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Anchored Inferential Learning: Platform-Specific Uncertainty, Venture Capital Investments by the Platform Owner, and the Impact on Complementors

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Abstract. Platform owners increasingly make corporate venture capital investments in complementors (e.g., app developers) to stimulate value creation, a practice we refer to as platform venture capital (PVC). Interested in the implications of PVC for other complementors, we investigate how PVC investments affect their product introduction and withdrawal decisions. Given that complementors confront platform-specific uncertainty concerning the strategic directions of the platform, which is asymmetrically set by the platform owner, we theorize that complementors leverage PVC investments as devices for anchored inferential learning. That is, because PVC investments are costly, visible, and consequential, complementors will infer them as credible indicators of the platform’s future focus. Consequently, we predict that complementors will seek out, and stick around, product categories of PVC investees. We further anticipate that these inclinations are weaker for complementors with greater platform ecosystem experience that place more emphasis on knowledge acquired via experiential learning, and stronger for complementors that center their business exclusively on the platform and therefore rely strongly on PVC to navigate platform-specific uncertainty. We provide quantitative evidence from the context of the Salesforce platform. Moreover, we draw on qualitative data from this context to unpack why complementors interpret PVC investments as a credible signal concerning the strategic direction of the platform. We highlight that complementors consider PVC as a form of middle-ground platform governance, where the platform owner is perceived as being committed to stimulating value creation in the platform ecosystem, while also inducing complementors to commit their efforts to the platform ecosystem.

Keywords: complementors • corporate venture capital • ecosystems • governance • learning • platforms • uncertainty

Introduction

Over the last few decades, large ecosystems of complementor firms (e.g., app developers) emerged that build their business on top of platforms. The platforms of Apple, Google, Microsoft, SAP, and others have made it relatively easy to start and scale a business, as those platforms simultaneously serve as foundations for product development and as interfaces to prospective customers (Gawer 2009, McIntyre and Srinivasan 2017). However, building a business on top of platforms also comes with new forms of uncertainty, which may translate into substantial perceptions of risk on the part of complementors (Cutolo and Kenney 2021). Importantly, by building their business on top of platforms, complementors become directly dependent on the platform for their performance and survival (Rietveld and Eggers 2018), yet the strategic direction of the platform is beyond their direct control as it is typically set and shaped asymmetrically by the platform owner (Boudreau and Hagiu 2009, Wareham et al. 2014). Correspondingly, complementors lack knowledge about where the platform is headed in the future. We refer to this lack of knowledge as platform-specific uncertainty (Beckman et al. 2004), as the issue of a lack of knowledge is shared among all complementors and is idiosyncratic to a particular platform.

To help ameliorate such uncertainty and motivate complementors, platform owners deploy a range of governance mechanisms, including direct competition, financial incentives, ranking systems, recognition, and rule-setting, to shape the behavior and decisions of complementors in ways that align with the broader...
strategic interests of the platform (Rochet and Tirole 2003, Gawer and Henderson 2007, Tiwana et al. 2010, Rietveld et al. 2019, Koo and Esseley 2021). Notably, many such governance mechanisms explicitly target a few complementors but not others. For instance, Sony promotes a small number of PlayStation video games with significant unrealized sales potential (Rietveld et al. 2019). Amazon selectively enters into competition with sellers in viable product categories that do not require substantial commitment or investment from complementors (Zhu and Liu 2018).

Some platform owners also stake out minority equity investments in some of their complementors through dedicated corporate venture capital (CVC) units (Covin and Miles 2007, Weiblen and Chesbrough 2015, Dushnitsky and Kang 2018). As one extreme example, SAP’s SAP.iO accelerator and CVC unit is dedicated exclusively to nurturing entrepreneurial ventures that leverage the SAP platform in novel ways. Likewise, Salesforce Ventures periodically announces investment funds targeting specific areas of the Salesforce platform. Platform owners use CVC investments to strategically spur the development of the platform in product categories that they consider to be of high value, by providing promising complementors in those categories with the resources necessary to scale. We refer to platform owners making equity investments in complementors as platform venture capital (PVC), clearly distinguishing it from the broader practice of CVC (Dushnitsky and Lenox 2005).

Although governance mechanisms such as PVC only target a subset of complementors, such actions nevertheless likely trigger responses from other complementors as well. Hence, in this paper we focus on examining how those complementors respond to PVC investments by the platform owner. Prior research suggests that even the threat of a platform owner’s intent to enter into direct competition with complementors could cause complementors to stop developing and maintaining products (Gawer and Henderson 2007, Wen and Zhu 2019). Such competitive threats especially loom large in the case of PVC (Katila et al. 2008, Diestre and Rajagopolan 2012, Hallen et al. 2014). For instance, it is not uncommon that CVC investees are acquired or imitated by their investors—in this case, the platform owner—which would have adverse consequences for many complementors in the platform ecosystem (Benson and Ziedonis 2009, Dushnitsky and Shaver 2009). Therefore, we ask “What are the implications of PVC investments for product introductions and withdrawals by other complementors in the platform ecosystem?”

Our core theoretical argument is that PVC investments, specifically, connote important information about the strategic direction of the platform as it is inferred by complementors. We build on and extend the literature on organizational learning (Miner and Haunschild 1995, Lieberman and Asaba 2006, Terlaak and Gong 2008, Argote et al. 2020) to theorize that complementors will use PVC investments as devices for anchored inferential learning about the strategic direction of the platform (Oldroyd and Gulati 2010, Chandler and Hwang 2015). Complementors will infer where the platform is headed from observing and interpreting PVC investments. We use the prefix “anchored” to underscore that those inferences are rooted not only in a manifested action by the platform owner but also in the interpretive significance that complementors ascribe to the credibility of PVC investments. PVC investments are highly visible, costly, and directly consequential for the future value creation in the platform ecosystem, though without the platform owner immediately capturing all that value. With a view on the platform-specific uncertainty that complementors experience, we anticipate that complementors will forego their potential perceptions of risks associated with PVC investments, such that they will respond favorably in response to such investments. Correspondingly, complementors will introduce and retain products in PVC investees’ product categories.

We also theorize two organizational characteristics that affect the strength of complementors’ responses to PVC because they impact the extent to which complementors focus on anchored inferential learning through PVC. First, we anticipate that complementors with greater platform ecosystem experience are less inclined to respond to PVC. As experienced complementors make their own projections about the specific product categories on the platform that matter most to them through experiential learning (Argote and Miron-Spektor 2011), they will attach more value to such knowledge, precisely because it is experiential in nature (March 2010). Second, the platforms literature highlights that an important difference among complementors is whether they focus exclusively on a single platform (Cennamo et al. 2018, Cutolo and Kenney 2021). We expect that complementors with an exclusive focus on the focal platform are more inclined to respond to PVC because they are more sensitive to platform-specific uncertainty and therefore more reliant on anchored inferential learning via PVC to navigate such uncertainty.

We study how PVC investments affect product introductions and withdrawals by complementors in the context of the Salesforce platform. Salesforce provides a cloud-based platform to enterprises and actively seeks out equity investments in complementors through its Salesforce Ventures investment arm. Our quantitative analyses focus on the consequences of 24 PVC investments by Salesforce Ventures between April 2013 and June 2014, a period in which we observe 652 product introductions and 156 product withdrawals. Our qualitative analyses
are primarily based on data from 81 interviews with 40 complementors. We find both quantitative and qualitative evidence indicating that complementors respond favorably to PVC investments because to them PVC constitutes a credible signal of the strategic direction of the platform. Quantitatively, we find that complementors are more likely to introduce and less likely to withdraw products in product categories affected by a PVC investment. Also consistent with our predictions, those inclinations are weaker for more experienced complementors and stronger for complementors with an exclusive platform focus. Qualitatively, we further describe why complementors view PVC investments as credible devices for anchored inferential learning about the strategic directions of the platform given the mutual commitment of the platform. These findings underscore that complementors perceive PVC investments not so much as a competitive threat, but rather as a means to fostering value creation in the platform ecosystem.

This study makes several theoretical contributions. We primarily contribute to the literature on platform governance, but we also add to the literature on organizational learning and corporate venture capital. Our study contributes to the literature on platform governance by focusing on a form of platform governance—PVC investments—that has frequently been mentioned as prominent and consequential (Chesbrough 2002, Tiwana 2004). Platform-specific uncertainty is largely due to the asymmetric control the platform owner has in shaping the future directions of the platform. We theorize and provide substantiating evidence on why complementors engage in anchored inferential learning via PVC to cope with and navigate such platform-specific uncertainty. We also contribute to the literature on PVC. Although prior work has recognized that CVC may be deployed for the purpose of ecosystem orchestration (Chesbrough 2002, Covin and Miles 2007, Dushnitsky and Kang 2018), most studies have focused on settings where CVC is used as a tool to learn and create options for investor or investee (Maula 2007, Drover et al. 2017). Consequently, the thrust of the literature has mainly been with investigating the merits and drawbacks of CVC investments for investor, investee, or both. We contribute by further conceptualizing the strategic use of CVC as a means for ecosystem orchestration and show how CVC investments may trigger responses beyond the investor-investee dyad. In our case, other complementors in the platform ecosystem are seeking out the investee’s product categories. Paradoxically, this dynamic poses a new conundrum for ventures contemplating whether to accept a CVC investment, as accepting a CVC investment could come at the cost of heightened competition.

Theory and Hypotheses
Platform Venture Capital Investments as a Form of Platform Governance

A key challenge facing platform owners is to engage and steer complementors that are beyond the platform owner’s direct control. This is especially important because the value of the platform to customers directly depends on complementors’ continued interest in and commitment to the platform (Rochet and Tirole 2003, Parker and Van Alstyne 2005). For example, video gaming consoles are valuable to customers only when provided in conjunction with a certain breadth and depth of video games. However, what constitutes an appropriate mix of complementary products is an inherently dynamic question. As the preferences of customers are bound to change and evolve over time, so should the supply of complementary products (Rietveld and Eggers 2018). Platform owners must, therefore, carefully manage the efforts of their complementors, continuously orienting their efforts toward product categories that are of strategic importance to the platform. They do this by practicing platform governance, which prior research conceptualizes as the design and deployment of mechanisms that incentivize and/or regulate complementors’ contributions.
(Boudreau and Hagiu 2009, Tiwana et al. 2010, Wareham et al. 2014).

As this broad definition of platform governance suggests, there are numerous ways through which a platform owner can steer the efforts of its complementors. For example, Koo and Esley (2021) describe how an e-commerce platform changed its algorithm for product recommendations to benefit sellers with a greater category focus, with the purpose of incentivizing sellers to concentrate their product portfolios on a limited number of product categories rather than spreading their products thinly across many different categories. Platform owners can also increase the degree of openness of the platform to enhance the depth and breadth of available complementary products (Boudreau 2012). Importantly, platform owners often incentivize complementors through their direct, selective involvement with some of them. Prior research suggests that platform owners can spur or stifle complementors’ innovation efforts by entering into direct competition with complementors through acquisitions or vertical integration (Foerderer et al. 2018, Zhu and Liu 2018, Wen and Zhu 2019) or by conferring awards and certifications on complementors (Rietveld et al. 2019, Foerderer et al. 2021). For instance, Gaver and Henderson (2007) document how Intel vertically integrated into areas where it was dissatisfied with the efforts of complementors, and Rietveld and colleagues (2021) demonstrate how microfinance institutions on the Kiva platform reoriented their loan portfolios to align with the certification they received.

Another way in which platform owners can incentivize and enable complementors is by making minority equity investments in select complementors. We refer to this practice as PVC investments. Although platform owners, and organizations more broadly, might be enticed by the potential for financial returns on their investments, organizations’ venture capital investments are largely governed by strategic motives (Chesbrough 2002, Maula 2007, Drover et al. 2017). Indeed, and for this reason, CVC units typically maintain intimate, but nonetheless intricate and careful, ties with their parent organization (Souitaris and Zerbinati 2014).

The CVC literature has recognized that CVC units may invest in ventures with the purpose of ecosystem orchestration, often referring to Intel Capital as a canonical example (Chesbrough 2002, Covin and Miles 2007). Since the 1990s, Intel Capital built a large portfolio of strategic equity investments in organizations that developed products that were complementary to Intel’s own offerings. Intel Capital invested in nurturing those organizations, usually alongside other venture capitalists, realizing that increased demand for investee organizations’ offerings would help spur the demand for Intel’s own products as well. A recent survey of press releases relating to CVC investments by Dushnitsky and Kang (2018) suggests that the number of CVC units with similar ecosystem orchestration motives is on the rise. Prominent examples of platform owners with CVC units include Baidu, Google, Microsoft, Salesforce, Samsung, and SAP. All this underscores the importance of venture capital investments by the platform owner in complementors—what we refer to as PVC—as an act of platform governance.

To elaborate, platform owners can use PVC to directly contribute to the value creation in specific product categories on the platform by staking out investments in complementors that those platform owners believe to be of strategic importance or consider as holding promise in those categories. Most directly, such investments provide resource-constrained complementors with the means necessary to further enhance their complementary products, integrate their other preexisting products with the platform, and/or develop new ones. As one example, Weiblen and Chesbrough (2015) describe how SAP used venture capital investments in complementors to accelerate the development of complementary products in the early days of its HANA enterprise software platform. PVC investments also set in motion substantial knowledge flows between investor and investee (Maula et al. 2005, Alvarez-Garrido and Dushnitsky 2016), likely enabling investee complementors to develop better complementary products. Importantly, an investee complementor could tap into the knowledge of the platform owner to learn how to best leverage the platform. Access to technological knowledge is particularly important in this regard, as the technological specifics of a platform are typically hidden from the direct view of complementors, abstracted away in the standardized interfaces (e.g., application programming interfaces) that complementors use to build their products (Baldwin and Woodard 2009). Besides, receipt of a PVC investment grants the investee complementor substantial reputation benefits (Nahata 2008). This enhances the investee complementor’s legitimacy (Suchman 1995), improving the appeal of its products to the platform customers to the benefit of their competitive standing in the platform ecosystem.

In short, PVC investments incentivize and enable an investee complementor to make further commitments to the platform. Hence, PVC investments will likely trigger complementors to further intensify their presence on the platform, that way contributing to the platform’s overall value creation for customers. Less clear, however, is how other complementors will respond to PVC investments. Prior literature indicates that CVC investments are a common prequel to an acquisition or imitation on the part of the investor, which in this case is the platform owner (Benson and Ziedonis 2009, Dushnitsky and Shaver 2009). Even the slightest threat
of the platform owner entering into direct competition with complementors could stifle complementors’ efforts (Gawer and Henderson 2007, Wen and Zhu 2019). It is this issue that we set out to investigate through this study.

**Complementor Responses to PVC Investments**

Our theoretical arguments build on the notion that complementors in platform ecosystems are exposed to substantial uncertainty. Of course, complementors face firm-specific (i.e., uncertainty that is unique and internal to a firm, for example, relating to its production processes, technology, logistics and operations, or human capital requirements) and market-specific uncertainty (i.e., uncertainty that is external and shared across a set of firms in a market category), much like firms in any other context (Beckman et al. 2004). However, complementors also confront a shared form of uncertainty that is largely idiosyncratic to building and conducting business around platforms. Because the platform owner asymmetrically controls the platform (Boudreau and Hagiu 2009, Wareham et al. 2014), complementors lack knowledge about the strategic direction of the platform, that is, where the platform is headed in the future. We refer to this uncertainty as **platform-specific uncertainty**, as it is distinct from other forms of uncertainty, notably firm-specific and market-specific uncertainty; see Table 1 for a comparison. Knowing where the platform is headed in the future is crucial to complementors’ performance and survival, as they build their business on top of the platform and therefore usually sell exclusively to the platform’s customers (Rietveld and Eggers 2018).

During exploratory interactions with complementors from our study context (Salesforce), issues of platform-specific uncertainty pertaining to the strategic direction of the platform were prominent themes. For example, the Chief Executive Officer (CEO) of CustomAnalytics, a Salesforce complementor, noted:

> I used to be part of [firm’s name] where we had a standalone analytics product that we developed and sold directly [to business customers]. It’s a very different game from building your product and even your entire business around a platform like Salesforce. Before, we used to worry about the market conditions and figuring out the evolving customer needs in the B2B Sales space. Now, we worry about all that

| Table 1. Firm-Specific, Market-Specific, and Platform-Specific Uncertainty |
|--------------------|---------------------------------|-------------------------------|-----------------------------|
| Characteristic     | Firm-specific uncertainty       | Market-specific uncertainty   | Platform-specific uncertainty |
| Definition         | A lack of information or knowledge that is unique, nonsystematic, and internal to a firm (Beckman et al., 2004) | A lack of information or knowledge that is external, systematic, and shared across a set of firms in a market category (Beckman et al., 2004) | A lack of information or knowledge that is largely idiosyncratic to building and conducting business around platforms, and shared across complementor firms who are part of a specific platform ecosystem |
| Primary source     | Arises from internal changes unique to a firm, such as entering a new market, developing a new technology or new production process, and turnover in top management | Arises due to the unpredictability of market shifts that is beyond the control of a particular firm, for example due to fluctuating changes in supply chain costs, product demand, unstable customer preferences, and changing competitive intensity | Arises largely due to complementor firms’ lack of knowledge about and control over the strategic direction of the platform, that is, where the platform is headed in the future |
| Level of control   | Controllable to a certain extent, as the nature of uncertainty is internal to a focal firm | Relatively difficult to control, as the nature of uncertainty is independent of what happens at level of the focal firm | Extremely difficult to control by complementor firms, as the platform owner asymmetrically controls the functioning of a platform and shapes its strategic direction |
| Consequence        | Firms seek additional information to reduce and/or manage firm-specific uncertainty (e.g., broaden their alliance partners and networks) | Firms respond by reinforcing existing relationships (e.g., forming additional alliances with existing alliance partners, forming additional interlocks with existing interlock partners) | Complementor firms pay close attention to the actions of the platform owner and engage in anchored inferential learning by drawing inferences from those actions pertaining to the future direction of the platform |
PLUS we also worry a lot, I mean a LOT, about what Salesforce is going to do next … On what they’ve set their eyes on and where are they going next, because we really don’t know and that’s one of the toughest parts of this business … But I guess when you chose to build your business around a giant like SFDC [Salesforce], that’s part of the package and you got to not only live with that, but also prepare yourself for it.

Firms cope with uncertainty through processes of organizational learning. The organizational learning literature distinguishes between different forms of learning that organizations could engage in, such as experiential learning, vicarious learning, and inferential learning (Miner and Haunschild 1995, Lieberman and Asaba 2006, Terlaak and Gong 2008, Oldroyd and Gulati 2010, Argote et al. 2020). Organizations can learn from “internal sources via their own experiences and trial-and-error processes,” referred to as experiential learning (Chandler and Hwang 2015, p. 1454; Levinthal and March 1993; Argote and Miron-Spektor 2011). Organizations can also learn from “external sources by observing the experiences and trial-and-error processes of others,” typically peer organizations, often referred to as vicarious learning (Chandler and Hwang 2015, p. 1454; Cohen and Levinthal 1990, Haunschild and Miner 1997, Lieberman and Asaba 2006, Terlaak and Gong 2008). Organizations can similarly learn inferentially by actively processing and analyzing internal and/or external information to establish chains of cause and effect (Miner and Mezias 1996, Oldroyd and Gulati 2010), known as inferential learning.

Prior studies have examined why and under what conditions firms resort to one form of learning over another. For example, studies suggest that firms engage in vicarious learning from their peers when they confront firm-specific or market-specific uncertainty (Greve 1995, Oldroyd and Gulati 2010, Gaba and Terlaak 2013, Ozalp and Kretschmer 2019; see also Beckman et al. 2004). Vicarious learning from peers (i.e., other complementors) is seemingly less useful in coping with platform-specific uncertainty, because the control over the strategic direction of the platform rests with the platform owner, and not with complementors (Greve 1995, Srinivasan et al. 2007). For the same reason, complementors’ own past experiences are of limited value because they tell little about the strategic direction of the platform (Argote 1993, Baum and Dahlin 2007), as this direction is not always related to, or cannot credibly be inferred from, complementors’ own specific experiences.

Complementors thus need to navigate and cope with platform-specific uncertainty by paying close attention to the platform owner’s actions, learning by drawing inferences from such actions. Organizational learning scholars refer to “inferences” as the ways in which organizations consciously interpret observations, attempting to understand the causal structure of those observations to determine an appropriate course of their own actions (Lieberman and Asaba 2006, Terlaak and Gong 2008, March 2010, Chandler and Hwang 2015). Ultimately, through inferential learning, firms seek to establish an understanding of the observed phenomenon, to construct causal beliefs, and overall attempt to confirm the credibility of their observations (Oldroyd and Gulati 2010, March et al. 1991).

We theorize that complementors are particularly likely to draw inferences from the platform owner’s PVC investments. PVC investments are costly and highly visible, as such investments are usually announced publicly by investor, investee, or both. By making an equity investment in a complementor, the platform owner, per definition, also makes a long-term commitment to this venture in a bid to stimulate value creation in the platform ecosystem. Accordingly, we anticipate that complementors will infer PVC to be a credible signal about the strategic direction of the platform. As those inferences directly relate to complementors’ platform-specific uncertainty, complementors will likely forego much of their potential concerns over direct competition with the platform owner following the PVC investment. Indeed, our interactions with complementors suggest that complementors not only pay particular attention to PVC, but also that they place significant weight on such investments by the platform owner as they entail “not just cheap talk” but rather “real potential that involves substantive commitment ….” As the Vice President (VP) of CTech, a Salesforce complementor, continued describing their perspective on PVC investments:

― Talk is cheap, Salesforce can say that their Service Cloud [part of the platform] is doing very well and ask us [complementors] to build apps around their Service Cloud offering. Some [complementors] even jump the bandwagon, but only when there is investment in that category, we know for sure that the category is growing. Even better, if it is their own VC money flowing in, then we can confirm that they [Salesforce] are … committed to guiding and growing that category.

Taken together, we argue that PVC constitutes a device for anchored inferential learning to complementors that help them navigate their platform-specific uncertainty and, in turn, inform their own decision making over product introductions (Miner and Haunschild 1995). We use the prefix “anchored” to underscore that inferences are grounded in the interpretive significance that complementors ascribe to the credible nature of PVC in signaling the strategic directions of the platform, over inferences from other signals (e.g., platform roadmaps and other public announcements) that might be less credible and more speculative. In line with our arguments, we thus anticipate that complementors will seek out product categories of PVC investees by introducing
new products into those categories immediately following a PVC investment.

**Hypothesis 1.** PVC investments are positively related to the likelihood of product introductions in affected product categories on the platform.

Symmetrically, we also anticipate that complementors are less likely to withdraw products from product categories affected by PVC. As such, we conceptualize product withdrawal decisions as forward-looking. That is, product withdrawal decisions do not merely depend on assessments of current performance and knowledge, but also on complementors’ anticipations concerning the future. To emphasize, Tiwana (2015) shows in the context of the Firefox web browser platform that complementors’ decisions to withdraw products from a platform are directly informed by their anticipations concerning the future coordination costs they will incur because of changing strategic directions of the platform. Accordingly, complementors confront similar platform-specific uncertainty in their product withdrawal decisions as they do when deliberating product introductions, which complementors resolve by drawing inferences from PVC.

**Hypothesis 2.** PVC investments are negatively related to the likelihood of product withdrawal in affected product categories on the platform.

**Organizational Characteristics and Complementors’ Responses to PVC Investments**

There are reasons to expect that some complementors will react somewhat differently to PVC. Specifically, we focus on two salient organizational characteristics of complementors that should affect the extent to which they focus on anchored inferential learning through PVC.

To begin, complementors differ in how long they have been participating in the platform ecosystem and how many complementary products they provide (Kapoor and Agarwal 2017, Koo and Eesley 2021). As such, complementors have different opportunities for experiential learning. Complementors with more products and a longer tenure in the platform ecosystem accumulate more knowledge faster. Stated another way, complementors vary in their stocks of platform-specific experience.

To reiterate, experiential learning refers to the process by which organizations accumulate and interpret information emanating from their own experiences, which in turn helps inform their future actions (Levinthal and March 1993, Argote and Miron-Spektor 2011). In the case of platform complementors, experiential learning mainly refers to what complementors can glean from analyzing the usage of their own products, a practice that is common and relatively easy in digital contexts (Yoo et al. 2012). Complementors can capture their products’ periodic download or sales volumes, collect customer usage logs, and scrutinize customer reviews to better understand how customers are using their products.

Experiential learning is mainly useful to complementors in improving their current products and sustaining their competitive position (Kapoor and Agarwal 2017) and to reducing firm-specific and market-specific uncertainty more generally (Ozalp and Kretschmer 2019). As noted previously, experiential learning is less useful in reducing platform-specific uncertainty because a complementor’s own experiences say little about the broader strategic direction of the platform. Even so, we theorize that knowledge gained via experiential learning will likely override part of complementors’ focus on anchored inferential learning via PVC. Complementors will interpret the learning based on their own direct experience as highly salient and even superior to learning via other means (e.g., inferential learning, vicarious learning; Simon and Lieberman 2010, Ozalp and Kretschmer 2019). It is not to say that PVC loses its importance as a device for anchored inferential learning, but the double-edged nature of experiential learning—and the nature of experiences, more generally (see March 2010 for related arguments)—means that more experienced complementors will implicitly place more value on their own experience in an overriding fashion, thus limiting their focus and dependence on inferential learning via PVC. To illustrate, the cofounder of Omega described this tradeoff between experiential and inferential learning as follows:

I think we [Omega] know this space inside out, more than anyone else including Salesforce, and we want to focus our energies here…. There is a lot of noise out there, and I filter some of them out but I trust what our team finds through their own analysis [of customer logs] across our apps … than inferring something based on what Salesforce [platform owner] said, and second-guessing stuff that I don’t have full knowledge about.

Correspondingly, we expect that complementors’ inclination to respond favorably to PVC investments weakens with greater platform ecosystem experience.

**Hypothesis 3a.** The positive effect of PVC investments on the likelihood of product introduction is weaker for complementors with greater platform ecosystem experience.

**Hypothesis 3b.** The negative effect of PVC investments on the likelihood of product withdrawal is weaker for complementors with greater platform ecosystem experience.

Another important difference among complementors is whether they focus exclusively on a single platform. Some complementors choose to build their business exclusively on one platform, usually integrating their products tightly with this platform, while other complementors also engage in other business activities. The
platforms literature has mainly emphasized this issue of platform focus through its treatment of multihoming: situations where complementors provide products on multiple, often competing, platforms at the same time (Cennamo et al. 2018). For example, some video game studios make their video games available on both PlayStation and Xbox, and there are sellers that sell their products through both Amazon and eBay. However, multihoming is merely one of the ways in which complementors may expand their focus beyond a single platform (Cutolo and Kenney 2021). Importantly, complementors can simultaneously use platform and nonplatform channels (He et al. 2020, Wang and Miller 2020). Book publishers can sell the same book in print in physical stores and as an e-book through platforms such as Amazon’s Kindle. Similarly, Spotify operates its music streaming service as a stand-alone product and as a complementary product to Apple’s iOS mobile platform.

What matters for our theorizing is not how exactly complementors can expand their focus beyond a single platform, but rather that doing so reduces complementors’ degree of platform dependence and by extension, their sensitivity to platform-specific uncertainty (Cutolo and Kenney 2021). Complementors that increase their alternatives by engaging in other business activities are, to a certain extent, buffered against adverse events or changes on a focal platform (He et al. 2020). Therefore, they will be less focused on anchored inferential learning via PVC. By contrast, complementors with an exclusive platform focus are highly sensitive to platform-specific uncertainty concerning the strategic direction of a certain platform and have their attention firmly placed on this platform. Therefore, we anticipate that complementors with an exclusive platform focus will be more inclined to respond to PVC as opposed to complementors also engaging in other business activities.

**Hypothesis 4a.** The positive effect of PVC investments on the likelihood of product introduction is stronger for complementors with an exclusive platform focus.

**Hypothesis 4b.** The negative effect of PVC investments on the likelihood of product withdrawal is stronger for complementors with an exclusive platform focus.

**Research Setting: Salesforce Ventures and the Force.com Platform Ecosystem**

We investigated the consequences of PVC for complementors’ product introduction and withdrawal decisions in the context of the Salesforce platform ecosystem. Founded in 1999, Salesforce is a leading provider of a cloud-based enterprise software platform that mainly focuses on sales automation and customer relationship management (CRM). Salesforce’s platform is used by business customers worldwide, across sectors such as banking, life sciences, manufacturing, and nonprofit, and ranging from multinational organizations to small and medium-sized enterprises. In 2014, Salesforce was the market leader in the global CRM market worth over $20.4 billion in annual customer spending (Gartner 2014), a position it only strengthened since. Salesforce’s competitors include Microsoft Dynamics, NetSuite, Oracle CRM Cloud, SAP Cloud for Customer, SugarCRM, Zoho, and others.

Salesforce introduced the Force.com platform in 2005. It serves as a foundation on which complementors (i.e., app developers) build software applications (i.e., apps) that extend Salesforce’s software functionalities. Force.com provides the tools necessary to develop Salesforce apps, streamlines interactions between apps and Salesforce software, and enables complementors to run apps directly from Salesforce’s data centers. In 2014, customers could install more than 2,200 apps through the AppExchange app store (https://appexchange.salesforce.com), which together were downloaded well over 2.5 million times. Those apps include industry-specific adaptations of the Salesforce software, tools for data visualization and analysis, applications for document generation, quotes and order management, and means for tracking interactions with customers. With a view on this diversity, AppExchange is organized along 42 narrowly defined subcategories, nested in nine main categories. This allowed us to track PVC investments and their impact on complementors’ app introduction and withdrawal decisions at the fine-grained level of the subcategory. A visualization of AppExchange’s category structure is provided in Online Appendix A.

Producing and publishing Salesforce apps requires substantial resources and effort from complementors. Complementors pay a $2,700 security review fee per app, along with a $150 annual listing fee. For free apps, only the annual listing fee is due. The typical development time of a Salesforce app is between 8 and 12 weeks, followed by another 4 to 6 weeks of mandatory security review by Salesforce. The Chief Technology Officer (CTO) of Salesforce complementor SalesLabs described the development process as follows:

We spent around 8 weeks, with 11 full-time developers and our offshore team—so that’s over four thousand man-hours—to come up with the base version of our app for the Salesforce platform. And then, we spent few more weeks fixing the bugs… Finally, there is the dreaded security review, which took another 5 weeks, they take their own sweet time but they do a good job to make sure the application is robust…. So it’s a real deal, it’s not easy like cranking out an iOS app. I used to do that, I was in-charge of development when I used to work at [company name], but when you are developing enterprise apps that will be listed on AppExchange, you need to make sure it works perfectly. It’s a lot of work, there are a lot of moving pieces.
In 2009, Salesforce introduced its CVC unit, Salesforce Ventures, which by 2014 was already among the most active U.S.-based CVC funds (CB Insights 2015). By then, Salesforce Ventures had already invested more than $215 million in more than 100 different ventures. Salesforce Ventures makes both earlier- and later-stage investments, and most of its investments are syndicated with other investors. Importantly, Salesforce Ventures actively engages in PVC by investing in complementors. Some of those PVC investments eventually resulted in an acquisition by Salesforce. For example, in 2015 Salesforce acquired SteelBrick, a complementor producing apps aiding sales representatives in generating quotes, proposals, and contracts, after previous involvement by Salesforce Ventures in several syndicated investment rounds. Salesforce subsequently integrated the functionality of SteelBrick’s apps into the Salesforce platform.

Methods
Our approach to investigating complementors’ responses to PVC investments was to combine both quantitative and qualitative data. We quantitatively examined how complementors’ choices to introduce or withdraw apps in specific subcategories changed as some of those subcategories became affected by PVC investments. We then used qualitative analyses based on interviews and observations to further unpack the proposed theoretical mechanisms driving complementors’ responses to PVC.

An alternative approach to examining our theoretical framework would have been to focus on one or a few PVC investments and to assess the changing likelihood of app introduction and withdrawal by complementors affected by PVC before and after the investment took place, ideally with reference to a group of complementors not affected or appealed by PVC. Aside from that, the latter would require the identification of a suitable control group with complementors not affected or appealed by a given PVC investment, such an approach also requires the use of a relatively short, otherwise undistorted observation window around the time a PVC investment took place. Unfortunately, those requirements were difficult to meet in our specific empirical setting. Salesforce makes relatively frequent PVC investments, such that at any point in time multiple subcategories are likely affected by PVC and/or the same subcategory is affected more than once within a short period of time. Besides, app introduction and withdrawal constitute comparably rare events (Boudreau 2012, Tiwana 2015). Therefore, we chose to perform our investigation through a combination of quantitative and qualitative research methods. Although this approach allows us to provide a rich account of complementors’ responses to PVC investments, we note that it does not allow drawing causal conclusions about those responses.

Quantitative Data Collection and Analysis

Data Sources. For our quantitative analyses, we turned to two main data sources. We constructed an event history of Salesforce Ventures’ investment activity between April 2013 and June 2014 using CrunchBase (https://www.crunchbase.com), a database that provides an overview of venture capital and acquisition activity in high technology sectors such as enterprise software (Ter Wal et al. 2016, Wang et al. 2022). CrunchBase was a particularly suitable data source for our purposes because it also documents whether and when press releases and news items appeared announcing a PVC investment, which enabled us to track when complementors first learned about an investment. Using CrunchBase, we identified 43 distinct investments by Salesforce Ventures for which a press release or news item was issued. Out of those 43 investments, 24 were PVC investments involving a Salesforce complementor. The PVC investments occurred across 17 different subcategories.

We combined this information with monthly observations on all 2,158 apps by 1,415 non-Salesforce-backed complementors that we collected directly from AppExchange using a web scraper. This data included detailed information on the apps, such as the subcategory, release date, app install ranking, and app ratings, among others. It also contained information about the complementors, including employee counts and short company descriptions. A total of 652 apps were introduced and 156 apps were withdrawn during our sampling period.

Using this data, we created two data sets. To analyze the relationship between PVC and app introduction, we constructed a complementor-subcategory-month panel data set. We created observations for all pairwise combinations of complementors (1,415), subcategories (42), and months (13), with the purpose of tracking whether a complementor chose to introduce one or more apps into a subcategory in a month. Complementors leave the data set the month after their last app was withdrawn from AppExchange, yielding an unbalanced panel data set of 761,376 observations. All independent and control variables were lagged by four months, given the time it takes to produce and publish apps and hence to respond to PVC. To analyze the relationship between PVC and app withdrawal, we created an unbalanced panel data set at the level of the app-month. The data set consists of observations on 2,158 apps over 12 months. Apps leave the data set when they are withdrawn from AppExchange. The data set contains 21,893 observations, lagging all independent and control variables by one month to avoid issues of simultaneity.

Dependent Variables. The dependent variable in the complementor-subcategory-month data set is app introduction. It was coded as a dummy variable capturing a
complementor’s decision to introduce one or more apps in a subcategory in a given month. As such, it took a value of one for each complementor-subcategory-month observation where a complementor chose to introduce apps, whereas in all other cases, it equaled zero. The dependent variable in the app-month data set is app withdrawal. App withdrawal took a value of one in the app-month where a complementor decided to permanently withdraw the app from AppExchange and a value of zero otherwise.

**Independent and Moderating Variables.** Our hypotheses relate to the effect of PVC in subcategory. It was operationalized as a dummy variable that took a value of one if one or more PVC investments were made in a complementor with apps in the subcategory during the previous three months and was coded zero otherwise. To operationalize this variable, we identified the subcategories in AppExchange in which an investee complementor had apps by the time the PVC investment became public.

The moderating variables were measured at the level of the complementor. We measured platform ecosystem experience as a function of both the size and age of a complementor’s app portfolio, that way accounting for the possibility that more active complementors may learn faster. To obtain this measure, we computed the sum of the number of months between the time of observation and the time of introduction over all apps by a complementor. We then log-transformed this variable to reduce skewness and to account for possible diminishing returns to learning. Exclusive platform focus was coded as a dummy variable taking a value of one when a complementor built its business exclusively on the Salesforce platform and zero otherwise. We hand-coded this variable using the information complementors provided about their business on AppExchange.

At the complementor level, we controlled for the tendency of complementors to differentiate across subcategories through complementor scope, measured as the number of subcategories in which a complementor had apps (Boudreau 2012). We included complementor apps in subcategory, a count of the number of apps a complementor has in a subcategory, to account for complementors’ tendency to seek out and stay in subcategories in which they already had apps (Ozalp and Kretschmer 2019).

In the app introduction analyses, we also controlled for complementor performance, which equaled the average performance percentile across all its apps in AppExchange based on their installation rank. We anticipated that better performing complementors were more likely to intensify their presence on the platform.

In the app withdrawal analyses, we included some further controls at the level of the app that might influence complementors’ withdrawal decisions. We accounted for app performance, measured as a percentile score based on its installation rank. We included app age, the number of months since the app was introduced. We also controlled for external indicators of app quality that likely influence complementors’ evaluations of their own apps through the log-transformed number of submitted user ratings, app ratings, and the valence of those ratings, app rating valence, between one and five stars.

**Control Variables.** We focused on controlling for time-varying factors at the level of the subcategory, complementor, and app that could affect complementors’ app introduction and withdrawal decisions. Starting at the level of the subcategory, we included app introductions in subcategory and app withdrawals in subcategory, measured as the number of app introductions and withdrawals in a subcategory during the previous three months, because complementors likely learn from the choices of other complementors (Ozalp and Kretschmer 2019). We controlled for the number of apps by Salesforce, apps by platform owner in subcategory, to account for the potential effects of competition from the platform owner (Foerderer et al. 2018, Wen and Zhu 2019). In the absence of detailed information on app installations, we proxied for total subcategory market size by including the log-transformed total number of submitted user ratings for all apps in the subcategory.

**Analyses.** We were interested in estimating the changing likelihood of complementors introducing or withdrawing apps as certain subcategories on the platform become affected by PVC investments. We chose to perform our estimations using linear probability models (LPMs) for three main reasons. First, estimation results from LPMs remain consistent when including many fixed effects (Horrace and Oaxaca 2006), which we
sought to include to address concerns about time-invariant heterogeneity across the different levels in our data. Second, LPMs facilitate the interpretation of interaction effects (Greene 2012). Third, consistently applying LPMs to analyze app introduction and app withdrawal decisions enhances the comparability of our results.

We performed the app introduction analyses at the level of the complementor-subcategory-month. The fully specified LPM for complementor \( i \), in subcategory \( c \), at month \( t \) had the following form:

\[
\text{INTRO}_{ict} = \beta_1 \text{PVC}_{ct} + \beta_2 \text{EXP}_{it} + \beta_3 (\text{PVC}_{ct} \ast \text{EXP}_{it}) \\
+ \beta_4 (\text{PVC}_{ct} \ast \text{FOC}_i) + X_{ict} + \zeta_i + \gamma_c + \delta_t + \epsilon_{ict},
\]

where \( \text{PVC}_{ct} \) is the PVC in subcategory variable, \( \text{EXP}_{it} \) represents platform ecosystem experience, \( \text{FOC}_i \) equals the dummy variable for complementors with an exclusive platform focus, and \( X_{ict} \) corresponds with a vector of control variables. The model further included complementor, subcategory, and month fixed effects \( \zeta_i, \gamma_c \) and \( \delta_t \), to address time-invariant heterogeneity at all three levels. Our identification strategy was to compare complementor-subcategory observations that had been affected by PVC with complementor-subcategory observations that had not been affected by PVC. We performed our estimations using robust standard errors, clustered at the level of the complementor.

The app withdrawal analyses were performed at the level of the app-month based on LPMs of the following saturated form for app \( a \) at month \( t \):

\[
\text{WITHDRAW}_{at} = \beta_1 \text{PVC}_{at} + \beta_2 \text{EXP}_{at} + \beta_3 (\text{PVC}_{at} \ast \text{EXP}_{at}) \\
+ \beta_4 (\text{PVC}_{at} \ast \text{FOC}_i) + X_{at} + \theta_a + \delta_t + \epsilon_{at}.
\]

Here, the app fixed effects \( \theta_a \), absorbed time-invariant heterogeneity at the level of the app, complementor, and subcategory. We analyzed whether the likelihood of app withdrawal changes as the subcategory in which the app is listed becomes affected by a PVC investment. Robust standard errors were clustered at the app-level.

**Qualitative Data Collection and Analysis**

**Data Collection.** To unpack our understanding of complementors’ responses to, and interpretations of, PVC investments, we conducted another round of qualitative data collection. In multiple phases, we undertook 81 interviews with representatives of 40 different Salesforce complementors. To sample our interview participants, we used “purposive sampling” (Patton 2002) along the following dimensions: (1) type of complementor (i.e., small and larger complementors); (2) platform ecosystem experience; and (3) complementors in subcategories affected and not affected by PVC investments.

We used naturalistic interview guidelines (Lincoln and Guba 1985) and crafted the interview protocol to ensure a balance between open-ended and close-ended questions to elicit grounded responses from the participants (Schultze and Avital 2011). The close-ended questions pertained to collecting data about the background of the founders, the complementor, whether they focused exclusively on the Salesforce platform, and more. The open-ended interview questions pertained to the experiences of complementors in the Salesforce platform ecosystem, why they decided to develop a Salesforce app, the nature of the uncertainties they face, how they make sense of PVC investments, other general challenges they encountered in the process of dealing with Salesforce, and how they went about addressing those challenges. In this task, we used the critical-incident technique (Flanagan 1954) centered around specific PVC investments as probes during the interviews to mitigate retrospective bias (Miller et al. 1997). This, in turn, helped us obtain specific, grounded responses from complementors about how they made sense of and interpreted PVC investments. All interviews lasted between 45 and 75 minutes, and most were transcribed.

In addition, one of the authors conducted more than 250 hours of observations in this context, attending five Salesforce platform conferences and 14 local complementor meetup events in Boston, New York City, and San Francisco. At the platform conferences, the author observed multiple presentations by Salesforce representatives targeted at complementors, as well as Q&A sessions between Salesforce ecosystem managers and complementors. At the local meetups, the author observed complementors discussing the uncertainties and challenges they confront when dealing with Salesforce ecosystem managers. At both these events, complementors discussed and raised questions about Salesforce’s platform governance, and what it meant to them. The author took detailed field notes at these events. The author also informally interviewed 45 complementors from 27 complementors at these events, probing them to share their perspective on how they view and interpret recent governance actions taken by Salesforce, especially PVC investments but also other forms of platform governance, and how those actions would influence (or not) their own strategies. These multiple data sources enabled us to triangulate (Jick 1979) and understand the phenomenon from different vantage points.

**Data Analysis**

Qualitative data analysis unfolded in an iterative manner. Data analysis included the synthesizing of field notes, memo writing, data coding, and abstracting overarching themes and concepts (Miles and Huberman 1994). Specifically, we used the approach of Charmaz (2006) to data coding of the interview transcripts and field notes. During the first phase of data analysis, we
We synthesized the field notes from platform conferences and local complementor meetup events into descriptive memos. In parallel, we also performed initial coding of the field notes and interview transcripts to better understand complementors’ platform-specific uncertainty and the meanings and interpretive significance that complementors attach to PVC investments by Salesforce. As new observations emerged, we revised the initial codes. For instance, we observed several complementors invoking terms such as “that’s quite revealing,” “that’s new information,” “useful info,” “validation,” and “put their money where their mouth is” when referring to PVC investments by Salesforce. We wanted to further understand why complementors associate these notions with PVC investments. In the second phase, we therefore engaged in “focused coding” to further unpack those mechanisms. Specifically, we sought to understand complementors’ interpretations and meaning-making of PVC investments, that is, why PVC was associated with notions such as “middle ground” and “mutual commitment.” We first coded for instances when complementors made these associations, and then wrote analytical memos to explicate the reasoning behind such associations. In the third stage, we did “theoretical coding” to organize the findings into conceptual categories and themes, such as middle ground platform governance. Through this reflective process of synthesizing field notes, memo writing, and data coding, we were able to further unpack the mechanism and underscore the interpretive significance and meanings that complementors attach to PVC investments.

Findings
Quantitative Findings
Hypothesis Tests. The descriptive statistics and pairwise correlations for the app introduction and app withdrawal analyses are in Tables 2 and 3, respectively. Table 4 presents the estimation results for app introductions; Table 5 contains those for app withdrawals. We note that the estimated coefficients in Tables 4 and 5 are relatively small, indicating minor changes in the absolute probability of app introduction and withdrawal. However, the estimated coefficients need to be interpreted relative to the average likelihood of app introduction and app withdrawal. The baseline likelihood of app introduction is 0.00087; the average likelihood of app withdrawal is 0.0071. In interpreting the results, we therefore clearly distinguish between absolute and relative effects.

Model 1 is the baseline model only containing control variables, but we directly turn to Model 2 in Tables 4 and 5 to test Hypotheses 1 and 2. In Hypothesis 1, we predicted that complementors are more likely to introduce products into subcategories affected by PVC. We find support for this hypothesis in Model 2 of Table 4.
Table 3. Descriptive Statistics and Pairwise Correlations: App Withdrawals

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. App withdrawal</td>
<td>0.0071</td>
<td>0.084</td>
<td>0.00</td>
<td>1.00</td>
</tr>
<tr>
<td>2. PVC in subcategory</td>
<td>0.20</td>
<td>0.40</td>
<td>0.00</td>
<td>1.00</td>
</tr>
<tr>
<td>3. Platform ecosystem experience (ln)</td>
<td>3.57</td>
<td>1.35</td>
<td>0.00</td>
<td>6.70</td>
</tr>
<tr>
<td>4. App introductions in subcategory</td>
<td>7.65</td>
<td>8.51</td>
<td>0.00</td>
<td>45.00</td>
</tr>
<tr>
<td>5. App withdrawals in subcategory</td>
<td>1.65</td>
<td>2.08</td>
<td>0.00</td>
<td>10.00</td>
</tr>
<tr>
<td>6. Apps by platform owner in subcategory</td>
<td>0.89</td>
<td>1.75</td>
<td>0.00</td>
<td>6.00</td>
</tr>
<tr>
<td>7. Subcategory market size (ln)</td>
<td>6.23</td>
<td>1.05</td>
<td>2.64</td>
<td>7.63</td>
</tr>
<tr>
<td>8. Complementor scope</td>
<td>1.71</td>
<td>1.25</td>
<td>1.00</td>
<td>9.00</td>
</tr>
<tr>
<td>9. Apps by complementor in subcategory</td>
<td>1.39</td>
<td>0.51</td>
<td>0.00</td>
<td>9.00</td>
</tr>
<tr>
<td>10. App performance</td>
<td>0.51</td>
<td>0.29</td>
<td>0.01</td>
<td>1.00</td>
</tr>
<tr>
<td>11. App ratings (ln)</td>
<td>2.24</td>
<td>2.24</td>
<td>0.00</td>
<td>5.00</td>
</tr>
<tr>
<td>12. App age</td>
<td>1.10</td>
<td>1.10</td>
<td>0.00</td>
<td>6.46</td>
</tr>
<tr>
<td>13. App ratings</td>
<td>3.01</td>
<td>2.92</td>
<td>0.00</td>
<td>5.00</td>
</tr>
<tr>
<td>14. App performance</td>
<td>0.51</td>
<td>0.29</td>
<td>0.01</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Notes: Descriptive statistics are based on the estimation sample (N = 21,893). Pairwise correlations greater than or equal to |0.02| are significant at p < 0.05.

($\beta = 0.00037; p = 0.036$). A PVC investment increases the absolute probability of app introduction by almost 0.04 percentage points. This corresponds to a relative increase in the likelihood of app introduction in a subcategory following PVC of 45%.

Hypothesis 2 predicted a similar favorable effect of PVC on app withdrawals, namely that the likelihood of app withdrawal in a subcategory decreases after a PVC investment. From Model 2 in Table 5 ($\beta = -0.0032; p = 0.042$), we find that the absolute probability of app withdrawal decreases by approximately 0.3 percentage points in subcategories affected by PVC, again a 45% reduction relative to the baseline likelihood. Hence, we also report support for Hypothesis 2.

We look at Model 3 in Tables 4 and 5 to test Hypotheses 3a and 3b, which stated that the favorable responses to PVC would weaken with greater platform ecosystem experience. The interaction between PVC in subcategory and platform ecosystem experience is negative and significant in Model 3 in Table 4 ($\beta = -0.00084; p = 0.000$), suggesting that greater platform ecosystem experience reduces complementors’ inclination to introduce apps into subcategories affected by PVC. A one standard deviation increase in platform ecosystem experience reduces the relative probability of app introduction in response to a PVC investment with 49%. Turning to app withdrawals, the same interaction is positive and significant in Model 3 in Table 5 ($\beta = 0.00258; p = 0.033$). This indicates a dampening of the negative relationship between PVC investment and the likelihood of app withdrawal. A one standard deviation increase in platform ecosystem experience increases the relative likelihood of app withdrawal following PVC by 28%. In Figure 1, (a) and (b), we visualize the moderating effect of platform ecosystem experience by plotting the predicted likelihood of app introduction and app withdrawal following PVC for complementors with low and high platform ecosystem experience, defined as one standard deviation below and above the mean, respectively.

In Hypotheses 4a and 4b, we predicted that the favorable responses to PVC would be stronger for complementors with an exclusive platform focus. We introduce the interaction between PVC in subcategory and the exclusive platform focus dummy variable in Model 4 and find support for Hypotheses 4a and 4b. Starting with Hypothesis 4a and app introductions, the interaction is positive and significant in Model 4 in Table 4 ($\beta = 0.00071; p = 0.036$). We observe that after introducing the interaction between PVC in subcategory and exclusive platform focus, the main effect of PVC in subcategory turns statistically insignificant, suggesting that it is mainly complementors with an exclusive platform focus that respond favorably to PVC. Moving to Hypothesis 4b, the same interaction is...
Table 4. Linear Probability Model Estimates of the Effect of PVC in a Subcategory on App Introductions

<table>
<thead>
<tr>
<th>Variable</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>PVC in subcategory</td>
<td>0.00037**</td>
<td>0.0027***</td>
<td>0.00014</td>
<td>0.0025***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.00018)</td>
<td>(0.00053)</td>
<td>(0.00019)</td>
<td>(0.00051)</td>
<td></td>
</tr>
<tr>
<td>Platform ecosystem experience (ln)</td>
<td>−0.0017***</td>
<td>−0.0017***</td>
<td>−0.0016***</td>
<td>0.0016***</td>
<td>−0.0016***</td>
</tr>
<tr>
<td></td>
<td>(0.00015)</td>
<td>(0.00015)</td>
<td>(0.00014)</td>
<td>(0.00014)</td>
<td>(0.00014)</td>
</tr>
<tr>
<td>PVC in subcategory × platform ecosystem experience (ln)</td>
<td>−0.00084***</td>
<td>−0.00084***</td>
<td>−0.00084***</td>
<td>−0.00084***</td>
<td>−0.00084***</td>
</tr>
<tr>
<td></td>
<td>(0.00015)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PVC in subcategory × exclusive platform focus</td>
<td></td>
<td></td>
<td></td>
<td>0.00071**</td>
<td>0.00083**</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.00034)</td>
<td>(0.00033)</td>
</tr>
<tr>
<td>App introductions in subcategory</td>
<td>−0.000085***</td>
<td>−0.000084***</td>
<td>−0.000086***</td>
<td>−0.000084***</td>
<td>−0.000086***</td>
</tr>
<tr>
<td></td>
<td>(0.000028)</td>
<td>(0.000028)</td>
<td>(0.000028)</td>
<td>(0.000028)</td>
<td>(0.000028)</td>
</tr>
<tr>
<td>App withdrawals in subcategory</td>
<td>0.000098</td>
<td>0.000094</td>
<td>0.000094</td>
<td>0.000094</td>
<td>0.000094</td>
</tr>
<tr>
<td></td>
<td>(0.000071)</td>
<td>(0.000071)</td>
<td>(0.000071)</td>
<td>(0.000071)</td>
<td>(0.000071)</td>
</tr>
<tr>
<td>Apps by platform owner in subcategory</td>
<td>−0.00049***</td>
<td>−0.00049***</td>
<td>−0.00048***</td>
<td>−0.00049***</td>
<td>−0.00048***</td>
</tr>
<tr>
<td></td>
<td>(0.00017)</td>
<td>(0.00017)</td>
<td>(0.00017)</td>
<td>(0.00017)</td>
<td>(0.00017)</td>
</tr>
<tr>
<td>Subcategory market size (ln)</td>
<td>0.00020</td>
<td>0.00021</td>
<td>0.00022</td>
<td>0.00021</td>
<td>0.00022</td>
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<tr>
<td></td>
<td>(0.00021)</td>
<td>(0.00021)</td>
<td>(0.00021)</td>
<td>(0.00021)</td>
<td>(0.00021)</td>
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<tr>
<td>Complementor scope</td>
<td>−0.0037***</td>
<td>−0.0037***</td>
<td>−0.0037***</td>
<td>−0.0037***</td>
<td>−0.0037***</td>
</tr>
<tr>
<td></td>
<td>(0.00025)</td>
<td>(0.00025)</td>
<td>(0.00025)</td>
<td>(0.00025)</td>
<td>(0.00024)</td>
</tr>
<tr>
<td>Apps by complementor in subcategory</td>
<td>0.0036***</td>
<td>0.0036***</td>
<td>0.0036***</td>
<td>0.0036***</td>
<td>0.0036***</td>
</tr>
<tr>
<td></td>
<td>(0.00057)</td>
<td>(0.00057)</td>
<td>(0.00057)</td>
<td>(0.00057)</td>
<td>(0.00057)</td>
</tr>
<tr>
<td>Complementor performance</td>
<td>−0.0021</td>
<td>−0.0021</td>
<td>−0.0020</td>
<td>−0.0021</td>
<td>−0.0021</td>
</tr>
<tr>
<td></td>
<td>(0.00014)</td>
<td>(0.00014)</td>
<td>(0.00014)</td>
<td>(0.00014)</td>
<td>(0.00014)</td>
</tr>
<tr>
<td>Complementor fixed effects</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Subcategory fixed effects</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Month fixed effects</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Number of complementors</td>
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<td>1,415</td>
<td>1,415</td>
<td>1,415</td>
<td>1,415</td>
</tr>
<tr>
<td>Number of observations</td>
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<td>761,376</td>
<td>761,376</td>
<td>761,376</td>
<td>761,376</td>
</tr>
<tr>
<td>( R^2 )</td>
<td>0.0058</td>
<td>0.0059</td>
<td>0.0061</td>
<td>0.0059</td>
<td>0.0062</td>
</tr>
</tbody>
</table>

Notes. Coefficients are reported with robust standard errors, clustered at the level of the complementor, in parentheses. The constant is estimated but not reported. 
\*p < 0.10; **p < 0.05; ***p < 0.01.

Additional Analyses. We performed several additional analyses to address some alternative explanations and to assess the stability of our estimations to alternative model specifications. We briefly report on those tests here, tabulating the full estimation results in Online Appendix B.

Our theoretical explanation for complementors’ favorable responses to PVC investments is that they use PVC to infer the strategic direction of the platform. Such inferential learning is directly related to the focal platform and therefore intimately tied to the equity investments by the platform owner. The moderation effects are in line with this explanation, especially our finding that complementors with an exclusive platform focus respond strongly to PVC. Even so, we implemented a falsification exercise using CVC investments in complementors by CVC units other than Salesforce’s to further enhance our confidence in the proposed theoretical explanation. Specifically, we examined how complementors respond to 15 CVC investments across 11 subcategories by Google Ventures, Intel Ventures, and others. If PVC indeed enables inferential learning specific to a platform, then complementors should respond differently to CVC investments by other CVC units devoid of platform-specific value creation interests. However, if some other mechanism drives our results, we expected that it is more likely we will observe similar responses to PVC and CVC. In line with our theoretical explanation, we found that complementors’ app introduction and withdrawal decisions are not sensitive to CVC investments by CVC units other than Salesforce’s.

As with any observational study, a concern is that our findings are driven by unobserved factors. Notably, our models rule out time-invariant heterogeneity at the level of the subcategory, complementor, or app through the inclusion of fixed effects and capture meaningful.

negative and marginally significant in Model 4 in Table 5 (β = −0.0055; p = 0.072). Here too, we observe that the negative effect of PVC on the likelihood of app withdrawal is mainly because of the favorable responses of complementors invested exclusively in the focal platform. Figure 1, (c) and (d), depicts the effect of PVC for complementors with an exclusive platform focus compared with those also engaging in other business activities. For completeness, Model 5 presents the fully specified model.
Table 5. Linear Probability Model Estimates of the Effect of PVC in a Subcategory on App Withdrawals

<table>
<thead>
<tr>
<th>Variable</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<tr>
<td>PVC in subcategory</td>
<td>−0.0032**</td>
<td>−0.012**</td>
<td>−0.0077</td>
<td>−0.0099**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0016)</td>
<td>(0.0047)</td>
<td>(0.0023)</td>
<td>(0.0049)</td>
<td></td>
</tr>
<tr>
<td>Platform ecosystem experience (ln)</td>
<td>−0.0019</td>
<td>−0.0019</td>
<td>−0.0027</td>
<td>−0.0019</td>
<td>−0.0026</td>
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<tr>
<td></td>
<td>(0.0019)</td>
<td>(0.0019)</td>
<td>(0.0020)</td>
<td>(0.0019)</td>
<td>(0.0020)</td>
</tr>
<tr>
<td>PVC in subcategory × platform ecosystem experience (ln)</td>
<td>0.0025**</td>
<td></td>
<td></td>
<td></td>
<td>0.0026**</td>
</tr>
<tr>
<td></td>
<td>(0.0012)</td>
<td></td>
<td></td>
<td></td>
<td>(0.0012)</td>
</tr>
<tr>
<td>PVC in subcategory × exclusive platform focus</td>
<td></td>
<td></td>
<td></td>
<td>−0.0055*</td>
<td>−0.0059*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.0030)</td>
<td>(0.0030)</td>
</tr>
<tr>
<td>App introductions in subcategory</td>
<td>−0.00011</td>
<td>−0.000087</td>
<td>−0.000086</td>
<td>−0.00079</td>
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<tr>
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<td>(0.00016)</td>
<td>(0.00016)</td>
<td>(0.00016)</td>
<td>(0.00016)</td>
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<tr>
<td>App withdrawals in subcategory</td>
<td>0.00071</td>
<td>0.00078</td>
<td>0.00074</td>
<td>0.00082*</td>
<td>0.00079</td>
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<tr>
<td></td>
<td>(0.00049)</td>
<td>(0.00049)</td>
<td>(0.00049)</td>
<td>(0.00049)</td>
<td>(0.00049)</td>
</tr>
<tr>
<td>Apps by platform owner in subcategory</td>
<td>−0.0039**</td>
<td>−0.0036**</td>
<td>−0.0037**</td>
<td>−0.0037**</td>
<td>−0.0039**</td>
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<tr>
<td></td>
<td>(0.0015)</td>
<td>(0.0015)</td>
<td>(0.0015)</td>
<td>(0.0015)</td>
<td>(0.0015)</td>
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<tr>
<td>Subcategory market size (ln)</td>
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<td>0.00074</td>
<td>0.0011</td>
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<td>0.0013</td>
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<tr>
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<td>(0.0041)</td>
<td>(0.0041)</td>
<td>(0.0047)</td>
<td>(0.0041)</td>
<td>(0.0041)</td>
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<tr>
<td>Complementor scope</td>
<td>−0.0034*</td>
<td>−0.0034*</td>
<td>−0.0032</td>
<td>−0.0033*</td>
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</tr>
<tr>
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<td>(0.0020)</td>
<td>(0.0020)</td>
<td>(0.0020)</td>
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<td>(0.0020)</td>
</tr>
<tr>
<td>Apps by complementor in subcategory</td>
<td>0.016**</td>
<td>0.016**</td>
<td>0.016**</td>
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<td>0.016**</td>
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<tr>
<td></td>
<td>(0.0064)</td>
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<tr>
<td>App performance</td>
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<tr>
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</tr>
<tr>
<td>App age</td>
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<td>0.0022</td>
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<tr>
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<td>(0.0024)</td>
<td>(0.0024)</td>
<td>(0.0024)</td>
<td>(0.0024)</td>
</tr>
<tr>
<td>Number of ratings (ln)</td>
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<td>−0.0063***</td>
<td>−0.0064***</td>
<td>−0.0064***</td>
<td>−0.0066***</td>
</tr>
<tr>
<td></td>
<td>(0.0014)</td>
<td>(0.0014)</td>
<td>(0.0014)</td>
<td>(0.0014)</td>
<td>(0.0014)</td>
</tr>
<tr>
<td>Rating valence</td>
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<td>0.00094</td>
<td>0.00090</td>
<td>0.00095</td>
<td>0.00090</td>
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<tr>
<td></td>
<td>(0.00071)</td>
<td>(0.00071)</td>
<td>(0.00071)</td>
<td>(0.00071)</td>
<td>(0.00071)</td>
</tr>
<tr>
<td>App fixed effects</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Month fixed effects</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Number of apps</td>
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<td>2,158</td>
<td>2,158</td>
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</tr>
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<td>Number of observations</td>
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<tr>
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<td>0.010</td>
<td>0.010</td>
<td>0.011</td>
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</tr>
</tbody>
</table>

Notes. Coefficients are reported with robust standard errors, clustered at the level of the app, in parentheses. The constant is estimated but not reported.
*p < 0.10; **p < 0.05; ***p < 0.01.

time-variant heterogeneity across levels through the inclusion of numerous control variables. Yet, concerns over time-varying unobservable factors, especially at the level of the subcategory (e.g., changing subcategory demand), could remain. We deem it unlikely that such unobservable factors drive our results, given our relatively short observation window and because demand typically changes gradually (Rietveld and Eggers 2018). Nevertheless, we performed some further tests to address this concern.

We exploited the nested category structure in AppExchange and examined whether there are responses to PVC in the subcategories related to the affected subcategory. Recall that the 42 subcategories in AppExchange are nested in 9 main categories. If unobserved factors drive our results, we might observe comparable responses to PVC in related subcategories. Subcategories nested within the same main category relate to the same business functions and technological needs and are therefore likely subject to the same trends and fads. To illustrate, the Marketing subcategories of campaign management and event management are closely related; they are both about marketing promotions. We tested whether complementors respond to PVC in related subcategories and found that this is not the case. We also performed a placebo test. We coded a dummy variable that takes a positive value in the three months before, rather than after, a PVC investment took place. The coefficient estimate on this placebo variable would likely be comparable to that of the PVC variable if time-varying subcategory-level unobservable factors would be the main driver of our estimation results. However, this was not the case, lending further confidence to our findings.

Another alternative explanation is that complementors are driven to subcategories affected by PVC for the mere prospect of access to resources. Equity investments constitute an important avenue for new ventures to acquire resources for growth. Therefore, we collected data on the investment status of all complementors from CrunchBase and performed split sample...
analyses to assess and compare how complementors with and without preexisting access to venture financing responded to PVC investments. We found no difference in how the two groups of complementors responded to PVC. For the sake of completeness, we performed a similar split sample analysis for subsamples of small and large complementors. For this, we used the complementor-provided employee count information from AppExchange. Dividing the data into two approximately equally sized samples by means of a median split, we found that the responses to PVC investments are similar for larger and smaller complementors.

We also looked into the heterogeneity in PVC investments. Specifically, we distinguished between early-stage and late-stage investments and between investments in which Salesforce was the lead investor vs. cases where it invested alongside other investors as part of a syndicate. We reasoned that if PVC investments are indeed potent platform-specific learning devices, then the mere involvement of Salesforce in an investment is what matters most to complementors. As such, they should respond favorably to PVC regardless of its type. Decomposing the effect of PVC on app introductions and withdrawals along investment type, we found that complementors’ responses are similar.

We evaluated the sensitivity of our findings to our modeling choices. Complementors may introduce more than one app in the same subcategory in a given month, so we estimated the effect of PVC on the log-transformed number of app introductions using an ordinary least squares (OLS) regression. Moreover, we analyzed the relationship between PVC and app withdrawal by means of a discrete-time proportional hazard model, for which we made use of a complementary log-log (i.e., cloglog) specification (Long 1997). In both cases, we obtained estimation results consistent with those from our main models.

We tested whether our results were sensitive to how we coded the moderating variables. We replaced our original measure of platform ecosystem experience with the log-transformed number of months since the oldest app by a complementor was released (Kapoor and Agarwal 2017). We substituted the hand-coded exclusive platform focus variable with a machine-coded measure of multihoming, that is, a subsample of complementors for which we can ascertain they do not
have an exclusive platform focus. To code this measure, we collected information from competing platform ecosystems to Salesforce’s: Microsoft Dynamics, NetSuite, SugarCRM, and Zoho. Subsequently, we matched complementors across those platforms based on their names and contact information and coded the dummy variable for multihoming positively if a Salesforce complementor was active on one or more of those other platforms. As the multihoming variable is reflective of a lack of exclusive platform focus, we expected that multihoming complementors’ responses to PVC would be weaker. Repeating our estimations with the two new moderator variables, we obtained estimation results consistent with our main findings.

Because the Salesforce platform grew substantially, our data consists of both incumbent and new complementors. To ensure that our results are not driven by the distinct behavior of new complementors, we repeated our analyses for the subsample of incumbent complementors. Our findings hold.

**Qualitative Findings**

To gain a deeper understanding of complementors’ responses to PVC, we conducted semistructured interviews with complementors and observed at platform events. We wanted to gain more insights not only into why complementors view PVC investments as a learning device to navigate platform-specific uncertainty, but also into the meanings and interpretive significance that complementors attach to PVC investments.

Further corroborating our quantitative findings, we found strong qualitative evidence that complementors leverage PVC investments as an inferential learning device to navigate platform-specific uncertainty. As just one example, the founder and CEO of CampaignAnalytica that produces marketing analytics apps mentioned:

... Conference keynotes [i.e., presentations given by Salesforce executives] are all fine and we know they tend to get a bit exaggerated [laughs]… and we don’t really know what they [Salesforce] would actually follow through with and what would be vaporware or just announcements, right? … But [PVC] venture investments are different story. It’s quite literally “put your money where your mouth is,” right? It’s literally that, and so my team and I pay a lot of attention to it, because it’s quite revealing … We are a small company and we can’t just throw things at the wall and see what sticks, we don’t have the resources to do so … we are very strategic on what we do next … so we do carefully note what Salesforce’s venture unit is doing … follow the money, really … and that tells us a lot. [emphasis added]

We probed further on why complementors inferred PVC as a particularly credible signal concerning where the platform is headed in the future. Complementors emphasized the monetary and capital-intensive nature of PVC, public appeal of the announcements and press releases that follow PVC investments, and that PVC investment decisions are monitored and scrutinized by analysts, institutional investors, and shareholders of Salesforce (i.e., keeping the platform owner accountable for their actions). The sum of those characteristics of PVC investments made complementors regard PVC as a particularly credible signal concerning the strategic priority of the platform owner. As the VP of Zeta, a long-time complementor of Salesforce, described:

Over the years, Zeta has released many apps in AppExchange. It takes time to develop these apps … So where do we go to when we want to develop a new app? We see what Salesforce is doing and we try to work around that … Say when they are investing in this app or that new start-up, we take notice of all that. Talking to the Salesforce Platform Marketing folks is one thing, but looking at what Salesforce actually does is quite another … we watch carefully [on what Salesforce does], take notice, and plan our next steps …. This business has a lot of churn, so we need to constantly push out apps …. But now you know where they [Salesforce] want to take their platform next, and what the customer wants in the next few years. [emphasis added]

Moreover, complementors also infer that the platform owner will assume an active stance concerning the areas where its strategic priorities lie. Hence, complementors anticipate that the platform owner will take additional actions to help propel value creation and generate traction with platform customers in the subcategories where it made a PVC investment. As the VP of CTech, a Salesforce complementor, puts it

If Salesforce is investing money [in complementors] from its pockets, then they are not going to sit quiet and hope for customer demand, hope for downloads, hope for some magic, to happen … but even if the demand is initially slow, then they can always steer demand. Give freebies. Free trials, and what not. Give the customers a taste of it, and that will create demand. You know, they can play both the sides.

Our interviews strongly suggested that complementors interpreted PVC investments as a form of “middle-ground” platform governance. Complementors indicated that PVC investments are indicative of mutual commitment. That is, PVC investments reflect the platform owner’s commitment to stimulating ecosystem-level value creation while at the same time inducing investee complementors to commit their own future efforts to the platform as well, instead of fully subsidizing investees and/or entering into direct competition with complementors and undercutting other (noninvestee) complementors as a consequence. For
example, consider the following quote by the President of FTech that produces accounting and financing apps:

I don’t have a problem with another startup getting some incubation fund, seed money, or VC from Sales-force. It shows that Salesforce is serious and not just trying to “wham bam …” Yeah, it’s a freebie for that startup, but hey Salesforce is also not fully bankrolling them, like they would if they were acquiring a company … So that startup too needs to be serious, work its butt off, and continue to prove its mettle …. So all around, it’s a fair game and I’m fine with it.

As this quote suggests, by making a minority equity investment in a platform complementor, complementors such as FTech believe that Salesforce is sending out the following messages: (a) that it has skin in the game and is serious about the growth of the platform ecosystem; and (b) by not fully subsidizing the investee complementor, Salesforce is asking this complementor to show their skin in the game and commitment to the platform ecosystem as well. Simultaneously, this leaves open the option for value to be created and captured by other (noninvestee) complementors. In other words, PVC investments are not perceived as solely motivated by value capture on the part of the platform owner. PVC investments do not give investee complementors a free rein in the platform ecosystem either.

Interestingly, the former also suggests that complementors quite explicitly compare and contrast various forms of platform governance. To emphasize this issue further, the cofounder of EmpAnalytics described PVC in the following manner:

“… PVC investments] come across not as predatory, because here at least they have taken a bet on a company and invested some real money in it so there are real things at stake here—so at least to me, that is more or less fair game … than just including that [app] in their next release cycle [vertical integration]—that pisses me off, yeah yeah yeah I know that’s how the game is played here, but still it seems screwed up and unfair.”

Consider another example, where a complementor with payment processing apps, described PVC investments by Salesforce as follows:

…I got into this business willingly and I know the risks it entails … they’re [Salesforce] not angels and that’s ok, I mean I don’t think anyone expects them to be saints. It’s a tough business … but they have to be fair. Or at least, [they] got to show us that they are committed to the broader community [of complementors]. Like, they can’t randomly put apps on the Spotlight [selective promotion] without proper justification. It should be based on something, like the performance of the app, and not some random criteria that they don’t even tell us. That’s unfair …. Also, acquiring an existing app and then bundling it as a new [Salesforce] Cloud [acquisition], that’s also very unfair to all of us. It’s exploitive of all the developers who are competing in the same space because it just pretty much puts them out of business. It’s easy to say that they can always pivot to something else, but all the hard work they’d put in, all the blood, sweat, and toil. All for tears. It’s so unfair …

But [platform venture capital] investments, that’s a different story. What’s different about it? Here too, they [Salesforce] are picking a company, but they are investing some money but not giving them [investee complementor] a free rein and squeezing everyone else out …. So there’s some balance, some fairness there, and so it’s ok.

These quotes suggest that as complementors actively compare different forms of platform governance mechanisms, they juxtapose and infuse such mechanisms with meanings. In the latter case, for example, the complementor juxtaposed selective promotions against vertical integration, and then juxtaposed both these governance actions with PVC investments. Whereas selective promotions were viewed by this complementor as “random” and vertical integration as “exploitive,” PVC investments were viewed as a form of middle-ground action. Such juxtaposed meanings render some forms of platform governance by the platform owner as acceptable and even useful, while others as unacceptable and morally repugnant.

To summarize, our qualitative findings further reinforce the notion that complementors use PVC investments to make anchored inferences about the strategic direction of the platform. They view PVC as a particularly credible signal in this regard because such investments are costly, public, and actively scrutinized by other influential stakeholders. Importantly, our qualitative findings suggest that complementors view PVC as holding a middle ground between other forms of platform governance (e.g., selective promotion, vertical integration), in that the platform owner resources a complementor without acquiring them, while at the same time also incentivizing the investee complementor to enhance their commitment to the platform as opposed to simply spotlighting them.

Discussion and Implications

There is a growing number of platform owners that orchestrate their platform ecosystems by making equity investments in complementors, a practice we refer to as platform venture capital (PVC). Those platform owners stake out investments in complementors whose products (or product categories) they believe to be of high importance to the future value of the platform. The investments provide investee complementors with the resources, knowledge, and reputation to successfully build and scale their business on the platform. It is in this way that platform owners
can deploy PVC to enhance the value of select parts of the platform for customers.

The goal of this study was to investigate how other complementors respond to such PVC investments, in terms of their decision to introduce and withdraw complementary products. Our central theoretical argument was that complementors would seek out product categories affected by PVC, because they use PVC as an anchored inferential learning device to navigate the platform-specific uncertainty they face concerning the strategic direction of the platform. The platform owner exercises asymmetric control over the strategic direction of the platform, and PVC is a particularly credible signal as to where the platform is headed in the future, in part because it is a costly action that is highly visible and directly targeted at and consequential for future value creation in the platform ecosystem. We examined our thesis both quantitatively and qualitatively in the context of Salesforce’s platform ecosystem.

Quantitatively, we studied how the likelihood of product introduction and product withdrawal by complementors changed in response to 24 PVC investments by Salesforce Ventures. Congruent with our theoretical expectations, we found that complementors were more likely to introduce and less likely to withdraw products in product categories affected by PVC. Moreover, we showed that those responses were weaker for complementors with greater platform ecosystem experience that place more overriding emphasis on the knowledge emanating from their own experiences, and stronger for complementors with an exclusive focus on the focal platform as they are highly sensitive to platform-level uncertainty and therefore particularly invested in drawing inferences from the platform owner’s PVC investments.

Qualitatively, we further examined why complementors view PVC investments as devices for anchored inferential learning about the strategic directions of the platform. We found that complementors interpret PVC as a middle-ground governance action because of the mutual commitment it connotes. Complementors perceive the platform owner as being committed to the overall value creation of the platform, while also inducing the investee complementors to show that they have skin in the game by committing their own future efforts to the platform ecosystem. In turn, this helps inform complementors’ decision making and shapes their eventual responses.

Contributions
Our study of complementors’ responses to PVC investments contributes primarily to the burgeoning literature on platform governance. Next to that, the findings from our study are also of interest to the organizational learning scholarship and the CVC literature.

Across the platforms literature, there is a broad consensus that the platform owner’s orchestration efforts are crucial to sustaining long-term value creation in the platform ecosystem (Boudreau and Hagiu 2009, Tiwana et al. 2010, Wareham et al. 2014, Rietveld and Schilling 2021). To this end, platform owners deploy a variety of platform governance mechanisms. Yet, to date, only a limited number of platform governance mechanisms have attracted the bulk of academic interest, as for instance illustrated by the rapidly accumulating bodies of work on vertical integration (Gawer and Henderson 2007, Foerderer et al. 2018, Zhu and Liu 2018, Wen and Zhu 2019, He et al. 2020) and selective promotion (Rietveld et al. 2019; 2021; Foerderer et al. 2021) by the platform owner. As such, much remains to be explored concerning other forms of platform governance, and we contribute by focusing our attention on PVC investments. There are some studies that have alluded to the use of PVC for the purpose of platform governance (Chesbrough 2002, Weiblen and Chesbrough 2015, Tong et al. 2021), and we extend those works by theorizing and investigating PVC more systematically. We explain how a platform owner can purpose PVC to enhance the value creation in select product categories on the platform by staking out equity investments in complementors that the platform owner deems of strategic importance or promising in those areas, and more importantly, we examine how and when other complementors respond favorably to PVC investments, viewing them as credible signals of the strategic direction of the platform. Those findings provide important insights for platform owners, as they always need to consider the implications of platform governance for the platform ecosystem at large, even if the governance action taken only explicitly targets one or a select number of complementors. Our findings suggest that complementors view PVC as holding the middle between other ways in which a platform owner may involve itself with certain complementors, most notably vertical integration and selective promotion. PVC is not as invasive as entering into direct competition with complementors via vertical integration or acquisitions, yet it is more consequential than selectively promoting some complementors and their products over others. Our study is also of interest because it investigates the responses of complementors to platform governance in the context of an enterprise platform, while prior work has mainly focused on consumer-facing platforms (Rietveld and Schilling 2021).

Relatedly, our findings unpack why complementors view PVC as a form of middle-ground governance action, thereby highlighting the interpretive significance and meaning-laden inferences that complementors attach to platform governance mechanisms and how it shapes their eventual responses. By focusing on
complementors’ interpretations and inferences from PVC, we deepen our understanding of complementors’ responses to platform governance. Indeed, ever since the foundational work by Gaver and Henderson (2007) that documents how Intel carefully managed the perceptions of its complementors concerning its platform governance, most emphasis in subsequent studies has instead been placed on the nature of particular governance mechanisms per se, which by and large foregoes the vantage point of complementors, even if some studies have documented complementors’ heterogeneous responses to platform governance (Tae et al. 2020, Koo and Eesley 2021, Rietveld et al. 2021, Thatchenkery and Katila 2022). Through our focus on PVC as a device for anchored inferential learning, we emphasize that the literature on organizational learning constitutes a useful theoretical frame to ponder the implications of platform governance. As such, we respond explicitly to recent calls for tighter integrations of organizational theories into platform scholarship (Rietveld and Schilling 2021). However, our findings also raise some interesting new questions. For example, to what extent do complementors’ past experiences with platform governance actions influence their inferences about future cases of platform governance? Or, more broadly, how do the inferences that complementors draw from platform governance develop over time? How do such inferences by complementors strengthen or unwittingly undermine platform accountability, that is, the efforts taken to keep platform owners accountable for the deployment of platform governance? Alternatively, and based on our qualitative finding that complementors contrast different platform governance mechanisms, how are complementors’ inferences influenced by the bundle of governance mechanisms that the platform owner undertakes? When and why do complementors justify the actions of the platform owner even if such actions ostensibly undermine the interests of complementors?

Our study makes contributions to the literature on organizational learning in the following manner. To begin, we introduce the notion of platform-specific uncertainty as an important factor that shapes the learning behaviors of complementors. While scholars have distinguished firm-specific uncertainty, that is, uncertainty that is unique and internal to a firm, from market-specific uncertainty, that is, uncertainty that is external and shared across a set of firms in a market category (Beckman et al. 2004), the concept of platform-specific uncertainty is particularly useful to understand the nature of control and dependence in the digital economy. Platform-specific uncertainty results from the asymmetric control that the platform owner has and exercises to set the platform’s strategic direction, and which complementors have little influence over or knowledge about. For this reason, this type of uncertainty is also idiosyncratic to a specific platform. Understanding the nature of platform-specific uncertainty, therefore, will help enable the development of mechanisms and processes that could facilitate organizational learning in the face of such control and dependence where businesses are often organized and built around platforms. Relatedly, we introduce the notion of anchored inferential learning to theorize how complementors cope with and navigate platform-specific uncertainty. Specifically, we examine how and why complementors inferentially learn from platform governance actions such as PVC, viewing them as credible signals about the strategic directions of the platform and thus become important devices for anchored inferential learning for complementors who confront platform-specific uncertainty. In this way, we also spotlight how complementors learn from the platform owner (Argote et al. 2020), as opposed to how the platform owner learns from complementors (Zhu and Liu 2018) or how complementors learn from one another (Ozalp and Kretschmer 2019).

Our study is also of interest to the literature on CVC. Even if it is well recognized that CVC can be used as a vehicle for ecosystem orchestration (Chesbrough 2002, Covin and Miles 2007, Dushnitsky and Kang 2018), most prior work on CVC has focused on the investor-investee dyad (Dushnitsky and Lenox 2005, Maula et al. 2005, Maula 2007, Nahata 2008, Benson and Ziedonis 2009, Dushnitsky and Shaver 2009, Hallen et al. 2014, Drover et al. 2017). Beyond the investor-investee dyad, the implications of CVC investments have remained largely unexplored, but this is exactly where the most interesting implications lie in the case of ecosystem orchestration. Hence, we extend the literature on two main fronts. First, leveraging our context of platform ecosystems, we explain how an orchestrating organization (in this case, the platform owner) can stimulate ecosystem-level value creation by maintaining a portfolio of strategically targeted equity investments in ventures, further elucidating how CVC can be used for purposes of ecosystem orchestration. Second, and relatedly, we show that CVC investments have consequences far beyond the investor-investee dyad. In our case, CVC investments by the platform owner directly influence the actions of complementors in the platform ecosystem, as they take note of the investment, interpret it, and adjust their own strategies accordingly. We find that other complementors flock to the areas that are the business focus of an investee. Interestingly, our findings thus surface a new challenge for ventures that are considering whether to accept a CVC investment. Accepting a CVC investment provides the venture crucial resources to scale, but it may come at the cost of increased competition.
Limitations, Scope Conditions, and Directions for Future Research

We note some limitations of our study that could provide interesting avenues for future research. Although our mixed methods approach allowed us to provide a rich account of complementors’ responses to PVC, it does not allow us to draw absolute causal conclusions. Therefore, we encourage future investigations of the causal impact of PVC on the behavior and decisions of complementors. We also limited the focus of our analyses to how other complementors respond to PVC. As such, we did not investigate how PVC impacts the decision-making of investee complementors nor how PVC ultimately impacts the value creation of the platform at large or vis-à-vis competing platforms. Notably, from our data we do observe that roughly half of the PVC-receiving complementors intensify their commitment to the Salesforce platform after receiving the investment, which is consistent with our theoretical arguments about PVC, but it would be interesting to investigate this issue more systematically.

An important question is whether our finding that complementors seek out product categories affected by PVC investments because they use such investments to infer the strategic direction of the platform generalizes to other platform ecosystems. Our conclusions directly derive from a single empirical context, a prominent enterprise platform, and validity of our findings thus needs to be established across other contexts. The literature suggests that PVC investments could pose legitimate competitive threats to investee complementors and therefore also to others (Katila et al. 2008, Dieste and Rajagopolan 2012, Hallen et al. 2014), for instance, because such investments may eventually lead to an acquisition or imitation by the platform owner (Benson and Ziedonis 2009, Dushnitsky and Shaver 2009), and the mere threat of having to enter into competition with the platform owner could stifle complementors’ efforts (Gawer and Henderson 2007, Wen and Zhu 2019).

In line with our theorizing, we anticipate that whether complementors will respond positively or negatively to PVC depends on the level of platform-specific uncertainty that complementors confront. When platform-specific uncertainty is high, complementors will place substantial weight on the specific inferences that help reduce such uncertainty, even if there might be a competitive threat associated with the observed action. As such, we consider the existence of high levels of platform-specific uncertainty an important scope condition for our findings. The notion that complementors with an exclusive platform focus, who are highly sensitive to platform-specific uncertainty, seek out product categories affected by PVC is in line with this assertion. In our specific empirical case, the importance of platform-specific uncertainty is also likely particularly profound. We focused on complementors’ product introduction and withdrawal decisions, which are highly consequential decisions that are well known as shrouded by all kinds of uncertainty (Greve 1995, Haunschild and Miner 1997, Lieberman and Asaba 2006, Gaba and Terlaak 2013, Ozalp and Kretschmer 2019). Besides, in the context of enterprise platforms it might simply be more difficult for complementors to access alternative sources of information that could serve as proxies for the strategic direction of the platform, such as information on future customer preferences and demand, because platform customers are usually large businesses themselves. It will therefore be interesting to investigate what the impact of PVC investments is on complementors’ choices concerning innovation and further development of their existing complementary products, as well as whether complementor responses to PVC investments may be different in the context of customer-facing platform ecosystems.

Also of importance is the extent to which complementors have reasons to perceive a PVC investment as a legitimate competitive threat. CVC units can be more or less hands on in the day-to-day business decisions of investees (Dushnitsky 2012), for instance, depending on whether they assume a board seat with voting rights following an investment. Moreover, PVC investments in the past may have more or less frequently led to cases where the platform owner entered into direct competition with other complementors by acquiring or imitating a PVC investee. In our case, Salesforce maintained a relatively large portfolio of hands-off investments in complementors, and it only sparingly acquired its portfolio companies. By examining complementors’ responses to PVC investments across different platforms, future research could further disentangle when exactly positive learning-based responses, as opposed to negative competition-based responses, to PVC investments ensue.

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Endnotes
1 We define uncertainty as “the lack of information or knowledge, which translates into difficulties in accurately assessing current and future decision situations” (Gaba and Terlaak, 2013, p. 1847).
2 To protect anonymity of the participants, all names of complementors are pseudonyms.
3 Complementors also share 25% of the revenues from their paid apps with Salesforce.
4 We lose one month because of the use of lags.
5 The slight difference in length across the two data sets is because we lose one month at the end of the app-month data set, which we use to trace app withdrawals.
6 We omitted the main effect of the exclusive platform focus variable from the model specification because it is time-invariant and therefore collinear with the complementor or app fixed effects.
7 We present the estimation results from the most conservative model specifications. Our results are robust to less conservative specifications of the fixed effects as well as alternative ways of clustering the standard errors. The findings from the app introduction analyses remain unchanged when dropping the complementor-level and/or the subcategory-level fixed effects. The app withdrawal analyses produce results similar to the reported results when replacing the app-level fixed effects with complementor-level fixed effects and/or subcategory-level fixed effects, and when clustering the standard errors at the level of the complementor.
8 We interpret the relative effects of the reported coefficients by dividing the coefficient value by the average likelihood of app introduction or withdrawal.
9 SAP and Oracle, the other two main players in the global CRM market, only introduced comparable app stores in 2016 and 2017, respectively.

References
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