offer an incomplete picture of breakthrough innovations, given most do not yield new product introductions. Further, certain sectors, such as the pharmaceutical industry, which offers the ability to objectively study breakthrough innovations, tend to have unique regulations. For these reasons, most studies that have measured breakthrough innovation have relied on single sectors, including autos (e.g., Pauwels et al. 2004; Srinivasan et al. 2009), banking (Yadav, Prabhu, and Chandy 2007), biotech (Rao, Chandy, and Prabhu 2008), CPG (Sorescu and Spanjol 2008; Wies and Moorman 2015), and pharmaceuticals (Sharma, Saboo, and Kumar 2018).

risk-tolerant investors; (v) ReferenceUSA and CRSP for firm age; (vi) Factiva for firm size; and (vii) IRI's *Marketing Factbook* for category controls.

Sample

Our predictions are tested on a sample of 207 CPG firms that went public between 1980 and 2011. This sample reflects 4,312 firm-year observations with an unbalanced number of years before and after the IPO. We restrict our sample to firms for which we have at least three years of data pre-IPO and post-IPO in order to examine firm innovation behaviors before and after the IPO. In the process of building the sample, we identified firms that remained private during this period. We used these firms to build a sample of 158 private firms, reflecting 3,591 firm-year observations, for endogeneity corrections and robustness tests.

Measures

Breakthrough innovations. We collect the number of firm *breakthrough innovations* introduced by U.S. firms into U.S. food, drug, and mass channels using Datamonitor's ProductLaunch Analytics. ProductLaunch Analytics counts each new product introduction as an innovation and defines an innovation as "breakthrough" if it targets a new market and/or offers a substantially new consumer benefit through product positioning, merchandising, packaging, formulation, or technology (Sorescu and Spanjol 2008). We count the number of firm breakthrough innovations per year and take the logarithm given its skewed nature, adding 1 when zero products are introduced to avoid losing observations. Examples of breakthrough innovations include, in packaging, DFV Wines' bag-in-box wine equipped with a tap technology to keep the wine fresh after opening (2011), in the technology area, Unipath Diagnostics' digital pregnancy tests (2003), and in the new market area, Big Heart Pet Brands' dog treats that prevent gum disease (2013). Table 2 summarizes our key variables' data sources and operationalizations.

[Insert Table 2 here]

Pre-IPO innovation imprinting. *Innovation imprinting* refers to pre-IPO actions by firms that establish product priorities and build market capabilities associated with breakthrough innovation. Given our theoretical focus on imprinting actions under the control of managers, externally visible before the IPO, and having a marketing focus, we sought to balance conceptual comprehensiveness with empirical feasibility. Four measures qualified as relevant to breakthrough innovation, reflecting two dimensions of product priorities (emphasis and pacing), and two dimensions of market capabilities (bundling and leveraging).

Considering the product priorities, we measure *level of emphasis on breakthrough innovation* in a manner analogous to Mizik and Jacobson's (2003) measure of strategic emphasis. Specifically, we calculate the average of the following ratio before the IPO:

$$Emphasis_{it} = (Breakthrough\_Innovations_{it} - Incremental\_Innovations_{it}) / Total\_Introductions_{it}.$$

The more positive the values on this measure, the stronger is the firm's strategic commitment to breakthrough innovations before going public.

We capture *pacing of breakthrough innovation* by the inverse of the standard deviation of the number of days between the firm's breakthrough introductions in the period before the IPO. A lower value indicates higher variability in introducing breakthrough innovations, and a higher value indicates a more consistent pace of breakthrough introductions.

Regarding market capabilities, we measure *bundling of breakthrough innovation* as the pre-IPO average number of incremental innovations introduced after and linked to each breakthrough innovation from the firm. To form this measure, we searched in ProductLaunch Analytics for the number of bundled incremental innovations the firm introduced as an offspring of the breakthrough innovation. In order to qualify as part of the breakthrough innovation bundle, an incremental innovation needed to satisfy two conditions: (i) the product was introduced within

the following 12 months and (ii) the product was introduced under the same brand name in the same category as the original breakthrough innovation.

Recall that leveraging is an aspect of a firm's breakthrough innovation capability that addresses the extent to which the firm can apply breakthrough innovations beyond its own market boundaries. We measure *leveraging of breakthrough innovation* as the logarithm of the firm's cumulative number of marketing alliances before the IPO.

We view these four variables as indicators of the formative measure of innovation imprinting. We therefore create our measure following standard procedures for formative measures (see Web Appendix W1 for details). Using the unweighted average of the four standardized indicators as our main measure, we validate the robustness of our results using alternative weighting schemes and operationalizations (see Web Appendix W1).

Concordant investors. Recall that concordant investors share the firm's tolerance for risk and predisposition toward breakthrough innovation. We derive investors' tolerance for risk by studying their past investment behavior. This approach is similar to Abarbanell, Bushee, and Raedy (2003) and Bushee and Goodman (2007) who derive investors' preference for growth based on their past trading behavior. First, we identify a firm's investors using the Thomson Reuters Institutional 13f Holdings database. For data availability reasons, we focus on the firm's institutional investors. This choice is also conceptually reasonable since institutional investors have a larger impact on firm behaviors than retail investors (Basak and Pavlova 2013). Second, for each investor, we retrieve her portfolio of companies over the last five years, as captured in the Thomson Reuters Institutional 13f Holdings database. We then proxy the riskiness of each company in this portfolio by its profit volatility, measured as the industry-adjusted standard deviation of profits in the prior five years (e.g., Myers et al. 2007). We construct this measure based on the view that if an investor holds a stake in companies with high profit volatility, she is

less likely to exert short-term performance pressure on the focal firm than other investors. We average the profit volatility across all firms an investor holds in her portfolio to proxy an investor's risk tolerance. Finally, to arrive at our firm-level measure, we average the risk tolerance of the firm's investors, weighted by the investors' shares in the firm.

Financial performance. We measure financial performance by the firm's *Tobin's q*, an established proxy for firm performance in the marketing literature (e.g., Rao, Agarwal, and Dahlhoff 2004). Following Chung and Pruitt (1994), we calculate Tobin's *q* as the logarithm of $TQ_{i,t} = (MVE_{i,t} + PS_{i,t} + BVD_{i,t}) / TA_{i,t}$, where $MVE_{i,t}$ is the market value of equity, $PS_{i,t}$ is the value of preferred stock, $BVD_{i,t}$ is the book value of debt, and $TA_{i,t}$ is the book value of total assets for firm *i* in year *t*.

Survival. The firm's *survival* duration is measured in number of years it exists post-IPO. We code each year as 1 in which the firm still operates, and code it as 0 if the firm's legal status is bankruptcy or liquidation. We classify firms that were acquired by other firms as surviving firms (although results hold if we code the acquired firms as dead).

Control variables. We include a comprehensive set of firm and industry control variables as described in Web Appendix W2 and listed in our model descriptions which follow.

Modeling and Estimation Approach

We describe four sets of models associated with our research questions. First, we model the degree to which firms beat the post-IPO innovation slump. Second, we model whether innovation imprinting helps explain this outcome. Third, we model how innovation imprinting attracts concordant investors, and test the mediating mechanism we outline in our hypotheses. Finally, we model the rewards associated with beating the innovation slump after going public in terms of firm financial performance and survival.

Do Firms Beat the Post-IPO Innovation Slump?

We begin by examining whether firms can actually beat the post-IPO innovation slump, that is, whether they continue to introduce breakthrough innovations after the IPO. To do so, we compare the actual breakthrough innovation levels in each post-IPO year to the expected breakthrough innovation levels in each post-IPO year. As our test, we build a breakthrough innovation prediction model based on a firm's pre-IPO observations to determine the predicted level of breakthrough innovations for each post-IPO firm-year. Using only the pre-IPO observations, we estimate the following fixed-effects autoregressive model:

$$Breakthrough\_Innovations_{i,t} = \beta_0 + \beta_1 Breakthrough\_Innovations_{i,t-1} + \beta_{2\text{-}6} X_{i,t} + \delta_t Year_t + \alpha_i + \varepsilon_{i,t} \text{ for } t<T(\text{IPO}_i), \quad (1)$$

where $Breakthrough\_Innovations_{i,t}$ is the natural logarithm of the number of breakthrough introductions by firm i in year t for all years before the firm's IPO ($t<T(\text{IPO}_i)$) based on the firm's lagged number of breakthrough innovations and a vector of control variables $X_{i,t}$ (firm age, firm size, firm incremental innovations, industry purchasing frequency, and industry concentration). $Year_t$ is a vector of year dummies, and α_i is a firm-specific fixed effect intercept to model unobserved firm heterogeneity. Because of the correlation in the dependent variable over time, we use the Arellano-Bond GMM estimator to generate consistent parameter estimates (Arellano and Bond 1991).[4]

Table 3 contains results of this model estimation, which is significant ($\text{Chi}^2 = 1465.75$, $p<0.01$). We use the estimated coefficients from this pre-IPO regression to predict breakthrough innovation levels for the post-IPO firm-years ($t>T(\text{IPO}_i)$) and to compute the difference between the actual and predicted number of breakthrough innovations for each post-IPO firm-year:

[4] We create instruments from the first and second lags of the dependent variable and use robust standard errors. The Arellano-Bond test for zero autocorrelation in the error term cannot be rejected at any order higher than 1 ($z_{t-1} = -0.632$, n.s.), so we conclude the error term is serially uncorrelated.

$$Beat\_Innovation\_Slump_{i,t} = Breakthrough\_Innovations_{i,t} - \widehat{Breakthrough\_Innovations}_{i,t} \text{ for } t>T(IPO_i). \quad (2)$$

This variable reflects the *degree to which the firm beats the post-IPO innovation slump* in a given year and is a key measure in testing our hypotheses. It is continuous and positive if the firm exceeds the expected level of breakthrough innovations in a given post-IPO year, negative if not, and zero if the firm exactly meets the expected level of breakthrough innovations.

[Insert Table 3 here]

Does Innovation Imprinting Help Firms Beat the Post-IPO Innovation Slump?

To test the idea that innovation imprinting helps firms beat the post-IPO innovation slump, several modeling options exist that have different strengths and weaknesses. We present the strongest test here and offer two more as robustness checks. Following Equation 2, our selected approach uses the degree to which the firm beats the innovation slump in a given post-IPO year as the dependent variable. We estimate:

$$Beat\_Innovation\_Slump_{i,t} = \beta_0 + \beta_1 Innovation\_Imprinting_i + \beta_{2\text{-}9} Control_{i,t} + \beta_{10} IMR_{i,t} + \delta_t Year_t + \gamma_j Industry_j + \nu_{i,t} \text{ for } t>T(IPO_i), \quad (3)$$

where $Beat\_Innovation\_Slump_{i,t}$ is the difference between the actual and predicted number of breakthrough innovations for firm *i* in year *t*. $Innovation\_Imprinting_i$ captures the pre-IPO innovation imprinting level for firm *i*. $Control_{i,t}$ is the vector of control variables (firm age, firm size, firm pre-IPO cumulative breakthrough innovations, firm incremental innovations, industry concentration, industry value appropriation emphasis, industry sales growth, and industry demand stability), $Year_t$ is a vector of year dummies, $Industry_j$ is a vector of industry dummies, and $\nu_{i,t}$ is an error term ~N(0,σ). We assume a composite error term with a firm-specific random component that captures unobserved firm-level effects as well as a random residual component that varies across firms and over time. This modeling structure accounts for unobserved firm-

specific heterogeneity, over and above the effects of controls that capture observed firm-specific heterogeneity. We estimate Equation 3 with a random-effects model using feasible generalized least squares and robust standard errors.[5]

Our empirical set-up has an important implication for estimating Equation 3. Given our focus on beating the post-IPO innovation slump, we observe the difference between actual and predicted breakthrough innovation levels only for firms that have gone public. To prevent the estimated coefficients in our model from being influenced by potential selection biases associated with the decision to go public, we employ a two-stage Heckman-type approach in which we first model the firm's choice to go public. To do so, we add the sample of 158 private CPG firms identified in ProductLaunch Analytics that did not go public in the observation period. We estimate the firm's likelihood of going public with a Probit model:

$$Pr(IPO_{i,t}=1|X_{i,t},\beta) = \Phi(\beta' X_{i,t}), \quad (4)$$

where $IPO_{i,t}$ is a binary variable equal to 0 if firm i is in a private state in year t and 1 in the year the firm turns public. $X_{i,t}$ is a vector of explanatory variables and Φ is the standard normal cumulative distribution function. Following Xiong and Bharadwaj (2011), we model the firm's choice to go public as a function of firm size, geographical location of firm headquarters (vector of nine Census Bureau-designated geographic regions based on states), firm age, and industry dummies. Although the model can be identified by the nonlinearity of the correction term, using an exclusion restriction reduces our reliance on the functional form for identification. Geographical location serves as our exclusion restriction for the model because it should be related to the decision to go public (e.g., Gulati and Higgins 2003), but not to beating the post-IPO innovation slump. Specifically, we exploit the fact that literature points to disclosure and

[5] We re-estimate our models using bootstrapped and clustered standard errors and our results replicate. Since the model includes firm-level variables that are time-invariant, we do not estimate it with firm-specific fixed effects.

regulatory incentives (e.g., Shi et al. 2013), which encourage firms to go public in certain geographic locations, while we have no reason to believe geography should influence a firm's propensity to beat the innovation slump. In support of this view, we find that including geographic location improves model fit when predicting the selection equation of going public ($Chi^2 = 26.11$, $p<0.05$), indicating relevance, while we observe no model improvement when including geographic location to Equation 3 ($Chi^2 = 0.33$, n.s.).

Using this exclusion restriction, we compute the Inverse Mills Ratio (*IMR*) as $\lambda=\phi(\beta'X_{i,t})/\Phi(\beta'X_{i,t})$, where ϕ and Φ are the probability density function and cumulative density function of the normal distribution, respectively, and add it as predictor in Equation 3. Web Appendix W3 offers further evidence regarding why we are not concerned about the potential endogeneity of firm choice to go public in our modeling set-up.

Does Innovation Imprinting Attract Concordant Investors?

To test whether innovation imprinting helps attract more risk-tolerant investors, we estimate the following model:

$$Risk\text{-}Tolerance\_Investors_{i,t} = \beta_0 + \beta_1 Innovation\_Imprinting_i + \beta_{2\text{-}10} Control_{i,t} + \beta_{11} IMR_{i,t} + \delta_t Year_t + \gamma_j Industry_j + \nu_{i,t} \text{ for } t>T(\text{IPO}_i), \quad (5)$$

where $Risk\text{-}Tolerance\_Investors_{i,t}$ is the degree to which a firm's investors are risk-tolerant, measured for firm *i* in year *t*. $Innovation\_Imprinting_i$ captures the level of pre-IPO innovation imprinting, $Control_{i,t}$ is the vector of firm and industry control variables (firm age, firm size, firm ROA, firm financial leverage, industry concentration, industry sales growth, industry demand stability, and industry appropriation emphasis), $IMR_{i,t}$ captures the selection control to go public, $Year_t$ is the vector of year dummies, $Industry_j$ is the vector of industry dummies, and $\nu_{i,t}$ is an error term ~N(0,σ). As before, we assume a composite error term with a firm-specific random component that captures unobserved firm-level effects as well as a random residual component

that varies across firms and over time. We estimate Equation 5 with a feasible generalized least squares model and robust standard errors.

To examine whether the attraction of risk-tolerant investors mediates the relationship between innovation imprinting and the ability to beat the post-IPO innovation slump, we test a mediation model following the bias-corrected procedure suggested by Zhao, Lynch, and Chen (2010) with 5,000 bootstrapped samples.

Are Firms Rewarded in the Long-Term for Beating the Post-IPO Innovation Slump?

Financial performance. This model examines whether beating the post-IPO innovation slump is associated with a stronger firm financial performance:

$$Tobinsq_{i,t} = \beta_0 + \beta_1 Beat\_Innovation\_Slump_{i,t} + \beta_{2\text{-}10} Control_{i,t} + \beta_{12} IMR_{i,t} + \delta_t Year_t \gamma_t Industry_j + \nu_{i,t}, \quad (6)$$

where $Tobinsq_{i,t}$ captures financial performance, $Beat\_Innovation\_Slump_{i,t}$ measures the degree of beating the post-IPO innovation slump, $Control_{i,t}$ is a vector of firm and industry control variables (firm size, firm age, firm sales growth, firm ROA, firm financial leverage, industry concentration, industry sales growth, industry demand stability, and industry appropriation emphasis), $IMR_{i,t}$ accounts for firm selection to go public, $Year_t$ and $Industry_j$ are fixed effects, and $\nu_{i,t}$ is an error term. Equation 6 is estimated with a feasible generalized least squares model with robust standard errors.

Firm survival. Finally, we test whether the degree of beating the post-IPO innovation slump affects firm survival with an accelerated failure-time (AFT) model:

$$Survival_i = \beta_0 + \beta_1 Innovation\_Imprinting_i + \beta_{2\text{-}11} Control_i + \beta_9 IMR_i + \delta_t Year_t + \sigma\upsilon_i, \quad (7)$$

where $Survival_i$ is the natural logarithm of the number of years firm *i* has been in existence since its IPO. We use the last year in our observation period as the cutoff year for measuring survival. $Control_{i,t}$ is a vector of firm and industry control variables (firm size, firm age, firm sales growth,

firm ROA, firm financial leverage, industry concentration, industry sales growth, industry demand stability, and industry appropriation emphasis), $IMR_{i,t}$ accounts for firm selection to go public, and υ_i is an error term. Guided by tests based on the Akaike information criterion (AIC), we set the distribution form of the error term to be the extreme-value density and use a Weibull base hazard function for which σ is the hazard function scale parameter.

Results

Do Firms Beat the Post-IPO Innovation Slump?

Beginning with a test of whether firms beat the post-IPO innovation slump in a *given year*, we corroborate prior research and find that the majority of firms innovate at lower breakthrough levels than their pre-IPO levels would predict. Figure 2 shows the distribution of the degree to which firms manage to beat their predicted breakthrough innovation levels post-IPO (*Beat_Innovation_Slump*, Equation 2). Negative values indicate the firm did not meet its predicted post-IPO level, zero indicates the firm reached its predicted post-IPO level, and positive values mean the firm beat this level. The mean level of -0.068 (S.D. = 0.394) confirms that most firms succumb to the post-IPO innovation slump. Specifically, in 69.6% of firm-year observations, firms fail to meet their predicted levels of breakthrough innovations (i.e., negative realizations) while firms beat these predicted levels (i.e., positive realizations) in 30.4% of observations. We do not observe any firm-years in which predicted levels are met exactly.

A second set of descriptive analyses examines whether firms *persistently* beat the innovation slump across their post-IPO years. Figure 3 displays the kernel density plot of the proportion of years each firm beats the innovation slump measured as a count of the number of post-IPO years in which firm *i* beats the post-IPO innovation slump (i.e., has positive realizations of Equation 2) divided by the total number of the firm's post-IPO years. If succumbing (beating)

to the innovation slump is persistent, we should observe this ratio's observations clustered close to zero (one). As the clustered observations close to zero show, most firms rarely meet or exceed their predicted breakthrough innovation levels in any of the public-year observations. The lower spike towards the right end of the distribution, however, suggests that some firms manage to do so consistently across post-IPO years. Table 4 summarizes further descriptive features of our sample firms and presents correlations among the variables of interest.

[Insert Figures 2 and 3 and Table 4 here]

Does Innovation Imprinting Help Firms Beat the Post-IPO Innovation Slump?

Having established that some firms beat the post-IPO drop in breakthrough innovations, we turn to the role of innovation imprinting as a predictor that influences this outcome. Table 5 shows our results. Column 1 provides our focal model employing the overall innovation imprinting measure. The model's adjusted R^2 ($R^2 = 0.51$) and Wald statistic ($Chi^2 = 1865.37$, $p<0.01$) point to satisfactory explanatory model power and fit. A VIF below 10 suggests that multicollinearity is not a concern. Supporting H1, we find that pre-IPO innovation imprinting helps firms beat the post-IPO innovation slump ($\beta_1 = 0.159$, $p<0.01$).

Column 2 of Table 5 provides results using the four separate imprinting indicators. Similar to the composite measure, we find that all four indicators increase the firm's likelihood of beating the post-IPO innovation slump. Column 3 reports standardized results of the four separate indicators, which is helpful in interpreting their magnitudes.

[Insert Table 5 here]

Does Innovation Imprinting Attract Concordant Investors?

We next consider the role of concordant investors in explaining how innovation imprinting helps firms beat the post-IPO innovation slump. H2 posits that innovation imprinting attracts more risk-tolerant investors and Table 6 reports results from the test of this hypothesis.

Results indicate good model fit ($R^2 = 0.145$, $Chi^2 = 912.91$, $p<0.01$). As predicted, imprinting has a positive effect on the attraction of more risk-tolerant investors ($\beta_1 = 0.051$, $p<0.01$).

[Insert Table 6 here]

H3 hypothesizes that innovation imprinting attracts more risk-tolerant investors, who in turn grant the firm leeway to persist at breakthrough innovation once it has gone public. This structure reflects a mediation model, which we test using the guidelines in Zhao, Lynch, and Chen (2010). We find innovation imprinting has a positive effect on attracting risk-tolerant investors. The risk-tolerance of investors, in turn, increases the firm's likelihood of beating the innovation slump after it goes public (indirect effect = 0.003, $p<0.01$, 95% CI: [0.001, 0.005]).

Besides testing the mediating mechanism, this estimation approach, which is reported in Web Appendix W4, also serves as a robustness check because it models the equations simultaneously (as opposed to each equation separately as we do in the main analysis).

Are Firms Rewarded in the Long-Term for Beating the Post-IPO Innovation Slump?

Tobin's q. We begin with model-free evidence to test H4. Specifically, the difference in Tobin's *q* between firms beating and succumbing to the post-IPO innovation slump is substantial—in the first year, Tobin's *q* is 57% higher for firms that beat the slump.

Table 7a presents the results of estimating Equation 6 to test the effect on Tobin's *q*. Confirming our expectation (H4), we find that firms that beat the post-IPO innovation slump have a higher Tobin's *q* ($\beta_1 = 0.609$, $p<0.01$). For instance, a firm that beats its expected level of breakthrough innovations of 2 by 1 additional breakthrough innovation increases Tobin's *q* by 0.25—amounting to an average increase of 12% in Tobin's *q*. This insight extends prior research, which has been limited to showing that breakthrough innovations have a stronger effect on firm performance than incremental innovations (Srinivasan et al. 2009).

Finally, although not theorized, when combined, our predictions imply a serial mediation model in which pre-IPO innovation imprinting increases the attraction of more risk-tolerant investors, which, in turn, increases the likelihood of beating the post-IPO innovation slump and ultimately Tobin's *q*. Our results support this serial mediation model (indirect effect = 0.003, $p<0.05$, 95% CI: [0.0003, 0.005]).

Survival. H5 predicts that firms beating the innovation slump will have a higher survival likelihood. Table 7b displays the results of estimating Equation 7. In line with H5, beating the post-IPO innovation slump increases firm survival likelihood ($\beta_1 = 0.401$, $p<0.01$). To facilitate interpretation of the magnitude of this effect, we transform the coefficient [100*(exp(β_1)-1)] to calculate the percentage change in expected survival time when firms beat the post-IPO innovation slump. For instance, a firm that beats its expected level of breakthrough innovations of 2 by 1 additional breakthrough innovation can increase its likelihood of survival by 20%.[6]

[Insert Tables 7a and 7b here]

Additional Analyses and Robustness

Do Results Hold Up to Alternative Modeling, Timing, and Measurement Choices?

Alternative models. We assess the robustness of our key finding that imprinting increases the likelihood of beating the post-IPO slump with two approaches. First, we repeat our analyses using a new sample that includes both the IPO and private firm samples and model the post-IPO innovation slump as an interaction with firm's private or public state. We estimate:

$$Breakthrough\_Innovations_{i,t} = \beta_0 + \beta_1 Public_{i,t} + \beta_2 Innovation\_Imprinting_i + \beta_3 Public_{i,t} * Innovation\_Imprinting_i + \beta_{4\text{-}11} Controls_{i,t} + \beta_{12} IMR_{i,t} + \delta_t Year_t + \gamma_j Industry_j + \nu_{i,t}. \quad (8)$$

[6] We do not test the serial mediation model for survival as the procedure for AFT models is not reliably implemented in statistical software packages.

As before, $Breakthrough\_Innovations_{i,t}$ is the natural logarithm of the number of breakthrough innovations by firm *i* in year *t* and $Public_{i,t}$ is a dummy variable that indicates whether firm *i* is public (1) or private (0) in year *t*. A negative estimate of β_1 indicates the post-IPO innovation slump. The other right-hand side variables are the same as in Equation 3. A key challenge of this approach is that private firms do not have an IPO date and hence pre-IPO imprinting cannot be observed. We circumvent this challenge by constructing hypothetical IPO dates by matching the private firms with the firms that go public using coarsened exact matching. We follow Blackwell et al. (2009) and match firms based on firm size, age, and two-digit industry membership using an automatic binning algorithm and selecting the first suggested IPO year. We first test for parallel trends between the IPO firms and private firms by regressing breakthrough innovations on the set of controls, year, and industry dummies from Equation 8, as well as the interaction of trend and IPO firm. This interaction is insignificant (β=0.001, n.s.), pointing to parallel trends. Testing our prediction in this sample, findings confirm that pre-IPO innovation imprinting helps weaken the post-IPO innovation slump (see Table W5.1 in Web Appendix W5).

In a second robustness check, we use innovation imprinting to predict the ratio of post-IPO years in which the firm beats the innovation slump to the total post-IPO years:

$$Proportion\_Beat\_Innovation\_Slump_i = \beta_0 + \beta_1 Innovation\_Imprinting_i + \beta_{2\text{-}8} Control_i + \beta_9 IMR_i + \varepsilon_i \text{ for } t>T(\text{IPO}_i). \quad (9)$$

As before, $Innovation\_Imprinting_i$ captures pre-IPO innovation imprinting. $Control_i$ is the post-IPO averaged vector of control variables in Equation 3. Our findings in Table W5.2 offer further evidence of the benefits of pre-IPO innovation imprinting in beating the post-IPO slump.

Alternative timing specifications. We examine the impact of different timing specifications and find all of our results replicate (see Web Appendix W6 for details).

Alternative measure of Tobin's q. We discuss the appropriateness of Tobin's q as

measure of firm performance in Web Appendix W7 and show the robustness of our results to alternative model specifications and to using Total q.

Do Post-IPO Resources Influence Results?

We examine the impact of four post-IPO resources as additional controls in Equation 3. First, we include the level of IPO proceeds and the percentage of equity sold to capture the financial resources available to firms undergoing an IPO. Second, we control for resource slack which might allow firms to invest in breakthrough innovation, including ROA, financial slack, excess cash, and human resource slack. Third, we add advertising and R&D expenses given they should influence innovation. Fourth, we control for post-IPO executive turnover in the top management team. Our results replicate across all models (see Web Appendix W8).

Does the Stock Market Reward Pre-IPO Innovation Imprinting?

Our H5 results show that investors reward firms for beating the post-IPO innovation slump. We now offer three additional tests that support the view that investors reward firms for pre-IPO innovation imprinting both at the IPO and after the IPO when they introduce new products, while punishing firms less severely if they report a sales drop post-IPO.

Investor response at the time of the IPO. We examine whether innovation imprinting influences two measures of investor valuation when the firm goes public. *IPO trading* is the number of shares traded relative to the total number of shares available on the first day when stocks are listed in financial markets. Higher IPO trading indicates strong interest for a stock. *IPO underpricing* is the extent to which a firm's stock closes at a price higher than the initial offering price on the first trading day (Ritter and Welch 2002). The larger the gap between closing price and offering price, the more the stock is underpriced. We respectively regress IPO trading and IPO underpricing on pre-IPO innovation imprinting and control variables. Results in Table W9 in Web Appendix W9 suggest that innovation imprinting is associated with higher IPO

trading but not IPO underpricing, although the effect is in the expected direction. These results offer partial support for the stock market's positive response to innovation imprinting. A larger sample of IPOs would be required for a more definitive test of these effects.

Investor response after the IPO: Introducing breakthrough innovations. Investors should also reward the firm for introducing breakthrough innovations when it has engaged in pre-IPO innovation imprinting. To test this, we calculate abnormal returns for breakthrough introductions after the IPO using an event study, and regress these returns on the firm's pre-IPO innovation imprinting level. Results in Table W10 in Web Appendix W10 support this view.

Investor response after the IPO: Reporting sales drop. We also expect investors to be more forgiving when firms that have engaged in pre-IPO innovation imprinting report a post-IPO drop in sales. We test this idea by regressing yearly stock returns on an interaction of sales drop and innovation imprinting and the covariates from Equation 3. *Sales drop* is equal to 1 if the firm reported negative revenue growth and 0 if the firm reported zero or positive revenue growth. Results indicate that engaging in innovation imprinting weakens the negative effect of sales drop on stock returns ($\beta = 0.052$, $p<0.05$, Table W11 in Web Appendix W11).

Does Pre-IPO Innovation Imprinting Influence Firm Risk?

There are two ways pre-IPO innovation imprinting could be related to firm risk. On the one hand, innovation imprinting is associated with higher breakthrough innovation activities, which is likely to increase overall firm risk. On the other hand, innovation imprinting is a way of managing and reducing innovation risk, which is likely to decrease overall firm risk. Testing these possibilities, we find no significant impact of innovation imprinting on firm risk (Table W12 in Web Appendix W12). We also test whether beating the post-IPO innovation slump is associated with higher firm risk but find no significant effect (Table W12).

Is the Post-IPO Innovation Slump the Outcome of a Strategic Value Extraction Choice?

Our paper is premised on the view that the post-IPO innovation slump occurs because firms succumb to short-term stock market pressures after they go public. However, an alternate view is that firms make a strategic choice to stop engaging in breakthrough innovation after going public. Decision makers in the firm may do so to monetize their existing innovations or to simply cash out and to seek other pursuits. Although such a choice is conceivable, our arguments and results show that such a choice would lead to negative and consequential outcomes for both investors and firms. It would therefore not be an especially astute choice for the firm.

Indeed, our arguments and results suggest that the strategic choices that firms make early in their lives to invest in innovation imprinting yields persistence in innovation outcomes even after these firms go public. Specifically, firms that engage in value creation through innovation imprinting early in their lives tend not to switch to value extraction mode after they go public. This is because they draw a group of concordant investors who share their tolerance for risky innovation activities. Furthermore, we find that decision makers in firms that engage in innovation imprinting are no more likely to leave their companies after the IPO than those in firms that do not engage in such imprinting. Specifically, we find no difference in top management turnover at the time of the IPO between firms engaging in innovation imprinting and those that do not ($mean_{high\_imprinting} = 1.69$ vs. $mean_{low\_imprinting} = 1.63$, $t = -0.72$, n.s.). Web Appendix W13 presents additional evidence to rule out that the post-IPO innovation slump is the outcome of a strategic value extraction choice.

Discussion

Our research addresses an important puzzle: why do some firms remain innovative after they go public, while going public yields a slump in innovation for many others? A substantial

literature—in marketing, management, and finance—focuses on the explanations for the latter half of the question. We seek to offer an answer to the puzzle as a whole with a particular emphasis on the former half of the question. We predict and find that the seeds of success or failure in breakthrough innovation among firms that go public are sown early. We propose a parsimonious, managerially actionable, and marketing-centric framework to explain the differing fates of those firms that succumb to the post-IPO innovation slump relative to those that beat it.

To do so, we introduce a new theoretical construct—innovation imprinting—and outline a coherent set of actions associated with this construct that managers can take before their firms go public to help them beat the post-IPO innovation slump. A key reason for the beneficial outcomes of innovation imprinting rests in the idea that firms that engage in innovation imprinting are able to signal to and attract a concordant segment of risk-tolerant investors. These investors, in turn, support the continued introduction of risky innovations after the firm's IPO. Moreover, firms that are able to beat the post-innovation slump are rewarded financially and are more likely to survive over the long term. We now discuss the implications of our findings while acknowledging limitations and offering future directions for research.

Theoretical Implications

Exceptions can suggest new rules. Past research on the impact of going public suggests a general rule: breakthrough innovation declines once firms go public, because many firms succumb to stock market pressures that seemingly discourage risky, long-term investments (e.g., Markovitch, Steckel, and Yeung 2005; Moorman et al. 2012). Our research highlights the insights to be gained from studying the *exceptions* to this rule—the firms that continue to introduce breakthrough innovations after they go public. By documenting the actions of these firms—not the averages—we offer insights to help managers prevent their firms from falling prey to this effect. Our perspective is similar in spirit to Chandy and Tellis (2000) who challenge

the seemingly inevitable status of the incumbent's curse by understanding the conditions under which existing industry members continue to innovate. This perspective also responds to recent calls to develop "strategy to beat the odds" by identifying actions that challenge industry norms and endowment effects (Bradley, Hirt, and Smit 2018; Pascale, Sternin, and Sternin 2010). We hope our findings will encourage more research that adopts this focus on helping firms "beat the average" as a means to add more value to customers and investors.

Early imprints have profound consequences. We introduce the concept of innovation imprinting to the marketing literature, and articulate a simple set of reasons why imprints set before the firm goes public can have long-term consequences. Our arguments and results show that strategic choices made fairly early in a privately owned firm's life can determine later outcomes that occur under the glare of stock markets. Indeed, we argue and show that the consequences of imprinting are far from trivial: they include outcomes as fundamental as the persistence of breakthrough innovation, financial performance, and the very survival of the firm.

Our approach has at least three benefits from a theoretical perspective. First, we focus on a set of imprinting-related actions that firms can take before they go public. This proactive view extends the marketing-finance literature, which has tended to focus on firms that have already gone public (see Table 1). Once firms go public, however, the die could already be cast—in other words, expectations from investors are set, and pressures on managers to conform to these expectations are high. Our research emphasizes the importance of studying actions taken when firms have not yet gone public—and therefore before perceptions of their product priorities and market capabilities have solidified in the minds of internal and external stakeholders.

Second, the imprinting-related actions we point to are under the direct control of managers. This agentic view is an important shift in theoretical focus, since past research (see Table 1) has tended to focus on industry factors or firm factors not under the direct control of

managers. Importantly, we find that the industry factors become less significant when innovation imprinting is added as explanatory variable. This implies that managers are not necessarily passive recipients (or indeed victims) of pressures from the stock market. Our research therefore points to the value of studying ways in which managers can be agents of their own destiny, even when confronted with shareholder pressure to take myopic or misguided actions.

Third, we focus on product priorities and market capabilities that are closely linked to the role of marketing in the firm. This marketing-relevant approach goes beyond the existing literature on imprinting, which tends to focus on generic organizational processes—not on the content of the firm's innovation activities.

Segmentation applies to investors too. A fundamental contribution of marketing thinking to the world of business is the idea that consumers are not a homogenous whole: there exist segments among consumers who have different preferences and propensities to purchase products. Hence, it is especially remarkable that marketing scholars have rarely applied this fundamental principle to explain the behavior of investors. Investors, much like consumers, are not a homogenous whole: there exist segments among investors who have different preferences, and propensities to purchase stocks from companies (see Bushee 1998; Tian and Wang 2014). Moreover, just as marketing-related actions by a firm can attract segments of customers who share its values and support its actions, so can marketing-related actions by the firm attract segments of investors who share its values and support its actions toward innovation. Introducing this idea to the marketing literature is a central contribution of this research. Relatedly, and another key contribution, is the suggestion that attracting a concordant segment of risk-tolerant investors who are more forgiving of the risk associated with breakthrough innovations serves as a mechanism by which innovation imprinting helps firms beat the post-IPO innovation slump.

Innovation imprinting has many audiences. Research has tended to view the power of

imprinting from the lens of its effects on *internal* stakeholders. We highlight the power of imprinting on *external* stakeholders. Although we have focused on investors, it is conceivable that innovation imprinting influences other groups of external stakeholders too. These groups could include consumers and channel intermediaries who witness the firm's imprinting actions, thus predisposing them to have a favorable response to the firm's breakthrough innovations. Barone and Jewell (2013) refer to this idea as "innovation credit" and find that it gives firms greater license to innovate by violating category norms. The same may hold true for competitors who could be dissuaded from entering sectors that house firms with strong imprinting. This view is consistent with Suddaby et al.'s (2020, p. 530) point that managers can use the firm's imprinting to "construct convincing scenarios of the future" and "enroll key stakeholders in the industry to support a strategic direction that advances the firm's strategic goals."

Substantive Implications

Assert agency over the post-IPO future. Our research offers managers four actions they can take before they go public that should offer more agency over beating the pre-IPO innovation slump than prior literature has surfaced. We focus on imprinting actions that are under the direct control of managers and are embedded in the firm's product priorities and market capabilities. Importantly, these actions are also individually valuable, indicating that managers have choices regarding how they might foster imprinting depending on firm resources.

Target segments of concordant investors. Our findings also point to the importance of attracting risk-tolerant investors who are in sync with the firm's focus on breakthrough innovation. This concordance allows the firm to focus on the long-run—a horizon that is necessary when managing breakthrough innovations—and not to worry that transitory sales drops might be punished by investors. Since this mechanism is one means by which firms can beat the post-innovation slump, it is important that firms offer sufficiently clear and strong

signals to the investing community regarding their product priorities and market capabilities. Consistent with prior research (Bebchuk and Stole 1993), our research focuses on observable actions of underlying priorities and capabilities. Future research could extend this work by offering additional insight into how firm reporting and other communication strategies might support the ability to signal the firm's focus on breakthrough innovation.

Future work might also expand the approach to segment investors. We focus on classifying investors based on their tolerance for profit volatility. This choice has conceptual appeal, since earnings management is considered a key obstacle for innovation. Future research could explore other approaches, such as those based on growth/value (see Abarbanell, Bushee, and Raedy 2003)—an approach that was not suitable for our single-sector CPG context.

Don't overlook the strategic value in incremental innovations. Our results suggest an important role for incremental innovations. Specifically, we identified the firm's bundling capability, through which it combines breakthrough innovations with related incremental innovations to create platforms for future growth. This points to a heretofore unacknowledged strategic role for incremental innovation. Instead of reinforcing the view that incremental and breakthrough innovations require resource tradeoffs and should be managed as separate processes, our findings indicate an important complementarity that should be managed by firms seeking to build a strategy on breakthrough innovation.

Limitations and Additional Future Research

There are a number of limitations associated with our paper that also offer opportunities for future research. The first limitation is that our measure of innovation imprinting, while focused on observable marketing-related factors under the control of managers, does not include all possible pre-IPO strategic actions. It could be expanded to include other actions that are visible to investors before the IPO, including value protection mechanisms such as patents and

trademarks that could help the firm beat the slump.[7] If observable beyond financial disclosures, research could examine the role of business model innovation, brand introductions, and novel advertising investments. Non-marketing related factors are also likely important in determining which firms can beat the slump. Access to financial resources, such as the presence or reputation of venture capitalists, for instance, might encourage firms to pursue breakthrough innovation.

Second and related, we offer an investor-attraction mechanism that helps explain why innovation imprinting can protect the firm from the post-IPO innovation slump. We acknowledge that this mechanism is but one mediating path. Future research should explore additional mechanisms. Finally, our findings pertain to the CPG sector. Although this is a large and important sector that relies on innovation, future research should also investigate the generalizability of our findings to other sectors.

Conclusion

Going public is an important event in the life of a firm. The firm enjoys access to more capital, but also faces pressures that affect its willingness to develop and introduce breakthrough innovations. We find CPG firms beat the post-innovation slump in only 30% of observations. Our findings indicate that firms are more likely to do so when they have engaged in innovation imprinting before they go public. These imprinting actions improve the odds of beating the post-IPO innovation slump, in part, because they attract more risk-tolerant investors who believe the firm can effectively manage the risks associated with breakthrough innovations. These investors reward these firms with stronger valuations and the firms survive longer.

[7] A challenge with patents is that very few CPG firms patent their new products (only 9% in our sample), making this a less robust imprinting signal. Likewise, new product introductions in this sector tend to be associated with a large number of trademarks (for product shapes, colours, fonts, slogans and package design), again weakening the value of this measure. Despite this, we replicate our results using patent and trademark counts to add a "value protection" dimension of innovation imprinting (results available from first author).

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Table 1: Organizing the Literature

	Firms in Public State	Firms Changing from Private to Public State
How the Stock Market Impacts Firm Innovation	- Firms cut R&D spending and new product activities to meet earnings targets (Graham, Harvey, and Rajgopal 2005). - Firms whose stocks underperform relative to industry peers implement higher-risk innovation strategies than other firms (Markovitch, Steckel, and Yeung 2005). - Firms cut R&D and marketing spending to inflate short-term earnings (Mizik 2010; Mizik and Jacobson 2007). - Firms cut R&D spending to avoid unexpected earnings shortfalls in the short-term (Chakravarty and Grewal 2011). - Firms time new product introductions in order to reap stock market benefits at the expense of product market sales (Moorman, Wies, Mizik, and Spencer 2012).	- Firms produce more patents that rely on the firms' prior patents after they go public (Wu 2012). - Newly-public firms introduce fewer and lower-quality patents (Aggarwal and Hsu 2013). - Firms experience a decline in the quality of internally-generated patents after they go public (Bernstein 2015). - Firms introduce fewer breakthrough innovations and fewer new-to-the-firm innovations after they go public (Wies and Moorman 2015).
How Firms Defy Stock Market Pressures in Innovation	***Uncontrollable Firm-level Predictors*** - Firms are less likely to cut R&D to reverse earnings declines when institutional ownership is high (Bushee 1998). - Firms are less likely to reduce R&D spending to compensate for earnings shortfalls when their size or industry concentration increases (Chakravarty and Grewal 2011). - Firms generate more patents and patents with more citations when fewer stock analysts follow them (He and Tian 2013). - Firms generate higher innovation output when institutional ownership is high (Aghion, Van Reenen, and Zingales 2013). - Firm generate more patents and patents with more citations when stock liquidity is higher (Fang, Tian, and Tice 2014). Firms produce a larger number of patents and patents with more citations when backed by more failure-tolerant venture capitalists (Tian and Wang 2014). - Firms generate a larger number of patents and patents with more citations when targeted by hedge fund activists (Brav et al. 2018). - Firms generate a larger number of patents and patents with more citations when subject to a larger number of anti-takeover provisions (Chemmanur and Tian 2018).	***Uncontrollable Industry-level Predictors*** - Firms are less likely to decrease breakthrough innovations after going public in industries with higher sales growth, higher strategic emphasis (toward value appropriation) and higher concentration (Wies and Moorman 2015). ***Controllable Marketing-Relevant Firm Predictors*** - Our current research

Table 2: Operationalization of Key Variables

Variable	Operationalization	Data Source
Innovation imprinting	Formative measure of four imprinting indicators (breakthrough innovation emphasis, breakthrough innovation pacing, market bundling capability, market leveraging capability), measured before the IPO	ProductLaunch Analytics
- Breakthrough innovation emphasis	Yearly difference between the firm's breakthrough innovations and incremental innovations over its total introductions, averaged across all periods before the IPO	ProductLaunch Analytics
- Breakthrough innovation pacing	Inverse of the standard deviation of the number of days between the firm's breakthrough introductions in the period before the IPO	ProductLaunch Analytics
- Market bundling capability	Average number of incremental innovations introduced after and linked to each breakthrough innovation from the firm across all periods before the IPO	ProductLaunch Analytics
- Market leveraging capability	Logarithm of the firm's cumulative number of marketing alliances before the IPO	SDC Platinum Mergers, Acquisitions and Alliances
Beating the post-IPO innovation slump	Difference between actual breakthrough innovation levels and expected breakthrough innovation levels in each post-IPO firm-year	ProductLaunch Analytics
Concordant investors	Risk tolerance of firm's investors, measured as the weighted average profit volatility of the portfolio companies in which the firm's institutional investors have invested over the last five years	Thomson Reuters Institutional 13f Holdings
Financial performance	Logarithm of firm's Tobin's q, calculated as the sum of market value of equity, value of preferred stock, and book value of debt, over book value of total assets	Compustat
Survival	Number of years firm exists post-IPO	SDC Platinum Global New Issues
Control variables		
Pre-IPO breakthrough innovations	Cumulative number of firm's breakthrough innovations in the period before the IPO	ProductLaunch Analytics
Incremental innovations	Logarithm of firm's non-breakthrough introductions	ProductLaunch Analytics
Size	Yearly-weighted number of articles found about the firm	Factiva
Age	Years since firm founding date or since first entry in CSRP database if no founding date could be located	ReferenceUSA and CRSP
ROA	Ratio of firm's operating income before depreciation to total assets	Compustat
Financial leverage	Sum of firm's long-term debt and debt in current assets divided by its book value of assets	Compustat
Sales growth	Change in sales as a proportion of sales in the preceding year's quarter	Compustat
Industry concentration	Herfindahl-Hirschman index; sum of squared market shares of firms in a firm's industry	Compustat
Industry sales growth	Compounded four-digit SIC industry sales growth rate over previous three years	Compustat
Industry demand instability	Standard deviation of four-digit SIC industry sales growth rate	Compustat
Industry appropriation emphasis	Firm advertising expenditures minus R&D expenditures, scaled by total assets, averaged over all firms in four-digit SIC industry	Compustat

Table 3: Breakthrough Innovation Prediction Model

	Breakthrough Innovations	
Breakthrough innovations *(t-1)*	0.057*	(0.033)
Age	-0.001	(0.005)
Size	-5.370*	(3.059)
Incremental innovations	0.207***	(0.020)
Industry purchasing frequency	0.006	(0.010)
Industry concentration	-0.065	(0.199)
Constant	-0.487	(0.377)
Observations	1,546	
Wald Chi^2 statistic (DF)	1465.75*** (30)	
Year fixed effects	Yes	

Notes: Robust standard errors in parentheses. All variables are at the firm level unless noted as industry level. All variables are measured in period *t* unless specified as *(t-1)*. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table 4: Descriptives and Correlations

		M	S.D.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1)	Beating the post-IPO innovation slump	-0.068	0.394	1													
(2)	Innovation imprinting	0.021	0.531	0.372	1												
(3)	Risk-tolerant investors	-0.063	0.202	0.151	0.142												
(4)	Tobin's *q*	1.98	0.919	0.179	0.028	0.096											
(5)	Pre-IPO breakthrough innovations	1.033	1.251	0.577	0.107	0.152	0.217	1									
(6)	Incremental innovations	1.15	1.37	0.617	0.193	0.071	0.201	0.754	1								
(7)	Size	0.006	0.016	0.403	0.382	0.196	0.144	0.324	0.245	1							
(8)	Age	3.093	1.206	0.058	-0.045	-0.115	-0.044	0.312	0.333	0.200	1						
(9)	Industry concentration	0.274	0.285	-0.09	-0.012	0.121	-0.148	-0.221	-0.269	0.191	-0.158	1					
(10)	Industry sales growth	0.923	2.731	0.014	0.033	0.027	0.025	0.01	-0.019	0.021	-0.044	0.133	1				
(11)	Industry demand instability	0.929	2.733	0.011	-0.033	0.024	0.033	0.018	-0.026	0.063	0.022	0.121	-0.125	1			
(12)	Industry value appropriation emphasis	0.000	0.014	-0.014	-0.013	0.015	-0.024	0.041	-0.029	0.024	-0.008	0.111	-0.041	0.004	1		
(13)	Profitability	0.099	1.395	0.024	-0.011	-0.032	-0.039	0.043	0.041	0.026	0.059	-0.091	0.031	0.007	0.001	1	
(14)	Financial leverage	2508.887	16414.390	0.079	0.08	0.003	-0.055	0.096	0.045	0.269	0.096	0.216	-0.071	0.099	-0.04	0.005	1

Notes: All correlations above 0.022 are significant at $p<.05$. All variables are at the firm level unless noted as industry level.

Table 5: Innovation Imprinting Helps Firms Beat the Post-IPO Innovation Slump

	Beating the Post-IPO Innovation Slump		Beating the Post-IPO Innovation Slump		Beating the Post-IPO Innovation Slump	
Innovation imprinting	0.159***	(0.037)				
Breakthrough innovation emphasis			0.114**	(0.055)	0.023**	(0.011)
Breakthrough innovation pacing			0.016***	(0.004)	0.045***	(0.011)
Breakthrough innovation leveraging capability			0.053*	(0.033)	0.014*	(0.008)
Breakthrough innovation bundling capability			0.031***	(0.005)	0.069***	(0.011)
Pre-IPO breakthrough innovations	0.119***	(0.028)	0.103***	(0.019)	0.103***	(0.019)
Incremental innovations	0.106***	(0.014)	0.105***	(0.015)	0.105***	(0.015)
Size	4.628***	(1.301)	5.153***	(0.645)	5.153***	(0.645)
Age	-0.058***	(0.011)	-0.051***	(0.012)	-0.051***	(0.012)
Industry concentration	-0.013	(0.054)	-0.010	(0.102)	-0.010	(0.102)
Industry sales growth	0.042***	(0.014)	0.043**	(0.018)	0.043**	(0.018)
Industry demand instability	0.003*	(0.002)	0.003	(0.002)	0.003	(0.002)
Industry value appropriation emphasis	0.873	(1.501)	1.025*	(0.599)	1.025*	(0.599)
IMR	-0.024	(0.043)	-0.013	(0.092)	-0.013	(0.092)
Constant	-0.003	(0.139)	-0.026	(0.282)	-0.017	(0.281)
Observations	2,265		2,265		2,265	
Adjusted R^2	0.511		0.521		0.521	
Wald Chi^2 statistic (DF)	1865.37*** (48)		1533.30*** (51)		1533.30*** (51)	
Industry fixed effects	Yes		Yes		Yes	
Year fixed effects	Yes		Yes		Yes	

Notes: Column 1 tests the composite innovation imprinting measure, Column 2 tests the four individual measures of innovation imprinting, and Column 3 repeats the individual test using standardized coefficient estimates. Robust standard errors in parentheses. All variables are at the firm level unless noted as industry level.

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

Table 6: Innovation Imprinting Attracts Concordant Investors

	Risk-tolerance of Investors	
Innovation imprinting	0.051***	(0.019)
Pre-IPO breakthrough innovations	0.006	(0.015)
Size	0.013	(0.014)
Age	0.015	(0.019)
ROA	-0.009*	(0.006)
Financial leverage	0.000	(0.000)
Industry concentration	0.019	(0.0146)
Industry sales growth	-0.026*	(0.020)
Industry demand instability	0.019	(0.075)
Industry value appropriation emphasis	0.026	(0.159)
IMR	-0.162	(0.129)
Constant	-0.186	(0.396)
Observations	1,976	
Adjusted R^2	0.145	
Wald Chi^2 statistic (DF)	912.91*** (49)	
Industry fixed effects	Yes	
Year fixed effects	Yes	

Notes: Robust standard errors in parentheses. All variables are at the firm level unless noted as industry level.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table 7a: Beating the Post-IPO Innovation Slump Improves Tobin's *q*

	Tobin's *q*	
Beating the post-IPO innovation slump	0.609***	(0.100)
Size	-0.320*	(0.182)
Age	-0.040	(0.147)
ROA	-2.219	(0.083)
Financial leverage	-0.000	(0.000)
Sales growth	0.835	(0.619)
Industry concentration	0.000	(0.001)
Industry sales growth	0.420	(0.737)
Industry demand instability	0.019	(0.062)
Industry value appropriation emphasis	-0.111	(0.585)
IMR	0.121	(0.277)
Constant	23.446*	(10.251)
Observations	1,884	
Adjusted R^2	0.120	
Wald Chi^2 statistic (DF)	187.44*** (47)	
Industry fixed effects	Yes	
Year fixed effects	Yes	

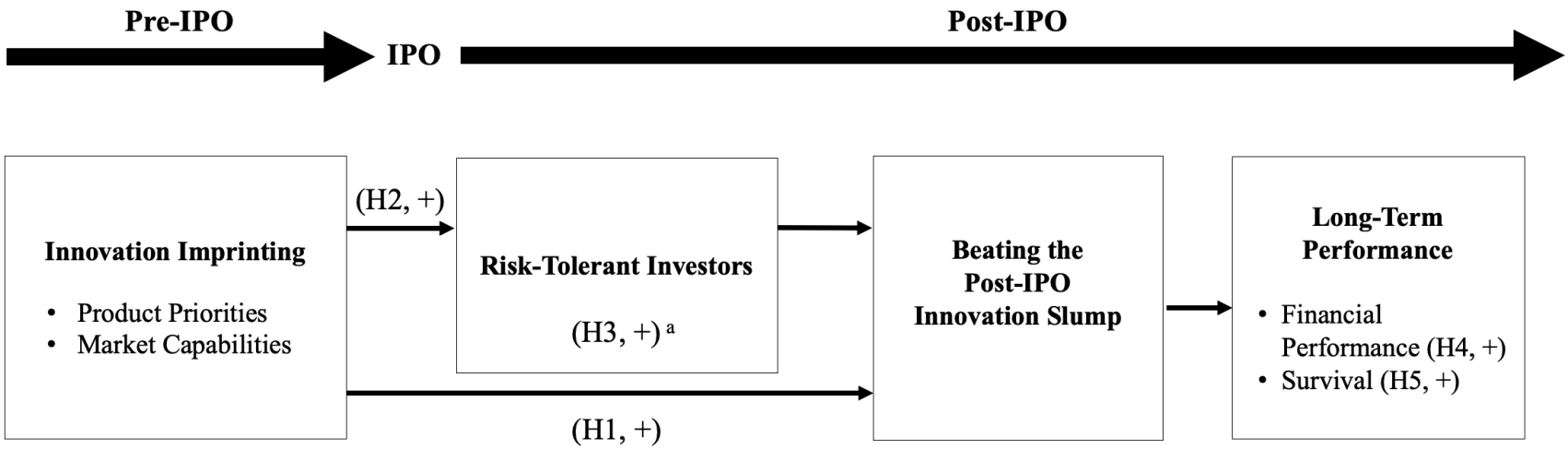
Notes: Robust standard errors in parentheses. All variables are at the firm level unless noted as industry level.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table 7b: Beating the Post-IPO Innovation Slump Improves Firm Survival

	Firm Survival	
Beating the post-IPO innovation slump	0.401***	(0.026)
Size	-5.322	(7.399)
Age	0.222***	(0.078)
ROA	0.078	(0.135)
Financial leverage	0.000	(0.000)
Sales growth	-0.001	(0.030)
Industry sales growth	0.225	(0.600)
Industry demand instability	-0.007	(0.032)
Industry value appropriation emphasis	5.260	(3.078)
Industry concentration	-0.412	(0.475)
IMR	0.528	(0.499)
Constant	1.123***	(2.961)
Observations	2,086	
LR Chi^2 statistic (DF)	102.35*** (47)	
Scale parameter	0.470	
Industry fixed effects	Yes	
Year fixed effects	Yes	

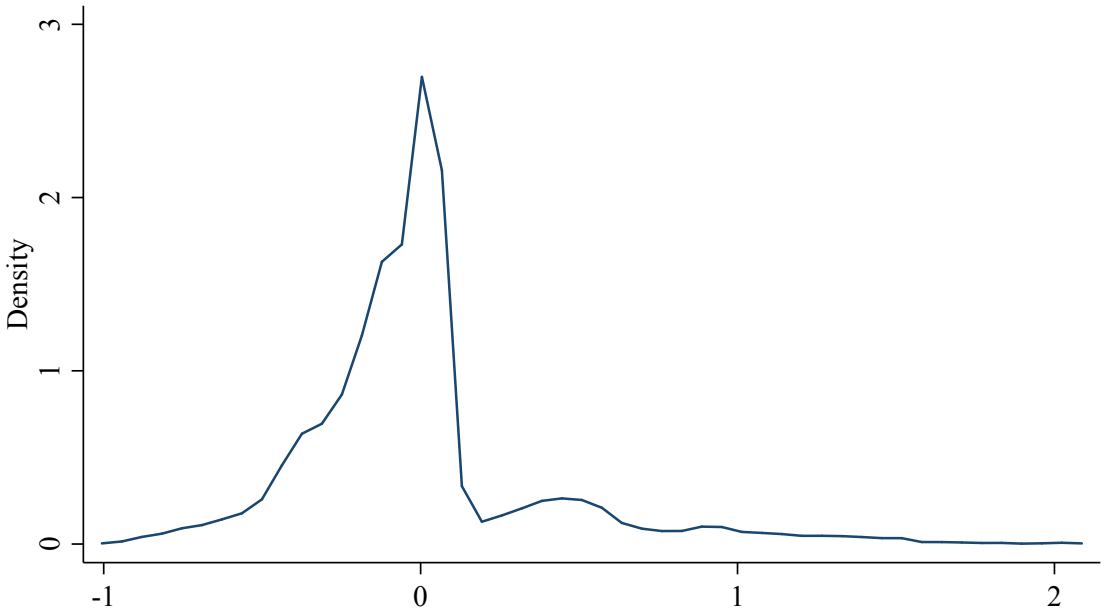
Notes: Robust standard errors in parentheses. All variables are at the firm level unless noted as industry level.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Figure 1: Conceptual Framework



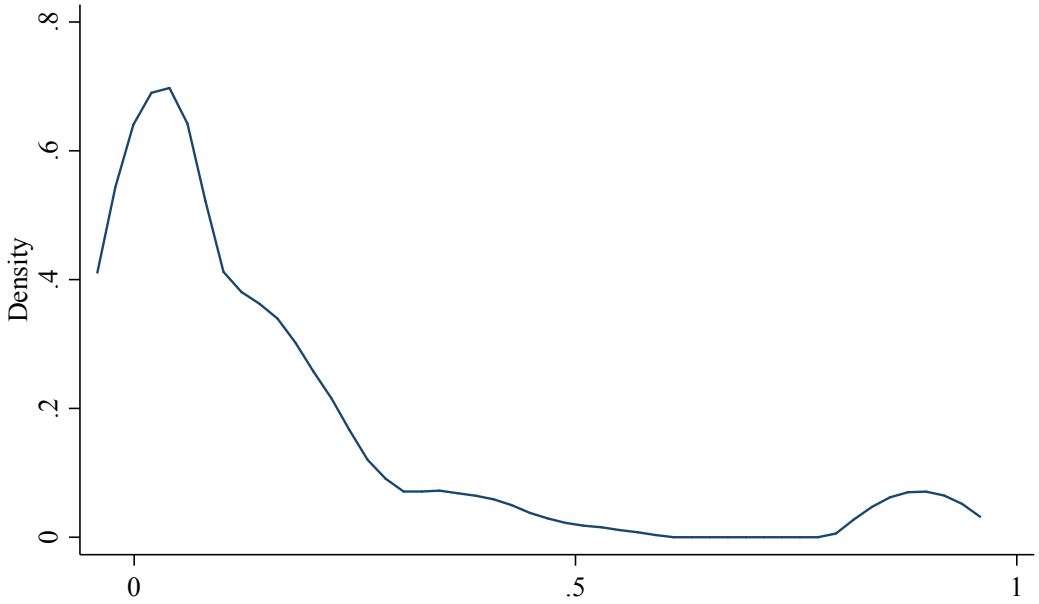
[a] H3 predicts the mediating effect of risk-tolerant investors on the relationship between innovation imprinting and beating the post-IPO innovation slump.

Figure 2: Distribution of Degree of Beating the Post-IPO Innovation Slump



Difference between actual and predicted post-IPO firm-year breakthrough innovations

Figure 3: Frequency of Firms Beating the Post-IPO Innovation Slump



Proportion of post-IPO years in which each firm beats the post-IPO innovation slump

Innovation Imprinting: Why Some Firms Beat the Post-IPO Innovation Slump

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Web Appendix[8]

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[8] These materials have been supplied by the authors to aid in the understanding of their paper. The AMA is sharing these materials at the request of the authors.

WEB APPENDIX W1

A. Validating the Formative Imprinting Measure

Following Diamantopoulos and Winklhofer (2001) and related applied literature (e.g., Ernst, Hoyer, and Rübsaamen 2010), we took two steps to establish the validity of our formative measure by assessing the collinearity and external validity of our indicators. To assess indicator collinearity, we calculate the correlations between the four indicators (see Table WA1.1 below). Results confirm moderate correlation, with indicators that belong to the same (different) product priority or market capability dimension displaying high (low) correlations. We also run a regression analysis of all indicators as independent variables on each single indicator as dependent variable, and find VIFs below 3 in all regressions—suggesting that multicollinearity is not a threat to our formative approach, and confirming that our indicators measure distinguishable aspects of innovation imprinting.

To assess the external validity of our measure, we examine the correlation of our indicators with a firm's post-IPO advertising levels—a variable that is distinct from, but theoretically related to, our product priorities and market capabilities constructs. Consistent with expectations that advertising is tied to the commercialization of breakthrough innovations, the product priorities indicator has a weaker correlation with advertising ($\rho = -0.12$) than the market capabilities indicator ($\rho = 0.50$).

Follow-up tests show our results are also robust to viewing innovation imprinting as reflective within the product priorities and market capabilities indicators and formative across the two types of indicators. Results are also robust to using the four individual indicators. We retain a focus on the overall measure given it has stronger conceptual features that support our emphasis on the strength and coherence of the external signal to investors.

Table W1.1: Correlations Among Innovation Imprinting Indicators

	Breakthrough innovation emphasis	Breakthrough innovation pacing	Breakthrough innovation leveraging	Breakthrough innovation bundling
Breakthrough innovation emphasis	1			
Breakthrough innovation pacing	0.29***	1		
Breakthrough innovation leveraging	-0.06	-0.11	1	
Breakthrough innovation bundling	-0.15*	-0.18**	0.41***	1

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

B. Robustness Test of Unequal Indicator Weights

The most parsimonious modeling choice that acknowledges the confluence of the four indicators is to construct an unweighted average of the indicator variables as our measure of innovation imprinting. To accommodate that investors might differ in their responsiveness to the individual indicators, we undertake two robustness tests that involve different weighting schemes of the four indicator variables. First, we estimate Equation 5 using four separate imprinting activities (as standardized values) instead of one composite innovation imprinting variable. We then extract the estimated coefficients of the four indicators and calculate the relative weight of each indicator *K* (Relative_Weight$_K$ = $\widehat{\beta_K} / \sum_{K=1}^{4} \widehat{\beta_K}$). Using these relative weights, we construct a newly weighted measure of innovation imprinting (i.e., Weighted innovation imprinting I). Estimating Equations 3 and 5 with this newly weighted measure yields results in close correspondence to those we report in the main analysis (see Tables W1.2 and W1.3 below).

Second, we estimate Equation 6 and include standardized values of the four separate activities instead of the beating the post-IPO innovation slump variable. As before, we then extract the estimated coefficients of the four indicators to calculate the relative weight of each indicator and use those to construct a newly weighted measure of innovation imprinting (i.e., Weighted innovation imprinting II). We estimate Equations 3 and 5 using this measure and find our earlier results unchanged (see Tables W1.2 and W1.3 below).

Table W1.2: Innovation Imprinting Helps Firms Beat the Post-IPO Innovation Slump (Using Different Indicator Weights for Innovation Imprinting)

	Beating the Post-IPO Innovation Slump		**Beating the Post-IPO Innovation Slump**	
Weighted innovation imprinting I	0.114***	(0.025)		
Weighted innovation imprinting II			0.116***	(0.028)
Pre-IPO breakthrough innovations	0.141***	(0.023)	0.138***	(0.020)
Incremental innovations	0.109***	(0.019)	0.107***	(0.018)
Size	6.523***	(2.057)	6.034***	(1.958)
Age	-0.050***	(0.012)	-0.055***	(0.013)
Industry concentration	0.038	(0.125)	0.034	(0.114)
Industry sales growth	0.036***	(0.011)	0.036***	(0.011)
Industry demand instability	0.002	(0.003)	0.002	(0.003)
Industry value appropriation emphasis	1.087	(1.839)	0.913	(1.436)
IMR	0.003	(0.081)	-0.007	(0.090)
Constant	-0.210	(0.218)	-0.167	(0.224)
Observations	2,265		2,265	
Adjusted R^2	0.493		0.492	
Wald Chi^2 statistic (DF)	1770.53*** (48)		1791.22*** (48)	

Industry fixed effects	Yes	Yes
Year fixed effects	Yes	Yes

Notes: Weighted innovation imprinting I is based on the following weights: breakthrough innovation emphasis 0.043, breakthrough innovation pacing 0.015, breakthrough innovation leveraging 0.007, and breakthrough innovation bundling 0.006. Weighted innovation imprinting II is based on the following weights: breakthrough innovation emphasis 0.342, breakthrough innovation pacing 0.384, breakthrough innovation leveraging 0.006, and breakthrough innovation bundling 0.055. Robust standard errors in parentheses. All variables are at the firm level unless noted as industry level.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table W1.3: Innovation Imprinting Attracts Concordant Investors (Using Different Indicator Weights for Innovation Imprinting)

	Risk-tolerance of Investors		**Risk-tolerance of Investors**	
Weighted innovation imprinting I	0.061**	(0.024)		
Weighted innovation imprinting II			0.073***	(0.026)
Pre-IPO breakthrough innovations	0.028*	(0.016)	0.027*	(0.016)
Size	0.013	(0.012)	0.013	(0.012)
Age	0.003	(0.017)	0.001	(0.016)
ROA	-0.009*	(0.005)	-0.009*	(0.005)
Financial leverage	0.000	(0.000)	0.000	(0.000)
Industry concentration	-0.048	(0.151)	-0.047	(0.151)
Industry sales growth	-0.026**	(0.010)	-0.026**	(0.010)
Industry demand instability	0.011	(0.010)	0.011	(0.010)
Industry value appropriation emphasis	1.900***	(0.629)	1.807***	(0.670)
IMR	-0.098	(0.115)	-0.087	(0.113)
Constant	-0.275	(0.369)	-0.301	(0.364)
Observations	1,976		1,976	
Adjusted R^2	0.149		0.152	
Wald Chi^2 (DF)	926.65*** (49)		932.02*** (49)	
Industry fixed effects	Yes		Yes	
Year fixed effects	Yes		Yes	

Notes: Weighted innovation imprinting I is based on the following weights: breakthrough innovation emphasis 0.043, breakthrough innovation pacing 0.015, breakthrough innovation leveraging 0.007, and breakthrough innovation bundling 0.006. Weighted innovation imprinting II is based on the following weights: breakthrough innovation emphasis 0.342, breakthrough innovation pacing 0.384, breakthrough innovation leveraging 0.006, and breakthrough innovation bundling 0.055. Robust standard errors in parentheses. All variables are at the firm level unless noted as industry level.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

C. Additional Indicator Operationalizations

We replicate our results when employing different operationalizations of the indicators that form our composite measure. First, considering the *level of emphasis on breakthrough innovation*, we replace the number of total introductions by firm size in the denominator so that the measure becomes:

$$Emphasis_{it} = (Breakthrough\_Innovations_{it} - Incremental\_Innovations_{it}) / Firm\_Size_{it}.$$

Second, regarding *bundling of breakthrough innovation,* we test the robustness of our results using a time period of 24 months (instead of 12 months) to identify whether an incremental innovation qualifies as part of the breakthrough innovation bundle. Accordingly, bundled incremental innovations satisfied two conditions: (i) the product was introduced within the following 24 months and (ii) the product was introduced under the same brand name in the same category as the original breakthrough innovation. Our results remain unchanged when employing any of the different operationalizations.

WEB APPENDIX W2

Control Variables Included in the Models

Do Firms Beat the Post-IPO Innovation Slump? (Equation 1)

For our beating the innovation slump model, we follow Wies and Moorman (2015) and include five control variables. These controls include the logarithm of firm *age* to account for firm life cycle effects. To measure, we collect firm founding dates from ReferenceUSA and if no entry was found, we use the first entry in the CRSP database as the founding date. We include firm *size* because the literature suggests that it influences firm innovation (Chandy and Tellis 2000). Because no conventional proxy of firm size is available for the pre-IPO firm observations, we use firm press coverage, operationalized as the yearly-weighted number of articles found about the focal firm in the Factiva newspaper database.[9] We include the number of firm *incremental innovations* to control for other types of firm innovation, measured by counting the firm's non-breakthrough introductions and use the natural logarithm. We also include a variable to account for the demand frequency of firm innovation, captured by the *industry purchasing frequency*. This variable is defined as the number of times the average buying household purchases products in a given category over a year. We use the purchasing frequency averages from the IRI *Marketing Factbook* for each category and year and match them based on our firms' dominant industry as retrieved from Compustat. To control for the impact of a firm's competitive situation, we add *industry concentration*, measured by the Herfindahl-Hirschman index as the sum of squared market shares of firms in a firm's industry.

Does Innovation Imprinting Help Firms Beat the Post-IPO Innovation Slump? (Equation 3)

For our model of whether innovation imprinting helps beating the innovation slump, our firm controls include the logarithm of firm *age* to control for firm life cycle effects and firm *size* because the literature suggests that it influences firm innovation (Chandy and Tellis 2000). We also include the number of firm *incremental innovations* to control for other types of firm innovation, measured by counting the firm's non-breakthrough introductions and use the natural logarithm. We use the firm's pre-IPO *cumulative breakthrough innovations* to account for the pre-IPO level of breakthrough innovations and capture momentum effects of firm breakthrough levels.

In terms of industry controls, we include *industry concentration* because market structure influences firm innovation strategies (Acs and Audretsch 1987). Following Wies and Moorman (2015), we include three industry controls that reflect demand-side opportunities offering incentives to firms to beat the slump. *Industry sales growth* is measured by the compounded four-digit SIC industry sales growth rate over the previous three years (Luo and Donthu 2006), and *industry demand instability* is assessed as the standard deviation of the four-digit SIC industry sales growth rate (Gruca and Rego 2005). We measure *industry appropriation emphasis*

[9] In line with previous research (e.g., Fang and Peress 2009), firm press coverage is strongly correlated with traditional firm metrics, such as sales ($\rho = 0.51$, $p<0.01$), total assets ($\rho = 0.47$, $p<0.01$), and number of employees ($\rho = 0.31$, $p<0.01$) in our post-IPO observations.

following Mizik and Jacobson (2003) as firm advertising expenditures minus firm R&D expenditures, scaled by total assets, averaged over all firms per year in a four-digit SIC industry.

Does Innovation Imprinting Attract Concordant Investors? (Equation 5)

Our model of innovation imprinting drawing concordant investors includes a set of firm controls that are likely to influence the attraction of risk-tolerant investors. These include firm profitability, measured by firm *return on assets* (ROA) as the ratio of operating income before depreciation to total assets, firm *financial leverage* measured by the sum of the firm's long-term debt and debt in current assets divided by the book value of assets, and two general firm controls—firm *age* and firm *size*—as described above. We also add the four industry controls described in the section for Equation 3.

Are Firms Rewarded in the Long-Term for Beating the Post-IPO Innovation Slump Through Stronger Financial Performance? (Equation 6)

For our test of financial performance, our firm controls include firm *ROA* as a proxy for profitability, which prior literature shows has a positive effect on Tobin's *q* (Jayachandran et al. 2013) and firm *market share* given it has also been shown to increase Tobin's *q* (Fang et al. 2008). It is measured by the fraction of firm sales revenues divided by sales revenues of all firms in the same four-digit SIC industry. We include firm *sales growth* measured as the change in sales as a proportion of sales in the preceding year's quarter (Nath and Mahajan 2008), given it might indicate higher future growth prospects that increase Tobin's *q*. Firm *financial leverage* is included given evidence it is related to firm value (Malshe and Agarwal 2015). Accounting for the negative associations between firm *size* and Tobin's *q* (Bharadwaj et al. 1999), as well as firm *age* and Tobin's *q* (Rao et al. 2004), we include both variables as controls. Finally, we add the four industry controls discussed earlier.

Are Firms Rewarded in the Long-Term for Beating the Post-IPO Innovation Slump Through Higher Survival Probability? (Equation 7)

For our model estimating survival, our firm controls include firm *size* (Srinivasan, Lilien, and Rangaswamy 2004) as large firms might be better endowed to survive in the longer-term, firm *age* as older firms are more likely to accumulate resources and survival capabilities, and firm *ROA* to account for firm profitability which should have an effect on firm survival (Zhou and Park 2020). We also control for *financial leverage* to account for financial flexibility helping to survive in the longer-term, as well as *sales growth* given it might indicate more favorable future growth prospects. Given prior literature points to industry features explaining firm survival (e.g., Robinson and Min 2002), we add the four industry controls discussed earlier. Across all our models, we also include a vector of year fixed effects and industry fixed effects to control for general macroeconomic and industry-specific factors, respectively.

WEB APPENDIX W3

Additional Endogeneity Checks

Firms choose to go public and we cannot rule out the possibility that firms select into this decision for reasons related to breakthrough innovations. Three reasons, however, lead us to conclude that this potential endogeneity should not impose a threat to our modeling approach and results.

First, previous literature does not suggest that such selection takes place or that it influences innovation results. Brau and Fawcett (2006), for instance, report that creating public shares for acquisitions are the most important motivation for going public, and that financial arguments related to lowering the cost of capital and exploiting favorable market conditions encourage firms to list. Wies and Moorman (2015) explicitly test whether the level of pre-IPO breakthrough innovations predict the firm's choice to go public and find that this reverse causality explanation does not hold.

Second, in our set-up, by construction, the potential selection should not confound our focal variable (i.e., the pre-IPO innovation imprint), because the latter is formed before the firm decides to go public.

Finally, in our models, we control for time-invariant firm-specific effects and employ a Heckman-type selection correction in which we control by means of an inverse Mill's ratio (IMR) for potential selection. This correction variable turns out insignificant in all models, suggesting that selection does not impact our models.

WEB APPENDIX W4

System of Equations Estimation

Table W4: Innovation Imprinting Helps Firms Beat the Post-IPO Innovation Slump (Simultaneous Estimation)

	Full Mediation Model				Simultaneous Estimation of Equations 3 and 4			
	Beating the Post-IPO Innovation Slump		Risk-tolerance of Investors		Beating the Post-IPO Innovation Slump		Risk-tolerance of Investors	
Innovation imprinting	0.156***	(0.010)			0.157***	(0.010)		
Risk-tolerance of investors	0.048***	(0.020)						
Pre-IPO breakthrough innovations	0.078***	(0.007)			0.080***	(0.007)		
Incremental innovations	0.155***	(0.007)			0.150***	(0.007)		
Size	5.426***	(0.449)			5.430***	(0.442)		
Age	-0.056***	(0.006)			-0.057***	(0.007)		
Industry concentration	-0.036	(0.087)			-0.040	(0.090)		
Industry sales growth	0.036**	(0.017)			0.033**	(0.016)		
Industry demand instability	0.002	(0.003)			0.002	(0.002)		
Industry value appropriation emphasis	0.254	(0.614)			0.247	(0.610)		
IMR	-0.026	(0.053)			-0.026	(0.053)		
Constant	0.004	(0.018)			0.006	(0.015)		
Innovation imprinting			0.043***	(0.007)			0.043***	(0.007)
Pre-IPO breakthrough innovations			0.010	(0.006)			0.010	(0.006)
Size			0.752**	(0.326)			0.752**	(0.326)
Age			-0.003	(0.006)			-0.003	(0.006)
ROA			-0.012***	(0.004)			-0.012***	(0.004)
Financial leverage			0.000	(0.000)			0.000	(0.000)
Industry concentration			0.058	(0.039)			0.058	(0.039)
Industry sales growth			-0.007	(0.011)			-0.007	(0.011)
Industry demand instability			0.003	(0.002)			0.003	(0.002)
Industry value appropriation emphasis			0.616	(0.542)			0.616	(0.542)

IMR	0.053	(0.036)	0.053	(0.036)
Constant	0.099	(0.233)	0.099	(0.233)
Observations	1,976		1,976	
Log likelihood	-1,162.77		-1,164.90	
Industry fixed effects	Yes		Yes	
Year fixed effects	Yes		Yes	

Notes: Robust standard errors in parentheses. All variables are at the firm level unless noted as industry level.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

WEB APPENDIX W5

Alternative Models to Predict Beating the Post-IPO Innovation Slump

Table W5.1: Innovation Imprinting Helps Firms Beat the Post-IPO Innovation Slump (Including Private Firm Sample)

	Breakthrough Innovations	
Public	-0.025***	(0.009)
Innovation imprinting	0.146***	(0.013)
Public * Innovation imprinting	0.076***	(0.012)
Incremental innovations	0.175***	(0.004)
Size	0.187	(0.402)
Age	0.009**	(0.004)
Industry concentration	0.001	(0.024)
Industry sales growth	0.025***	(0.009)
Industry demand instability	0.001	(0.001)
Industry value appropriation emphasis	-0.053	(0.532)
Constant	-0.104**	(0.044)
Observations	7,387	
Adjusted R^2	0.544	
Wald Chi^2 statistic (DF)	3946.90*** (56)	
Industry fixed effects	Yes	
Year fixed effects	Yes	

Notes: Robust standard errors in parentheses. All variables are at the firm level unless noted as industry level.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table W5.2: Innovation Imprinting Helps Firms Beat the Post-IPO Innovation Slump (Proportion of Post-IPO Years Firms Beat the Innovation Slump as Dependent Variable)

	Proportion of Years Beating Innovation Slump	
Innovation imprinting	0.282**	(0.120)
Size	-4.893	(3.352)
Age	-0.196***	(0.062)
Pre-IPO breakthrough innovations	0.138*	(0.079)
Incremental innovations	0.193*	(0.100)
Industry sales growth	0.180	(0.154)
Industry demand instability	0.006	(0.013)
Industry value appropriation emphasis	-8.666*	(4.373)
Industry concentration	0.349	(0.246)
IMR	-0.463	(0.410)
Constant	2.790***	(0.962)
Observations	203	
Adjusted R^2	0.23	
F statistic (DF)	6.83*** (10)	

Notes: To account for the bounded range of the dependent variable, we use a logit-type transformation (see Cleeren et al. 2013): $Proportion\_Beat\_Innovation\_Slump_i^* = \ln((Proportion\_Beat\_Innovation\_Slump_i + 1.01)/(1.01 - Proportion\_Beat\_Innovation\_Slump_i))$. Robust standard errors in parentheses. All variables are at the firm level unless noted as industry level.

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

WEB APPENDIX W6

Alternative Timing Specifications

We examine the impact of three different timing specifications on our results. First, we begin by re-estimating Equation 3 but restrict the post-IPO estimation period to the five years after the IPO given it becomes more difficult to predict post-IPO breakthrough innovation levels as time advances. Our findings replicate. Second, we control for the month in which the firm goes public to acknowledge that the firm's first post-IPO year behavior might differ if it goes public in January (i.e., with a full year ahead) or in December. We also exclude one year before and one year after the IPO to ensure a more equal footing of the IPO year. Both tests confirm our earlier findings. Third, we include the number of observed firm pre-IPO years to control for the duration of time during which the pre-IPO innovation imprinting has been formed. Our earlier results replicate. Acknowledging that pre-IPO innovation imprinting might become less influential as time passes, we also add a control for a time trend to Equation 3 and find that it is insignificant. Our results replicate and are available upon request.

WEB APPENDIX W7

Alternative Models to Explain How Beating the Post-IPO Innovation Slump Improves Firm Financial Performance

Given recent work has challenged the universal use of Tobin's *q* (Bendle and Butt 2018), we use this web appendix to address why we have no reason to believe that Tobin's *q* might be a biased measure in our context and to outline steps we take to rule out concerns. First, our sample firms are from the same sector and should not significantly differ in the mix of tangible and intangible assets that either accounting conventions determine or that firms choose in their competitive strategy. Second, in our set-up, firms have invested in innovation imprinting and beating the innovation slump *before* we observe Tobin's *q* as an outcome variable. As a result, the bulk of investments that could have affected the denominator (i.e., the asset base) has occurred in the past and should not impact Tobin's *q* through reduced recorded tangibles in the same period. Despite these facts, we take the additional precaution of including advertising expense as a further control in our model to test H4 to account for the investments used for the launch of the innovations (see Table W7.1). Our results replicate.

Table W7.1: Beating the Post-IPO Innovation Slump Improves Tobin's *q* (Including Advertising Expense)

	Tobin's *q*	
Beating the post-IPO innovation slump	0.327***	(0.089)
Size	-0.500***	(0.081)
Age	0.288***	(0.038)
ROA	0.705	(0.948)
Financial leverage	-0.000	(0.000)
Advertising	0.001**	(0.000)
Industry concentration	-0.900	(3.929)
Industry sales growth	0.440	(0.543)
Industry demand instability	0.110**	(0.050)
Industry value appropriation emphasis	2.212	(51.676)
IMR	0.440	(1.444)
Constant	26.490**	(11.578)
Observations	1,189	
Adjusted R^2	0.227	
Wald Chi^2 statistic (DF)	186.17*** (47)	
Industry fixed effects	Yes	
Year fixed effects	Yes	

Notes: Robust standard errors in parentheses. All variables are at the firm level unless noted as industry level.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

We also re-estimate our model testing H4 using Total *q* as our measure of financial performance (e.g., Du and Osmonbekov 2020). Developed by Peters and Taylor (2017), Total *q* is built on the classical Tobin's *q* measure but adjusts the asset base in the denominator by adding intangible capital. We confirm our earlier results using the Total *q* measure (see Table W7.2).

Table W7.2: Beating the Post-IPO Innovation Slump Improves Total *q*

	Total *q*	
Beating the post-IPO innovation slump	0.050***	(0.018)
Size	0.064***	(0.026)
Age	-0.239***	(0.039)
ROA	1.129***	(0.227)
Financial leverage	-0.000	(0.000)
Industry concentration	-0.799	(1.082)
Industry sales growth	0.050	(0.031)
Industry demand instability	-0.001	(0.008)
Industry value appropriation emphasis	4.867	(4.609)
IMR	0.866*	(0.477)
Constant	1.233	(1.833)
Observations	1,848	
Adjusted R^2	0.120	
Wald Chi^2 statistic (DF)	332.01*** (47)	
Industry fixed effects	Yes	
Year fixed effects	Yes	

Notes: Robust standard errors in parentheses. All variables are at the firm level unless noted as industry level.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

WEB APPENDIX W8

Alternative Set of Control Variables to Predict Beating the Post-IPO Innovation Slump

Table W8.1: Innovation Imprinting Helps Firms Beat the Post-IPO Innovation Slump (Controlling for IPO Proceeds and Equity Sold)

	Beating the Post-IPO Innovation Slump	
Innovation imprinting	0.181***	(0.023)
Pre-IPO breakthrough innovations	0.097***	(0.020)
Incremental innovations	0.120***	(0.021)
Size	5.673**	(2.543)
Age	-0.039***	(0.013)
Industry concentration	0.011	(0.097)
Industry sales growth	0.025	(0.031)
Industry demand instability	0.000	(0.002)
Industry value appropriation emphasis	1.723***	(0.512)
IMR	-0.040	(0.100)
IPO proceeds	0.001*	(0.001)
Equity sold	0.000	(0.000)
Constant	-0.230	(0.453)
Observations	1,009	
Adjusted R^2	0.560	
Wald Chi^2 statistic (DF)	1124.00*** (50)	
Industry fixed effects	Yes	
Year fixed effects	Yes	

Notes: Robust standard errors in parentheses. All variables are at the firm level unless noted as industry level. Note that our sample is reduced due to data unavailability in SDC Platinum.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table W8.2: Innovation Imprinting Helps Firms Beat the Post-IPO Innovation Slump (Controlling for Firm Slack)

	Beating the Post-IPO Innovation Slump		Beating the Post-IPO Innovation Slump		Beating the Post-IPO Innovation Slump		Beating the Post-IPO Innovation Slump	
Innovation imprinting	0.162***	(0.021)	0.162***	(0.030)	0.162***	(0.021)	0.163***	(0.010)
Pre-IPO breakthrough innovations	0.116***	(0.019)	0.115***	(0.024)	0.117***	(0.018)	0.116***	(0.019)
Incremental innovations	0.107***	(0.011)	0.109***	(0.012)	0.107***	(0.011)	0.109***	(0.009)
Size	5.041***	(0.559)	4.897***	(0.615)	5.072***	(0.715)	4.929***	(0.690)
Age	-0.060***	(0.008)	-0.060***	(0.018)	-0.060***	(0.009)	-0.060***	(0.014)
Industry concentration	0.043	(0.084)	0.037	(0.051)	0.048	(0.094)	0.038	(0.130)
Industry sales growth	0.042***	(0.012)	0.042***	(0.015)	0.043***	(0.012)	0.041***	(0.009)
Industry demand instability	0.003	(0.003)	0.002	(0.003)	0.002	(0.003)	0.003	(0.003)
Industry value appropriation emphasis	0.851	(1.217)	0.847	(1.170)	0.849	(1.220)	0.919	(1.265)
IMR	-0.014	(0.113)	-0.017	(0.068)	-0.018	(0.113)	-0.011	(0.077)
Slack measure: ROA	-0.000	(0.007)						
Slack measure: Financial slack			-0.003**	(0.001)				
Slack measure: Excess cash					-0.000	(0.000)		
Slack measure: Human resource slack							-0.020	(0.571)
Constant	-0.196	(0.341)	-0.107	(0.270)	-0.122	(0.330)	-0.169	(0.230)
Observations	2,044		2,067		2,045		1,975	
Adjusted R^2	0.521		0.519		0.520		0.522	
Wald Chi^2 (DF)	2210.01*** (49)		2298.51*** (49)		2203.13*** (49)		2151.11*** (49)	
Industry fixed effects	Yes		Yes		Yes		Yes	
Year fixed effects	Yes		Yes		Yes		Yes	

Notes: Financial slack is operationalized as the ratio of current assets to current liabilities (De Jong, Zacharias, and Nijssen 2021). Excess cash is operationalized as last period's operating income after subtracting income taxes, interest expense and dividends paid (Slotegraaf, Moorman, and Inman 2003). Human resource slack is operationalized as the ratio of number of employees to sales minus the industry average of this ratio, based on two-digit SIC codes (De Jong, Zacharias, and Nijssen 2021). Robust standard errors in parentheses. All variables are at the firm level unless noted as industry level.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table W8.3: Innovation Imprinting Helps Firms Beat the Post-IPO Innovation Slump (Controlling for Advertising Expense)

	Beating the Post-IPO Innovation Slump	
Innovation imprinting	0.160***	(0.042)
Pre-IPO breakthrough innovations	0.104***	(0.015)
Incremental innovations	0.120***	(0.018)
Size	5.237***	(1.967)
Age	-0.055***	(0.021)
Industry concentration	-0.063	(0.252)
Industry sales growth	0.036	(0.025)
Industry demand instability	0.003	(0.005)
Industry value appropriation emphasis	1.634	(10.362)
IMR	0.148	(0.163)
Advertising expense	0.000	(0.000)
Constant	-0.683	(0.626)
Observations	1,266	
Adjusted R^2	0.554	
Wald Chi^2 (DF)	1563.35*** (49)	
Industry fixed effects	Yes	
Year fixed effects	Yes	

Notes: Robust standard errors in parentheses. All variables are at the firm level unless noted as industry level.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table W8.4: Innovation Imprinting Helps Firms Beat the Post-IPO Innovation Slump (Controlling for R&D Expense)

	Beating the Post-IPO Innovation Slump		Beating the Post-IPO Innovation Slump	
Innovation imprinting	0.182***	(0.027)	0.197***	(0.004)
Pre-IPO breakthrough innovations	0.095***	(0.019)	0.086***	(0.022)
Incremental innovations	0.114***	(0.015)	0.131***	(0.018)
Size	5.240***	(1.340)	5.421***	(1.554)
Age	-0.044	(0.037)	-0.031	(0.043)
Industry concentration	0.171	(0.347)	0.008	(0.250)
Industry sales growth	0.044	(0.028)	0.042	(0.064)
Industry demand instability	-0.001	(0.002)	0.000	(0.006)
Industry value appropriation emphasis	1.011	(0.871)	-2.002	(6.216)
IMR	-0.046	(0.126)	0.038	(0.094)
R&D expense	-0.000	(0.000)	0.000	(0.000)
Advertising expense			-0.000	(0.000)
Constant	-0.277	(0.434)	-0.540***	(0.105)
Observations	1,156		777	
Adjusted R-squared	0.580		0.618	
Wald Chi^2 (DF)	1592.47*** (49)		1253.93*** (50)	
Industry fixed effects	Yes		Yes	
Year fixed effects	Yes		Yes	

Notes: Robust standard errors in parentheses. All variables are at the firm level unless noted as industry level.
*** p < 0.01, ** p < 0.05, * p < 0.10.

Table W8.5: Innovation Imprinting Helps Firms Beat the Post-IPO Innovation Slump (Controlling for Top Management Turnover and CEO Change at IPO)

	Beating the post-IPO innovation slump		**Beating the post-IPO innovation slump**	
Innovation imprinting	0.173***	(0.030)	0.159***	(0.027)
Pre-IPO breakthrough innovations	0.107***	(0.030)	0.120***	(0.023)
Incremental innovations	0.119***	(0.017)	0.102***	(0.015)
Size	4.186***	(1.395)	4.613***	(1.157)
Age	-0.055**	(0.025)	-0.058***	(0.014)
Industry concentration	-0.108	(0.241)	0.029	(0.126)
Industry sales growth	0.049*	(0.028)	0.035***	(0.013)
Industry demand instability	0.004	(0.003)	0.002	(0.003)
Industry value appropriation emphasis	-1.343	(4.636)	0.896	(1.488)
IMR	-0.117	(0.188)	-0.034	(0.076)
Change TMT	-0.002	(0.030)		
Change CEO IPO			0.057	(0.035)
Constant	0.176	(0.603)	-0.054	(0.231)
Observations	1,072		2,265	
Adjusted R^2	0.558		0.513	
Wald Chi^2 statistic (DF)	1342.12*** (49)		2378.17*** (49)	
Industry fixed effects	Yes		Yes	
Year fixed effects	Yes		Yes	

Notes: Change TMT is a binary variable capturing a change in the top management team post-IPO as derived from Execucomp. Change CEO IPO is a hand-collected binary variable indicating whether the CEO changed at the IPO. Robust standard errors in parentheses. All variables are at the firm level unless noted as industry level.

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

WEB APPENDIX W9

Innovation Imprinting Partly Influences IPO Performance

Table W9: Innovation Imprinting Partly Influences IPO Performance

	IPO Trading		IPO Underpricing	
Innovation imprinting	43.067**	(18.289)	6.410	(5.041)
Pre-IPO breakthrough innovations	-14.037	(9.251)	-8.770	(6.910)
Size	0.007	(0.014)	0.003	(0.007)
Age	5.277	(5.669)	5.223	(4.900)
VC investor	1.573	(1.460)	-0.108	(0.854)
Market return	0.000	(.)	0.000	(.)
Industry number of IPOs	-0.051	(0.038)	-0.015	(0.025)
Market share	151.615	(99.250)	-17.271	(15.616)
Financial leverage	-0.000	(0.076)	-0.016	(0.027)
Constant	-143.484	(95.340)	29.445	(21.613)
Observations	178		178	
Adjusted R^2	0.32		0.18	
Wald Chi^2 statistic (DF)	432.88***	(38)	672.18***	(38)
Industry fixed effects	Yes		Yes	
Year fixed effects	Yes		Yes	

Notes: Robust standard errors in parentheses. All variables are at the firm level unless noted as industry level.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

WEB APPENDIX W10

Innovation Imprinting Increases Returns to Post-IPO Breakthrough Innovations

Table W10: Innovation Imprinting Increases Returns to Post-IPO Breakthrough Innovations

	CAR	
Innovation imprinting	0.005**	(0.002)
Size	-0.004	(0.076)
Age	0.003	(0.003)
Innovation SKUs	0.000	(0.001)
Constant	0.162***	(0.050)
Observations	1,349	
Adjusted R^2	0.21	
Wald Chi^2 statistic (DF)	40.59** (30)	
Year fixed effects	Yes	

Notes: Robust standard errors in parentheses. All variables are at the firm level.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

WEB APPENDIX W11

Innovation Imprinting Mitigates the Stock Market Impact of Post-IPO Sales Drops

Table W11: Innovation Imprinting Mitigates the Stock Market Impact of Post-IPO Sales Drops

	Stock Returns	
Sales drop	-0.110***	(0.021)
Innovation imprinting	0.004	(0.012)
Sales drop * Innovation imprinting	0.052**	(0.026)
Pre-IPO breakthrough innovations	-0.013	(0.009)
Incremental innovations	0.001	(0.010)
Firm size	-0.853*	(0.450)
Firm age	0.012	(0.009)
Industry sales growth	0.069***	(0.022)
Industry demand instability	0.004	(0.004)
Industry value appropriation emphasis	0.217	(0.494)
Industry concentration	0.144	(0.162)
IMR	-0.024	(0.060)
Constant	-0.050	(0.253)
Observations	1,896	
Adjusted R^2	0.100	
Wald Chi^2 statistic (DF)	217.43*** (51)	
Industry fixed effects	Yes	
Year fixed effects	Yes	

Notes: Robust standard errors in parentheses. All variables are at the firm level unless noted as industry level.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

WEB APPENDIX W12

Table W12: Innovation Imprinting and Beating the Post-IPO Innovation Slump Does Not Influence Firm Risk

Measure of Risk	Operational Measure	Reference	Finding
Total equity risk	Standard deviation in daily stock returns	Thomaz and Swaminathan (2015); Rego, Billett, and Morgan (2009)	No significant effect of innovation imprinting on total risk; no significant effect of beating the post-IPO innovation slump on total risk
Systematic risk	Beta obtained from Carhart four-factor model	Dotzel and Shankar (2020); Tuli and Bharadwaj (2009)	No significant effect of innovation imprinting on systematic risk; no significant effect of beating the post-IPO innovation slump on systematic risk
Systematic risk	Difference of squared standard deviation in returns and squared standard deviation in residuals	Thomaz and Swaminathan (2015); Rego, Billett, and Morgan (2009)	No significant effect of innovation imprinting on systematic risk; no significant effect of beating the post-IPO innovation slump on systematic risk
Idiosyncratic risk	Standard deviation of residuals from Carhart four-factor model	Dotzel and Shankar (2020); Thomaz and Swaminathan (2015)	Marginally significantly positive effect of innovation imprinting on idiosyncratic risk ($p < 0.10$); no significant effect of beating the post-IPO innovation slump on idiosyncratic risk
Idiosyncratic risk	Standard deviation of residuals from market model	Rego, Billett, and Morgan (2009)	No significant effect of innovation imprinting on idiosyncratic risk; no significant effect of beating the post-IPO innovation slump on idiosyncratic risk

WEB APPENDIX W13

Is the Post-IPO Innovation Slump a Strategic Choice?

It is conceivable that some firms might choose not to beat the post-IPO slump (and potentially not engage in innovation imprinting) either because they want to exploit and monetize existing innovations or because key executives within the firm seek to cash out and leave the respective firm soon after the IPO. While we acknowledge these are a theoretical possibility, our findings demonstrate that choosing to not beat the slump leads to negative and consequential outcomes for both investors and for firms. Additionally, we note the following points:

(1) While successful IPOs can allow key executives to cash out, our results indicate that such cashing out would, in fact, be more lucrative for executives whose firms engaged in innovation imprinting. This is true of financial returns at the IPO and financial performance in the medium- and longer-term. Hence, if key executives were looking for the cash-out, they would try to maximize proceeds and should therefore engage in imprinting to boost the firm's innovation output and its valuation.

(2) Firms that choose to not beat the post-IPO slump would have to have accumulated enough breakthrough innovations by the time they go public to be able to profitably exploit them in the future. Since innovation imprinting and the number of cumulative breakthrough innovations at the time of the IPO are highly correlated ($\rho = 0.40$, $p<0.01$), this suggests that in order to generate a stash of breakthrough innovations, they would have to engage in activities that improve innovation imprinting. Also, since the coefficient of the number of breakthrough innovations introduced pre-IPO on beating the post-IPO slump is positive and significant, this suggests that, on average, firms that are innovative pre-IPO continue to innovate even after they go public.

(3) A monetizing or exploitation explanation would also be reflected in a shift from value creation to value extraction/appropriation. However, our conceptualization and measurement of innovation imprinting includes activities that are related to product development (which is related to value creation) *as well as* to product commercialization (which is related to value appropriation). Empirically, we find that innovation imprinting is not correlated with strategic emphasis ($\rho = 0.039$, n.s.), which is the ratio of value creation to value appropriation (Mizik and Jacobson 2003). There is also no significant difference in strategic emphasis among firms that are above or below the median on innovation imprinting ($mean_{high\_imprinting} = 0.055$ vs. $mean_{low\_imprinting} = 0.060$, $t = 1.04$, n.s.). In other words, innovation imprinting is uncorrelated with exploitation behavior.

(4) We do not find significant differences in top management turnover at the time of the IPO between firms engaging in innovation imprinting and those that do not ($mean_{high\_imprinting} = 1.69$ vs. $mean_{low\_imprinting} = 1.63$, $t = -0.72$, n.s.). This result suggests that the managers of high innovation imprinting firms are no more likely to leave than those of other firms.

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