Randomness, Variability, and Competitive Advantage:
A Value-Based Analysis

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Abstract

This paper provides an explicit treatment of the link between competitive advantage and random variability in value creation. Using a series of value-based formal models, the paper addresses (1) why random variability in a firm's value creation strategy should be considered positive rather than negative; (2) how horizontal differentiation, the level of competition, and the cost of variability determine the ideal tradeoff between random variability and a firm's expected value proposition; (3) how firms differentiate from each other in 'probability space'; and (4) which type of random variability in value creation a firm should select in competition with other firms. The paper's focus on randomness and variability complements the traditional strategy focus on deterministic processes.

Keywords: value-based competition, differentiation, formal methods, competitive positioning, luck

1. Introduction

The strategy field has focused recently on how a firm's value proposition determines the profits the firm appropriates in competitive interactions. Building on the formal framework developed by Brandenburger and Stuart (1996, 2007), Lippman and Rumelt (2003), and MacDonald and Ryall (2004), authors have studied the theoretical underpinnings of the evolution of demand (Adner and Zemsky 2006), horizontal scope (Chatain and Zemsky 2007), network position (Ryall and Sorenson 2007), outsourcing (De Fontenay and Gans 2008), and resource heterogeneity and complementarity (Adegbesan 2009).

Each of these papers provides guidance on how a set of empirically and theoretically relevant contextual factors influences the answer to a fundamental question in business strategy: How does competition among economic actors determine the value each appropriates? (MacDonald and Ryall 2004: 1319). With this guidance in hand, a firm's managers should have a clearer understanding of how to invest in value creation and how to position their firm in relation to other market participants.

However, in so doing, managers face a challenge this literature has yet to address: in the presence of bounded rationality and causal ambiguity [as well as, perhaps, a fundamental indeterminateness of the workings of the universe itself, as suggested by modern physics (Born 1954)], there is an unavoidable random variability associated with any competitive move and the development of new capabilities. At first blush, one might be tempted to write off this uncertainty as merely noise in the system, the error term in a regression, as it were. The implication would then be, to borrow the words of Barney (1986: 1232), that managers should focus on developing "special insights into the future value of strategies" (which would raise expected capabilities and performance and thus lead to competitive advantage) and not spend precious managerial energy fretting over a competitive advantage that is merely a "manifestation of a firm's good fortune or luck".

Yet, while managers cannot control the hand of fate, *per se*, they do influence the degree to which their firm's profitability is subject to fate's vicissitudes. Managers may follow a competitive strategy with fairly predictable outcomes (e.g., maintaining a flagship product in its current form or maintaining the boundaries of the firm as they are) or a competitive strategy highly subject to random variability in outcomes (e.g., boldly repositioning the firm's flagship product, as Coca-Cola did unsuccessfully with New Coke and Asahi did successfully with its dry beer in the 1980s, or dramatically changing the boundaries of the firm with a large acquisition or divestiture). Moreover, the nature of random variability itself varies. Pursuing a revolutionary technology instead of a tried-and-true technology risks a large chance of failure in exchange for a small chance of great success. Conversely, anti-social activities like environmental dumping, using child labor, or failing to implement proper health and safety procedures reduce a firm's costs of production and thus increase the firm's net value proposition in most states of the world, but also risk severe reputational damage if the firm is caught. This strategy trades a small probability of a disastrous outcome for a large probability of a somewhat better outcome than could otherwise be achieved.

This paper's contribution is to develop a formal framework for studying these strategic choices. The approach is intentionally abstract and is not intended to reflect the specific features of any real-world industry. More contextualized modeling is left for future work.

The analysis shows that, *ceteris paribus*, random variability in value creation is a 'good' rather than a 'bad'. In other words, holding a firm's expected value proposition constant, more random variation about the future expected value proposition is better than less random variation. Note that this is in marked contrast to many other areas of the social sciences, where variability is known as 'risk' and is considered a 'bad' that requires a premium (e.g., financial economics). It follows that a firm should be willing to pay a cost for variability in its value creation strategy. The maximum cost is decreasing in a firm's market power; a firm with a safe monopoly position should not pay any cost for variability, whereas a firm with no *a priori* market power should potentially pay a large cost. It is thus strategic interaction that renders variability in value creation valuable and important.

The variability of a firm's value creation strategy may have positive externalities for competitors. It may accordingly be more profitable for a firm to induce a rival to choose a value creation strategy with high variability than for the focal firm to choose such a value creation strategy itself. In general, among a group of competing firms, the most profitable firms are those with either very high variability in their value creation strategies or none. The least profitable firms are those with only a modest level of random variability. These results not only imply a role for the strategist in choosing the right level of variability in value creation, but also suggest that the perils of being "stuck in the middle", à la Porter (1998), are as applicable in the 'probability space' as in the space of conventional product attributes.

The analysis also suggests that holding the expected value and random variability of a firm's value creation strategy constant, the more asymmetric the distribution of possible value propositions, the better. In particular, among a group of competing firms, we find that every firm but one will try to 'hit a home run' by choosing a strategy that may produce a very high value proposition with a small probability or a modestly low value proposition with a large probability. Only one firm will 'court disaster' by choosing a strategy that may produce a very low value proposition with a small probability or a modestly high value proposition with a large probability. In addition, and somewhat remarkably, the most profitable position in the 'probability space' along this dimension is to be the lone firm that courts disaster. This result is not only interesting from a strategic point of view but also has implications for corporate social responsibility. The (possibly anti-social) strategy of cutting corners to improve the firm's value proposition in most states of the world, while risking a terrible outcome in a rare, particularly bad state of the world, is precisely the strategy that a profit-maximizing firm should adopt if it can reach that market position ahead of its rivals.

The mechanism underlying these results, which will be elaborated in detail later, is that random variability creates the opportunity for vertical differentiation among firms that would otherwise be trapped in 'cutthroat' competition. In effect, by adopting a value creation strategy that is subject to random variability, a firm creates the possibility of having a differentiation *advantage* over competing firms if the focal firm's value creation strategy has a favorable outcome. Surprisingly, however, the benefit of this is not fully offset by having a differentiation *disadvantage* in other states of the world, because the value propositions of competing firms limit the negative effect on the focal firm's profits of an unfavorable outcome from its own value creation strategy. This fundamental asymmetry of randomness in value creation is central to the paper's analysis.

1.1 Antecedents in the Literature

Using words like 'chance', 'fate', and 'luck', scholars have taken an interest in the role of randomness in human affairs since antiquity. Some believe that, in principle, everything is deterministic if only one were smart enough to apprehend the underlying mechanism, like Laplace's omniscient Daemon.[1] The ancient Greeks saw things differently, lamenting that one should "count no man happy until he is dead," in reference to fate and the gods' games with human lives; likewise, for Aristotle, chance plays a large role in nature and, through good fortune, is a foundation for his concept of happiness (Aristotle 1984). This debate has even reached the field of strategic management with regard to whether strategies are determined by managers' choices or chance circumstance. [See the discussion in De Rond and Thiertart (2007).] In comparison, our concern here is more practical. How should managers seek to influence the inherent random variability in their value creation strategies?

Adopting a similarly practical perspective, other work in the social sciences has considered how randomness influences firm behavior and performance. Within economics and finance, a number of scholars have analyzed the incentive of an equity-aligned manager of a levered firm to increase the random component of a firm's future value [e.g., John and John (1993), Stiglitz and Weiss (1981)]. The idea is that a firm's equity is like a call option on firm value with a strike price equal to the face value of the firm's debt. Since the value of an option is increasing in the variability (i.e., volatility) of the underlying instrument, an equity-aligned manager increases the value of equity at the expense of debt by increasing the variability of the firm's future value. These arguments rely on the limited liability of a modern corporation, which imposes a lower bound of zero on the value of a firm's equity. Thus, the effect of a bad strategic outcome on shareholder returns is bounded by zero from below (although debt holders

[1] "We should thus regard the current state of the universe as the effect of its past and the cause of what is to come. An intellect who knew, at a given instant, all the forces that animate nature and the respective positions of the entities that compose it, if, moreover, that intellect were sufficiently vast to submit these data to analysis, it would encompass in one formula the movements of the greatest bodies of the universe and those of the slightest atom; for such an intellect, nothing would be uncertain and the future, like the past, would be present before its eyes" (Laplace, 1816: 5-6) [translated from the original French].

and other stakeholders would absorb much of these losses), while the effect of a good outcome is not bounded from above.

Similarly, strategic decisions that leave room for further development at a later date may be regarded as 'real options'. Examples include investments in organizational capabilities (Kogut and Kulatilaka 2001) and technology positioning (McGrath 1997). Holding the expected value of the strategy constant, it stands to reason that the higher the variability of the future value of the strategy, the more valuable the real option, because the firm may avoid the negative repercussions from a negative realization of the value of the strategy by not exercising the option to develop it further.

Like these literatures, the basic mechanism in this paper arises from a lower bound on the losses that would arise from a negative realization of a firm's value creation strategy. The key difference is that, herein, the lower bound is represented by the value propositions of competing firms. The way that random variability affects a firm's profit is accordingly moderated by the nature of strategic interaction, the study of which lies at the heart of the field of strategy and this paper's analysis.

The profit function of a monopolist or oligopolist firm facing a downward-sloping demand curve is convex in the marginal costs of production (Dasgupta and Stiglitz 1980, Rosen 1991). *Ceteris paribus*, random variability in marginal costs may therefore increase the firm's expected profits, as does random variability in a firm's value creation strategy in the present paper. The convexity and the consequent benefits of random variability in marginal costs arise from the assumption that a firm faces a large mass of anonymous consumers whose demand is a decreasing function of price; if marginal costs fall, then not only can a firm sell at greater profit to existing consumers, but to new consumers as well. That model may be appropriate for some markets with many individual consumers. In contrast, this paper follows the more general approach of value-based analysis in envisioning unrestricted economic exchange between market participants in a value chain (Brandenburger and Stuart 1996), for example between a manufacturer of auto parts and an auto maker. We find in that context that random variability is valuable *if and only if* a firm competes strategically with others; a monopolist does not benefit. More importantly, moreover, the present paper goes well beyond the observation that random variability may increase profits to study different kinds of random variability and how horizontal differentiation, the level of competition, and the cost of variability affect the quality and quantity of random variability a firm should pursue in its value creation strategy.

The theoretical industrial organization literature has primarily considered random variability in the context of comparing the private and social incentives for R&D, but a few papers have focused on random variability in strategic interaction. Using a Cournot model as described above, Rosen (1991) finds that *a priori* low-cost firms will tend to invest more in cost reduction and choose less risky cost reduction investments than *a priori* high-cost firms. Using a series of elegant models and numerical examples, Cabral (2003) and Anderson and Cabral (2007) analyze the conditions under which, in dynamic competition, a lagging firm will choose riskier R&D projects than a leading firm. This is related to this paper's analysis of how *a priori identical* firms should choose from among different types of random variability. Intriguingly, we also find that these *a priori* identical firms should differentiate the type of variability in their value creation strategies.

The formal analysis proceeds as follows. First, we outline the basic modeling approach. Second, we demonstrate how random variability is good, not bad, in value creation; while this basic result is less of a departure from prior literature than our subsequent results, we will spend some time on it to develop the intuition of what is to follow. Third, we consider the tradeoff between random variability and a firm's expected value proposition. Fourth, we consider different types of variability in value creation, holding the level of random variability and expected value proposition constant. The final section concludes.

2 Formal Analysis

2.1 Setup

This paper adopts the value-based approach, as proposed by Brandenburger and Stuart (1996). This methodology posits that when a 'coalition' of industry participants transact (e.g., a seller and a buyer), a certain amount of value (V) is created (the difference between the buyer's willingness to pay and the seller's costs of production), which is then split among the coalition members according to their respective bargaining powers. This is an abstract way of capturing the idea that when a seller sells a product to a buyer, there are gains from trade, with those gains split according to the price. We use V to denote a firm's value proposition (or value creation), whereas π is value captured or profits. See the left panel of Figure 1, which depicts a monopoly 'Firm 1' with value proposition V and its value capture π_1, which could be anything from 0 to V, depending on Firm 1's relative bargaining power.

**** INSERT FIGURE 1 ABOUT HERE ****

Markets may have many buyers and sellers. To determine which sellers transact with which buyers, the value-based approach uses the concept of the 'core' from cooperative game theory. The idea is to consider every possible allocation of industry participants to coalitions (e.g., matches between sellers and buyers). A particular allocation is in the core if and only if no group of one or more industry participants can split off to form another coalition (i.e., transact with each other instead) and thereby make every member of the group better off.

An important and very intuitive result from this literature is that a market participant can never capture more than its added value, which for a firm in this case would mean the greater of (a) the difference between its value proposition and that of the rival firm with the highest alternative value proposition and (b) zero. As an illustration, suppose that there is another firm ('Firm 2') with a value proposition of $V/2$. Firm 1 has added value of $\max\left(V - V/2, 0\right) = V/2$, whereas Firm 2 has added value of $\max\left(V/2 - V, 0\right) = 0$. The buyer, for its part, has added value of V, since without the buyer, there would be no market. Therefore, the outcome is that Firm 2 does not transact and captures no value, and Firm 1 and the buyer transact, creating value of V. This V is then split between the buyer and Firm 1 such that the buyer gets at least $V/2$ and as much as V, and Firm 1 gets no more than $V/2$ and as little as 0, with the precise split determined by exogenously given bargaining power. In essence, Firm 1 has a vertical differentiation advantage over Firm 2 in that the buyer has a higher willingness to pay for Firm 1's product or service (relative to production costs) than for Firm 2's product or service (Makadok 2010). It is this vertical differentiation advantage that allows Firm 1 to earn a profit.

Henceforth, this paper follows Adner and Zemsky (2006) in assuming that firms capture all of their added value, i.e., that vis-à-vis the buyer, firms have all the bargaining power. As explained by Adner and Zemsky (2006), we can make this assumption without the loss of generality in this context, because a firm's profits increase multiplicatively in both its bargaining power and the size of its market; to assume instead that a firm had to split its added value with the buyer would be equivalent to shrinking the size of the market by an equal proportion. This would not substantively affect our results, so we do not pursue this complication. Following this convention, Firm 1's profits in the preceding example would be precisely $V/2$. See the center panel of Figure 1.

2.2 Random Variability in Value Creation

Firm 1 earned profits in the foregoing example because it had a competitive advantage. If Firm 2 also had a value proposition of V, however, both firms would have no added value and would make no profits. The firms would be trapped in a form of rivalry akin to Bertrand competition (Aumann 1985, Chatain and Zemsky 2011). This is depicted in the right panel of Figure 1.

One way of escaping Bertrand-like competition is through horizontal differentiation, i.e., changing one's product to make it more appealing to some consumers and perhaps less appealing to others (Makadok 2010). We will allow for horizontal differentiation later. For the moment, retain the assumption that firms are not horizontally differentiated but make the alternative assumption that the value creation strategy of Firm 1 is subject to random variability. For example, Firm 1 may be altering its product or service in the face of uncertain reception by buyers. Alternatively, buyers' tastes may be evolving such that the value of Firm 1's existing product to buyers is subject to random variability. We formally capture such random variability by assuming that instead of generating a value proposition of V with certainty, Firm 1 generates a value proposition of $V + x$ with probability $1/2$ and $V - x$ with probability $1/2$. Henceforth, we refer to such a value creation strategy as 'symmetric'.

The expected value proposition of Firm 1 is still V. Therefore, if Firm 1 were a monopoly, Firm 1 would be indifferent to the random factor x in its value creation strategy.[2] (To see this, observe that, as a monopolist, Firm 1 would earn profits of $V+x$ with probability $\frac{1}{2}$ and $V-x$ with probability $\frac{1}{2}$, which is just V in expectation; this is precisely what Firm 1 would earn if it generated a value proposition of V with certainty as a monopolist.) Firm 1, however, is not a monopolist. In competition with Firm 2, if Firm 1 generates a value proposition of V with certainty, Firm 1 earns no profit. With the random factor x in its value creation strategy, by contrast, Firm 1 earns profits of

$$\pi_1 = \frac{\max(V+x-V,0)}{2} + \frac{\max(V-x-V,0)}{2} = \frac{x}{2} > 0 \tag{1}$$

What is more, Firm 2 also earns profits of

$$\pi_2 = \frac{\max(V-(V+x),0)}{2} + \frac{\max(V-(V-x),0)}{2} = \frac{x}{2} > 0 \tag{2}$$

How did random variability in Firm 1's value creation strategy turn zero-profit Bertrand-like competition into a profitable duopoly where both firms make positive profits in expectation? The answer is by creating the possibility of a vertical differentiation advantage for each firm. Figure 2 illustrates the mechanism. In the left panel of the figure, Firm 1 has a favorable outcome from its value creation strategy, yielding a value proposition of $V+x$; in this case, Firm 1 makes a profit of x and Firm 2 makes no profit. In the right panel of the figure, Firm 1 has an unfavorable outcome, yielding a value proposition of $V-x$; in this case, Firm 1 makes no profit and Firm 2 makes a profit of x. It is as if the two firms have agreed to flip a coin: 'Heads: Firm 1 has a vertical differentiation advantage and makes a positive profit. Tails: Firm 2 has a vertical differentiation advantage and makes a positive profit.'

**** INSERT FIGURE 2 ABOUT HERE ****

To put the matter differently, profits come from having a value proposition superior to those of one's competitors, i.e., from vertical differentiation. However, having a value proposition that is inferior to those of one's competitors does not result in losses (beyond any costs that may have been incurred to generate the inferior value proposition). In consequence, Firm 1 fully benefits from a *positive* difference between its value proposition and that of Firm 2 but does not bear the cost of a *negative* difference between its value proposition and that of Firm 2. This is the fundamental asymmetry of randomness in value creation. Moreover, the randomness in Firm 1's value creation strategy also benefits Firm 2 by

[2] Note that this is different from the standard microeconomic market model where firms face a downward sloping demand curve from a mass of anonymous consumers. In that context, which may apply to some consumer markets, even a monopoly benefits from random variability in the marginal costs of production.

creating the possibility for Firm 2 to have a vertical differentiation advantage as well.

The foregoing example may give the impression that Firm 1 and Firm 2 have to cooperate in some way, with Firm 1 adopting a value creation strategy *with* random variability and Firm 2 adopting a value creation strategy *without* random variability. This is not true. To see this, suppose that Firm 2's value creation strategy also has the same and uncorrelated random variability. Then, Firm 1's profits are

$$\begin{aligned}\pi_1 &= \frac{\max\left(V+x-\left(V+x\right)\right)}{4}+\frac{\max\left(V+x-\left(V-x\right)\right)}{4} \\ &+\frac{\max\left(V-x-\left(V+x\right)\right)}{4}+\frac{\max\left(V-x-\left(V-x\right)\right)}{4} \\ &=\frac{x}{2}\end{aligned} \tag{3}$$

which is the same as above. By symmetry, Firm 2's profits are also the same. Figure 3 depicts the result graphically.

**** INSERT FIGURE 3 ABOUT HERE ****

Examining Firm 1's profit function would suggest that the more variable is Firm 1's value creation strategy, i.e., the larger is x, the more profits Firm 1 earns. To make this precise, we need a mathematical definition of 'more variable'. In many areas of statistics, it is convenient to work with the sum of squared deviations about the mean (e.g., linear regression, variance of a distribution). Such measures have the property of attaching greater weight to large deviations from the mean. There is no obvious reason to give greater weight to large deviations in this context. So, we define variability in value creation as the probability-weighted sum of the absolute deviations about the expected value proposition. Thus, the variability of Firm 1's value creation strategy in the foregoing example is

$$S_1=\frac{\left|V+x-V\right|}{2}+\frac{\left|V-x-V\right|}{2}=x \tag{4}$$

It is clear from equations (3) and (4) that, indeed, more variability in value creation leads to greater profits. Specifically, the profits of Firms 1 and 2 increase by \$0.5 for every \$1 increase in the variability of their value creation strategies. As negative value propositions do not have an obvious interpretation, let us limit x to the range $\left[0,V\right]$. At $x=V$, both firms make profits of $V\!/_2$, or half the profits of a monopolist with the same expected value proposition.

Although that is a big improvement for the two firms relative to what they would have earned without variability, even more extreme examples are possible. Suppose each firm has a value creation strategy with a small probability of producing a high value proposition (hitting a 'home run') and a large probability of producing a low value proposition (which could be zero). Formally, let the value creation strategy of each firm be defined by the parameter $p \in (0,1]$ such that (a) with probability p, $V_i = V/p$, and with probability $1-p$, $V_i = 0$, where $i \in \{1,2\}$ is an index of Firms 1 and 2; and (b) the value creation strategies of the two firms are uncorrelated. Note that the expected value proposition of each firm i is simply V, as before, and that the variability is

$$S_i = p\left|\frac{V}{p} - V\right| + (1-p)\left|0 - V\right| = 2V(1-p) \tag{5}$$

which is decreasing in p. Profits are

$$\begin{aligned} \pi_i &= p^2 \max\left(\frac{V}{p} - \frac{V}{p}, 0\right) + p(1-p)\max\left(\frac{V}{p} - 0, 0\right) \\ &+ (1-p)\, p \max\left(0 - \frac{V}{p}, 0\right) + (1-p)^2 \max(0-0, 0) \\ &= V(1-p) \end{aligned} \tag{6}$$

which are also decreasing in p. In fact, the expected profits of each firm are arbitrarily close to those of a monopolist, V, if p is low enough and thus variability is high enough!

In the foregoing examples, the profits of the two firms are continuously increasing in the variability of their value creation strategies. We now show that this result generalizes in the sense that when holding constant (a) expected value creation and (b) the type of variability in value creation (i.e., the shape of the distribution of possible value propositions), more variability is always better. This requires a precise definition of 'more variable while holding constant the type of variability'. For this purpose, we adopt the notion of an 'elementary increase in risk', which is defined as a transformation of a distribution, whereby the probability mass from the support of the distribution is transferred to, or beyond, the endpoints of the distribution, such that the mean of the distribution does not change (Mas-Colell et al. 1995).[3]

Increasing x from x' to x'' where $x' < x''$ in the symmetric value creation strategy described above would be an elementary increase in risk. This is depicted graphically in the left panel of Figure 4, where the vertical axis represents the probability of a given value proposition and the horizontal axis represents the magnitude of the value proposition (further to the right is larger). Likewise, decreasing p from p' to p'' where $p' > p''$ in the home-run value creation strategy described above is an elementary increase in risk. This is depicted graphically in the right panel of Figure 4. In each case, some part of the

[3] Mas-Colell et al. (1995) define an elementary increase in risk only to include transfers to, not beyond, the endpoints of the support of a distribution. We work with a more general definition here.

probability mass of the original distribution (solid bars) is moved to or beyond the endpoints of the original distribution (clear bars) such that variability, S, increases while the expected value proposition remains V.

**** INSERT FIGURE 4 ABOUT HERE ****

The following proposition says that such transformations of a firm's value creation strategy always (weakly) increase the firm's expected profits:

Proposition 1: **Ceteris paribus,** ***increasing the variability of a firm's value creation strategy through an elementary increase in risk always (weakly) increases the firm's profits***.

The formal argument is instructive. Denote the value proposition of a focal firm by V_f and the maximum value proposition of $N-1$ competing firms by V_{-f}. Consider any realization of V_{-f}. Apply an elementary increase in risk to the value creation strategy underlying V_f. Let T_f^- be the probability-weighted sum of the increase in *negative* deviations about the mean of the focal firm's value creation strategy from the elementary increase in risk. Let T_f^+ be the corresponding figure for the increase in *positive* deviations. Divide T_f^- into (a) $\overline{T}_f^-$ for those realizations of V_f in the calculation of T_f^- that are greater than V_{-f} and (b) $\underline{T}_f^-$ for those realizations of V_f in the calculation of T_f^- that are less than V_{-f}. Divide T_f^+ into (a) $\overline{T}_f^+$ such that $\overline{T}_f^+ - \overline{T}_f^- = 0$ and (b) $\underline{T}_f^+$ such that $\underline{T}_f^+ - \underline{T}_f^- = 0$. This is possible by the definition of an elementary increase in risk. It then follows from the fact that the focal firm's profits are equal to $\max\left(V_f - V_{-f}, 0\right)$ that the negative effect of $\overline{T}_f^-$ on the profits of the focal firm is exactly offset by $\overline{T}_f^+$ and the negative effect of $\underline{T}_f^-$ on the profits of the focal firm is more than offset by $\underline{T}_f^+$. Since this argument applies to any realization of V_{-f}, it applies regardless of the value creation strategies of the $N-1$ competing firms.

Thus, we have that random variability in value creation is good and not bad, *ceteris paribus*. But what if 'everything else' is *not* constant? Are there circumstances that moderate the effect of variability on profits? If so, how should firms act to influence the variability of their value creation strategies? We extend our model to address these questions.

2.3 Variability as a Choice Parameter

So far, we have taken variability to be exogenous. However, as discussed in the introduction, firms do have considerable influence over the variability of their value creation strategies. To model these choices in competitive interaction with other firms making similar choices, we use the biform game proposed by

Brandenburger and Stuart (2007). In a biform game, players first make moves non-cooperatively, and these non-cooperative moves determine players' added value in subsequent value-based competition. In the context of this paper, this means that firms first make non-cooperative choices of value creation strategies, and then, based on the random outcomes of these strategies, firms' ultimate profits are determined in value-based competition.[4]

We also enrich our analysis in two additional ways. First, to this point, we have assumed that firms do not enjoy any *a priori* market power; hence, without variability in value creation that could give rise to a vertical differentiation advantage, firms were ineluctably trapped in Bertrand-like competition. However, many firms do enjoy some degree of market power because they have horizontally differentiated from other firms by providing a unique product or service (location, brand, product attributes, etc.) that some customers particularly value. For example, in the U.S. super-premium ice cream market, Häagen-Dazs focuses on smooth flavors and has a somewhat luxurious image, whereas Ben & Jerry's has a socially-conscious image and focuses on flavors with exotic ingredients and names drawn from popular culture. As a result of the distinct attributes of each ice cream, many consumers strongly prefer one ice cream brand over the other, giving each ice cream maker a measure of market power; yet, some consumers like both ice creams more or less equally.

Stuart (2004) provides a model of horizontally-differentiated rivalry in the context of value-based competition. We use a simplified version of his model here. Specifically, let $\alpha \in [0,1]$ represent the portion of the market with respect to which a given firm has a monopoly by virtue of being the only firm whose product or service is suitable for that buyer; and let $1-\alpha$ represent the portion of the market for which both firms offer suitable products. Thus, α of 0 is the unrestrained competition of our analysis so far and α of 1 is a monopoly firm.[5] Note that α could be probabilistic in the sense that there is only one buyer but the firm does not know *ex ante* when choosing its value creation strategy whether it will have a monopoly position with respect to that buyer.

Second, Proposition 1 only applies to value creation strategies with the same expected value proposition. Yet, it is intuitive that a firm could choose from among a variety of value creation strategies, each with a different expected value proposition and random variability. (The nature of the random variability would also vary, but we will discuss that in the next section.) We know from our analysis so far that of two value creation strategies of the same type and with the same expected value proposition,

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[4] We only consider pure strategies in the non-cooperative stage for simplicity and because considering mixed strategies does not yield additional insight.

[5] α is also similar to Chatain and Zemsky's (2011) "frictions" parameter, which is the probability that a given buyer and firm cannot transact for an unspecified reason; frictions include not only the possibility that some firms do not offer a product or service that is suitable for a particular buyer (like α herein), but also other impediments to trade that may prevent a firm with a suitable product or service from transacting with a given buyer, for example, informational obstacles to effective search.

the more variable strategy is always more profitable. So, we can identify an efficient frontier of possible value creation strategies as defined by the set of strategies that, for a given expected value proposition, have the greatest variability. Given that variability is good and not bad, the expected value proposition must be declining along the frontier as variability increases. We now turn to the question of how a firm should choose a strategy along this frontier.

To analyze this formally, suppose that each firm has a symmetric value creation strategy, which is as described above except for the following two differences: (1) each firm chooses the variability of its value creation strategy by selecting the parameter $x \in [0,V]$; and (2) larger x are associated with a cost of variability in terms of a lower expected value proposition. Thus, a firm's value proposition is $V + x - c(x)$ with probability $1/2$ and $V - x - c(x)$ with probability $1/2$.

To rule out uninteresting cases, assume that $c(x)$ is low enough for x near 0 and large enough for x near V that firms will choose some intermediate level of variability. For simplicity, we will formally assume that $c(x) = \beta x^2$ and that $\beta \geq 3/4V$.[6] A firm's value proposition is then $V + x - \beta x^2$ with probability $1/2$ and $V - x - \beta x^2$ with probability $1/2$.

**** INSERT FIGURE 5 ABOUT HERE ****

The left panel of Figure 5 depicts the strategy space graphically. Bars with lighter shading (low x) have relatively low variability and a relatively high expected value proposition. As x increases, variability increases and the expected value proposition decreases. This means that as the gap between bars of the same shading increases, the location of the midpoint between the two bars moves towards 0. The following proposition characterizes the competitive equilibrium among N firms. Without loss of generality, we index the firms by the x each chooses such that $x_1 \leq x_2 \leq \ldots \leq x_N$:

Proposition 2: ***In the equilibrium of the market where firms are horizontally differentiated and variability is costly,*** $x_1 = 0$ ***and for all*** $i > 1$,

$$x_i = \left(\frac{1}{2\beta}\right)\left(\frac{1-\alpha}{1+\left(2^{N-i+1}-1\right)\alpha}\right).$$

If $\alpha = 1$, $\pi_i = V, \forall i$. ***Otherwise,*** $\pi_1 > \pi_2$. ***If*** $\alpha = 0$, $\pi_1 > \pi_j, \forall j > 1$. ***If*** $\alpha \in (0,1)$, $\pi_k > \pi_{k-1}, \forall k \in [3,N]$, ***and there is an*** N^* ***such that*** $\forall N > N^*$,

---

[6]The lower bound on β ensures that V_f is always nonnegative. At the cost of more complexity, we could also work with the class of $c(x)$ satisfying Inada conditions of the form $c'(x) > 0\,\forall x, c''(x) > 0\,\forall x, c'(0) = 0$, and $c'(V) = \infty$.

$\pi_N > \pi_1$.

Consider any Firm i, where $i > 1$. For proportion $(1-\alpha)$ of buyers, Firm i makes a profit if and only if it enjoys a favorable outcome from its value creation strategy and no Firm j, where $j > i$, also enjoys a favorable outcome from its value creation strategy. The profit function of Firm i is accordingly

$$\pi_i = \alpha\left(V - c\left(x_i\right)\right) + \left(1-\alpha\right)\left(\frac{V + x_i - c\left(x_i\right) - V_{-f}}{2^{N-i+1}}\right) \tag{7}$$

where the term on the left represents the proportion of the market in which Firm i has a horizontal differentiation advantage. Differentiating with respect to x_i and solving for the optimum yields a global maximum as stated in the proposition. Intuitively, Firm i faces a tradeoff. The greater the variability in Firm i's value creation strategy, the more that Firm i trades a larger vertical differentiation advantage in some states of the world for a larger disadvantage in other states of the world. This tradeoff is beneficial to Firm i but comes at a cost of a lower expected value proposition by an amount $c\left(x_i\right)$. Firm N, which has the greatest variability in value creation, benefits the most from variability because a favorable outcome from its value creation strategy always results in a vertical differentiation advantage. The marginal value of variability equals the marginal cost at precisely $x_N = \left(1/2\beta\right)\left(1-\alpha/1+\alpha\right)$. Firm $N-1$, by contrast, earns positive profits if and only if it enjoys a favorable outcome *and* Firm N does not. The marginal benefit of variability for Firm $N-1$ is accordingly lower; it chooses a lower level of variability, $x_{N-1} = \left(1/2\beta\right)\left(1-\alpha/1+3\alpha\right)$. This pattern continues for Firm $N-2$ and so on with the level of variability asymptotically approaching 0 as we move to Firm $N-3$, to Firm $N-4$, and so on.

In contrast, the profit function of Firm 1 is

$$\pi_1 = \alpha\left(V - c\left(x_1\right)\right) + \left(1-\alpha\right)\left(\frac{V + x_1 - c\left(x_1\right) - V_{-f}}{2^N} + \frac{V - x_1 - c\left(x_1\right) - V_{-f}}{2^N}\right) \tag{8}$$

This function is clearly maximized at $x_1 = 0$, i.e., Firm 1 sets variability to zero. The reason is that Firm 1 can only enjoy a vertical differentiation advantage if Firms $2,\ldots,N$ all have unfavorable outcomes from their own value creation strategies. Variability in the value creation strategy of Firm 1 would only serve to lower Firm 1's profits by reducing its expected value proposition by an amount $c\left(x_1\right)$. The implication is that if there is only one firm in the market, $\left(N=1\right)$, then Firm 1 sets variability to zero. If there are two firms, $\left(N=2\right)$, Firm 1 sets variability to zero, whereas Firm 2 (i.e., Firm N), sets a high level of variability. As more and more firms are added to the market, these Firms $N-1, N-2, \ldots$ position themselves closer and closer to Firm 1 with progressively lower levels of variability.

The lower is α, the greater the benefits of variability and thus the larger are all $x_i, i>1$. If $\alpha=0$, all the firms but Firm 1, choose the same maximal level of variability, $x_i = \frac{1}{2\beta}$. If $\alpha=1$, the firms are monopolies, do not benefit from variability, and accordingly set variability to zero. The implications of this for profitability are stated formally in the second part of the proposition. Clearly, if, $\alpha=1$, firms are monopolies and each earns a profit of V. Otherwise, Firm 1 is always more profitable than Firm 2. To see why, we substitute equilibrium values into the profit functions of the two firms:

$$\begin{aligned} \pi_1 &= \alpha V + \frac{(1-\alpha)\left(x_2 + c(x_2)\right)}{2^{N-1}} \\ \pi_2 &= \alpha\left(V - c(x_2)\right) + \frac{(1-\alpha)\left(x_2 - c(x_2)\right)}{2^{N-1}} \end{aligned} \tag{9}$$

Firm 2 benefits from the fundamental asymmetry of randomness but also pays a cost, $c(x_2)$, in the form of a lower expected value proposition. Firm 1 benefits from the variability in Firm 2's value creation strategy, too, but pays no cost; indeed, the cost to Firm 2 actually benefits Firm 1 by increasing Firm 1's differentiation advantage over Firm 2, if Firm 2 has a negative outcome from its value creation strategy (and every other firm does as well); this is reflected in the term on the right of Firm 1's profit function: $x_2 + c(x_2)$. The top panel of Figure 6 depicts an example of the simplest case, where $N=2$. Firm 1's profit advantage is highest for $\alpha=0$, where the firms compete for all customers, and shrinks asymptotically to zero as the firms become fully horizontally differentiated, $\alpha=1$.

**** INSERT FIGURE 6 ABOUT HERE ****

However, the situation changes as the number of firms grows. In general, Firm N's equilibrium profit function can be written as

$$\pi_N = \alpha\left(V - c(x_N)\right) + (1-\alpha)\left(\frac{x_N - c(x_N)}{2} - \sum_{i=2}^{N-1} \frac{x_i - c(x_i)}{2^{N-i+1}}\right) \tag{10}$$

where the term on the right inside the parentheses represents the reduction in Firm N's profit from competition with other firms. Given that, irrespective of N, the equilibrium x_N does not change and that the term on the right inside the parentheses converges to a finite positive number, π_N must converge to some finite positive number *greater than* αV as N increases. Meanwhile, Firm 1's equilibrium profit function from Equation (9) clearly converges to αV as N increases. The implication is that for large enough N, Firm N (as well as, perhaps, Firms $N-1, N-2, \ldots$) makes higher profits than Firm 1, because the high variability in Firm N's value creation strategy makes it less vulnerable to the effects of competition than is Firm 1. Putting it all together, we see that it is most profitable to have very high variability or to have none and the least profitable position is to be "stuck in the middle" with low but non-zero variability. The middle panel of Figure 6 depicts an example with 5 firms. When α is near 0, Firms 2 through 5 crowd around high levels of variability, depressing each other's profits. As α rises, Firm 2 and Firm 3 reduce their variability, creating breathing room for Firm 4 and Firm 5. For α large enough but less than 1, Firm 5 (as well as Firm 4, eventually) is more profitable than Firm 1.

The lower is β, the less costly is variability, so firms pursue more of it, spreading out the x_i. Since variability is good not bad, the larger is β, the lower are all firms' profits, but especially those of Firm 1, which benefits doubly from the variability in the value creation strategy of Firm 2. The bottom panel of Figure 6 illustrates how the profits of Firm 1 and Firm 2 converge as β rises.

2.4 Different Types of Variability

The analysis so far has focused on differences in the level of variability rather than on the nature of that variability. However, not every value creation strategy has the same kind of distribution of outcomes. One value creation strategy may produce a very high value proposition with a small probability or a low value proposition with a great probability (e.g., pursuing a revolutionary technology), while another value creation strategy may produce a modestly high value proposition with a great probability or a very low value proposition with a small probability (e.g., adopting anti-social business practices to economize on cost). The first of these value creation strategies has a distribution with a long positive tail, whereas the second has a distribution with a long negative tail (relative to the mean). How should firms choose from among such possibilities when competing with other firms?

To address this question, we consider a model where firms choose the parameter $p \in \left[\underline{p}, \overline{p} \right]$, where $0 < \underline{p} < \overline{p} = 1 - \underline{p} < 1$, and the resulting value creation strategy produces a value proposition of $V + x/2p$ with probability p and of $V - x/2(1-p) \geq 0$ with probability $1-p$. Thus, the expected value proposition (V) and variability ($S = x$) are the same for all p[7]; as p approaches $\underline{p}$, however, the distribution of value propositions has a longer and longer positive tail; and as p approaches $\overline{p}$, the

[7] The expected value proposition is $p\left(V + x/2p\right) + \left(1-p\right)\left(V - x/2(1-p)\right) = V$, and variability is $p\left|V + x/2p - V\right| + \left(1-p\right)\left|V - x/2(1-p) - V\right| = x$.

distribution has a longer and longer negative tail.

This is depicted graphically in the right panel of Figure 5. Darker-shaded bars are associated with higher values of p. For $p = \frac{1}{2}$, the value creation strategy is symmetric, so there are two bars of intermediate shading, one above V and one below V, each equidistant from it. For high p, there is a large darkly-shaded bar just above V, and a small darkly-shaded bar near the origin. For low p, there is a large lightly-shaded bar just below V, and a small lightly-shaded bar far above V. The following proposition characterizes the competitive equilibrium among $N > 1$ firms.[8] Without loss of generality, we index the firms by the p each chooses such that $p_1 \leq p_2 \leq \ldots \leq p_N$:

Proposition 3: ***In the equilibrium of the market where firms choose from among value creation strategies of common expectation and variability,*** $p_N = \overline{p}$ ***and for all*** $i < N$, $p_i = \underline{p}$***. If*** $N = 2$, $\pi_1 = \pi_2$***. Otherwise,*** $\pi_N > \pi_i, \forall i < N$.

In general, a firm's profit increases by choosing a value creation strategy that puts more weight on value proposition outcomes that are more likely to exceed the highest value proposition of competing firms (V_{-f}). The implication is that the profit function of Firm 1 is increasing as $p_1 \to \underline{p}$, because Firm 1's value proposition is always higher than V_{-f} whenever Firm 1 receives a favorable outcome from its value creation strategy. For any i greater than 1 but less than N, Firm i earns a positive profit if and only if no other Firm $j < i$ receives a favorable outcome from its value creation strategy. Thus, π_i is also increasing as $p_i \to p_{i-1}$. Applying this same argument to Firm N implies, conversely, that π_N is increasing as $p_N \to \overline{p}$, since this value creation strategy puts the greatest weight on the one possible outcome where Firm N makes positive profits, i.e., where it has a favorable outcome and no other firm does. Taken together, these arguments imply that every firm will either choose $\underline{p}$ or $\overline{p}$, that at least one firm will choose $\underline{p}$, and that at least one firm will choose $\overline{p}$.

Suppose, then, that Z firms choose $\overline{p}$, where Z is an integer greater than or equal to 1 and less than N, and that $N - Z - 1$ firms choose $\underline{p}$. Consider the profit function of the one remaining Firm i:

$$\pi_i = p_i \left(1 - \underline{p}\right)^{N-Z-1} \left(\left(1 - \overline{p}\right)^Z \left(\frac{x}{2p_i} + \frac{x}{2\left(1 - \underline{p}\right)} \right) + \left(1 - \left(1 - \overline{p}\right)^Z\right) \left(\frac{x}{2p_i} - \frac{x}{2\overline{p}} \right) \right) \tag{11}$$

Differentiating yields

[8] If there is only one firm, the choice of p does not matter.

$$\frac{\partial \pi_i}{\partial p_i} = \frac{x\left(1-\underline{p}\right)^{N-Z-1}}{2}\left(\left(1-\overline{p}\right)^{Z}\left(\frac{1}{1-\underline{p}}+\frac{1}{\overline{p}}\right)-\frac{1}{\overline{p}}\right) \tag{12}$$

The term in the parentheses on the right is clearly decreasing in Z. Setting $Z=1$ (its lowest possible value) and simplifying that term yields $-\left(1-\underline{p}\right)^{-1}\left(\overline{p}-\underline{p}\right)<0$. It follows that π_i is decreasing in p_i and thus that the only equilibrium is for Firms $1,\ldots,N-1$ to choose $\underline{p}$ and for Firm N to choose $\overline{p}$.

Turning to profitability, we have that if $N=2$, the equilibrium profits of Firm 1 are

$$\begin{aligned}\pi_1 &= \underline{p}\overline{p}\left(\frac{x}{2\underline{p}}-\frac{x}{2\overline{p}}\right)+\underline{p}\left(1-\overline{p}\right)\left(\frac{x}{2\underline{p}}+\frac{x}{2\left(1-\overline{p}\right)}\right)+\left(1-\underline{p}\right)\left(1-\overline{p}\right)\left(\frac{x}{2\left(1-\underline{p}\right)}+\frac{x}{2\left(1-\overline{p}\right)}\right)\\ &= \frac{x}{2}\left(1-\underline{p}+\overline{p}\right)\end{aligned} \tag{13}$$

while the equilibrium profits of Firm 2 are

$$\pi_1 = \left(1-\underline{p}\right)\overline{p}\left(\frac{x}{2\overline{p}}+\frac{x}{2\left(1-\underline{p}\right)}\right)=\frac{x}{2}\left(1-\underline{p}+\overline{p}\right) \tag{14}$$

Thus, profits are equal. For any $N>2$, the equilibrium profits of any Firm $i<N$ are

$$\pi_i = \underline{p}\left(1-\underline{p}\right)^{N-2}\left(\left(1-\overline{p}\right)\left(\frac{x}{2\underline{p}}+\frac{x}{2\left(1-\underline{p}\right)}\right)+\overline{p}\left(\frac{x}{2\underline{p}}-\frac{x}{2\overline{p}}\right)\right)=\frac{x}{2}\underline{p}\left(1-\underline{p}\right)^{N-2}\left(\frac{1}{\underline{p}}+\frac{1-\overline{p}}{1-\underline{p}}-1\right) \tag{15}$$

The equilibrium profits of Firm N are

$$\pi_N = \left(1-\underline{p}\right)^{N-1}\overline{p}\left(\frac{x}{2\overline{p}}+\frac{x}{2\left(1-\underline{p}\right)}\right)=\frac{x}{2}\left(1-\underline{p}\right)^{N-1}\overline{p}\left(\frac{1}{\underline{p}}+\frac{1}{1-\underline{p}}\right) \tag{16}$$

We then have that Firm N is the most profitable:

$$\pi_N-\pi_i = \frac{x}{2}\left(1-\underline{p}\right)^{N-2}\left(\left(1-\underline{p}+\overline{p}\right)-\left(1+\frac{\underline{p}\left(1-\overline{p}\right)}{1-\underline{p}}-\underline{p}\right)\right)=\frac{x}{2}\left(1-\underline{p}\right)^{N-3}\left(\overline{p}-\underline{p}\right)>0 \tag{17}$$

In other words, one firm courts the largest disaster possible, i.e., picks the value creation strategy with the most extreme negative tail, whereas every other firm tries to hit the biggest home run possible, i.e., picks the value creation strategy with the most extreme positive tail. The intuition for this result relates to the way that randomness in value creation creates the opportunity for vertical differentiation.

Because of the fundamental asymmetry of randomness, it is always profitable for a firm to trade the possibility of a value proposition below that of a competing firm for an equivalent possibility (in probability-weighted terms) of a value proposition above that of every competing firm. Value creation strategies with long tails benefit most from this asymmetry because they have extreme outcomes that are almost certainly far below or far above whatever outcome arises from the competing firms' value creation strategies. When there are only two firms, each firm makes the same level of profits. Firm 1 always makes a profit if it has a favorable outcome from its value creation strategy, and this profit is especially large on the rare occasion when Firm 2 receives a very low outcome from its value creation strategy. On the more common occasions when Firm 1 does not receive a favorable outcome from its value creation strategy, Firm 2 usually enjoys modest profits, except on those rare occasions when Firm 2 also does not receive a favorable outcome, in which case Firm 1 makes a profit.

With more than two firms, the symmetry breaks down, because there is no room for more than one firm to court disaster; they would drive each other's profits to zero most of the time. Thus, with more than two firms, only one firm courts disaster (chooses $\overline{p}$) and the other $N-1$ firms try to hit a home run (choose $\underline{p}$); yet, these latter firms still get in each other's way by preventing each other from benefiting from the long negative tail in the value creation strategy of Firm N, i.e., even if Firm N receives the very low unfavorable outcome from its value creation strategy, $\left(V - x/2(1-\overline{p})\right)$, every other firm generates an outcome no worse than $\left(V - x/2(1-\underline{p})\right)$, which is much higher. Thus, although competition adversely affects all firms, Firm N is affected much less. As N grows ever larger, the profits of both Firm N and every other Firm $i<N$ decline asymptotically to zero, but the profits of Firm N are always higher than those of every other Firm $i<N$ by the same proportion. The top panel of Figure 7 presents an example.

**** INSERT FIGURE 7 ABOUT HERE ****

Our equilibrium has the feature that firms differentiate from each other in probability space, akin to a model of spatial competition (e.g., D'Aspremont et al. 1979, Mussa and Rosen 1978), where firms differentiate in physical or product space. One might then expect that profits would be increasing in the difference between the maximum and minimum p, which we denote by $\Delta p = \overline{p} - \underline{p}$. The bottom panel of Figure 7 illustrates how firm profitability increases as Δp grows for a particular example.

3. Concluding Remarks

This paper has used the formal value-based approach to explore how randomness and variability affect profitability. The main results are as follows: (1) *Ceteris paribus*, random variability is good, not bad, in strategic interaction, counter to everyday intuition and the perspective of some other areas of the social sciences (e.g., financial economics). The more the environment gives rise to variability in a firm's value creation strategy, the greater are the firm's profits, and this variability also benefits the firm's competitors. The reason is that the value propositions of competing firms limit the negative impact on profits of unfavorable outcomes from the focal firm's own value creation strategy. This is the fundamental asymmetry of randomness. (2) Given the fundamental asymmetry of randomness, an efficient frontier can be constructed from a firm's various value creation strategies: Holding the expected value proposition (and the type of variability) constant, more variable value creation strategies are always preferred. The efficient frontier therefore comprises a tradeoff of higher variability for lower expected value creation. (3) In equilibrium, firms will align themselves along the efficient frontier as follows: one firm will pursue no variability at all in its value creation strategy; the second firm, if there is one, will pursue a high level of variability; as more and more firms are added to the market, they will pursue less and less variability. Zero variability is the most profitable position along the frontier if firms are relatively undifferentiated horizontally, because, in that case, all the other firms will pursue a high level of variability, reducing each other's profits by producing high, competing value propositions. Zero variability is also the most profitable position if there are only a small number of competing firms, because the firm without variability benefits from the random variability in other firms' value creation strategies without incurring the cost of that variability. However, firms with a high level of variability are more insulated against competition because their value propositions are so high when they receive a favorable outcome. In fact, profitability is increasing in variability for every firm except the firm with zero variability, and firms with high levels of variability may be more profitable than the firm with zero variability if there are many competing firms. The implication is that the most profitable firm has either the most or the least variability, and the least profitable firms are those 'stuck in the middle' with low but positive levels of variability. (4) *Ceteris paribus*, firms will tend to differentiate the type of variability in their value creation strategies, with most trying to hit a home run (a small chance of a very high outcome and a large chance of a modestly low outcome) and one courting disaster (a small chance of a very low outcome and a large chance of a modestly high outcome). Remarkably, this latter firm is strictly more profitable if there are more than two competing firms.

These results provide guidance for empirical research. The general value of variability suggests that industries with more sources of variability should be more profitable (conditional on entry and other moderating factors). The lower the level of horizontal differentiation among firms in an industry, the greater the variability in firm profitability we should observe, because firms will have greater incentive to pursue random variability in their value creation strategies. We should also observe a U-shaped relationship between a firm's average profitability and the variability of the firm's value proposition, reflecting the perils of being stuck in the middle in the probability space. Likewise, firms whose value creation strategies have asymmetric outcomes, either positive or negative, should generally be more profitable than firms whose value creation strategies have more symmetric outcomes.

For practice and pedagogy, the implications of the analysis are at once both simpler and more complex. They are more complex because any real-world firm faces a far more complex situation in developing its value creation strategy than depicted in our highly-stylized models. They are simpler because they can be distilled into a straightforward admonition: managers need to stop regarding risk as uniformly bad and begin to see it as a tool in strategic interaction. Makadok and Barney (2001: 1622) state, “By definition, there is nothing that a firm can do to alter its luck….” Yet, there is much a firm can do to alter its exposure to luck. Managers and those who teach them should consider questions such as these: How can we increase the variability of our value creation strategy without impairing our expected value proposition? What value creation strategies do we expect our competitors to adopt? How can we occupy the most profitable positions in the probability space before competitors?

A number of connections with strategic management theory are worth highlighting. A tenet of the resource-based view is that economic profits are impossible (Barney 1986, Peteraf 1993) without ‘luck’, superior strategic insight into the value of resources, or a barrier to entry in strategic factor markets. Although recent theoretical work has suggested this view may be too pessimistic in light of idiosyncratic knowledge and capabilities (Denrell et al. 2003), pre-existing resource heterogeneity (Adegbesan 2009), and the role of frictions like evaluation costs in strategic factor markets (Ross 2011), there is reason to believe that if resources that generate high random variability in value creation do indeed create greater scope for profit, those resources should carry a higher price in strategic factor markets. This proposition is testable. We also note that any extra costs of acquiring the resources for a value creation strategy with high variability would implicitly be reflected in the cost, $c(x)$. More generally, typologies of profit-generating mechanisms (e.g., Makadok, 2010, 2011) should include the role of random variability as either a mechanism itself or an important contingency.

Much empirical research has been devoted to explaining the ‘Bowman Paradox’, i.e., the cross-sectional negative correlation between the second moment (e.g., variance) and mean of profitability (Bowman 1980), which seems to contradict the relationship predicted by financial economics. Candidate explanations can be classified into three broad categories: decision-making in the face of risk, the quality of strategic conduct, and statistical artifacts (Andersen et al. 2007). In this paper’s model, the Bowman Paradox is a natural consequence of the relationship between the value of variability and market power. Where firms have a great deal of market power, either due to barriers to entry or horizontal differentiation, variability has less value, so firms pursue little of it in their value creation strategies and enjoy high profits. Where competition is more intense, at least some firms pursue a fairly high level of variability in value creation, which increases the variance of all firms’ profits in the industry, even those that pursue low or no variability. In this case, firm profits are lower (due to competition) and exhibit higher variance.

As noted at the outset, this analysis could be productively extended and generalized in a number of directions. Clearly, firms choose from a much richer set of value creation strategies than those depicted in the paper's highly stylized models. Future work in this vein could consider the interactions among the first, second, third, and fourth moments of the distribution of value proposition outcomes. While this and similar lines of inquiry could well produce new insights, they might require non-analytic solutions as well, suggesting a different modeling methodology.

Another potential avenue for future work relates to the rich literature on the behavioral antecedents of managerial risk tasking. One important antecedent that the paper has not formally treated is managerial risk-aversion, but that could easily be incorporated as part of the cost of variability, $c(x)$, and thus would not qualitatively change the paper's results. Another issue is the optimistic propensity of entrepreneurs, which has been shown to influence the optimal venture capital investment contract (Dushnitsky 2010) and could well influence equilibrium behavior in the model herein.

Dynamic aspects of competition would also be interesting to consider. A favorable outcome from a random value creation strategy may not only confer a long-lasting first-mover advantage but also reveal information of benefit to rivals (Lieberman and Montgomery 1988), making the sort of causal ambiguity that specifically impairs imitation (Ryall 2009) an important contingency. Likewise, a firm's initial technological position vis-à-vis those of competitors may influence a firm's incentive to adopt a technology strategy with variable outcomes (Anderson and Cabral 2007, Cabral 2003,), raising the question of whether a firm's relative technological position may also have implications for the type of variability in value creation the firm should pursue. An open innovation strategy may allow a firm to discover value creation possibilities that it could not have envisioned on its own (Almirall and Casadesus-Masanell 2010) but may also reduce variability by moving the firm's value creation strategy closer to an industry average trajectory. The variability of a firm's value creation strategy may be increasing in the speed with which the firm makes the investments required for implementation and thereby forgoes the opportunity to make adjustments as more information becomes available; this may have implications for the tradeoffs associated with time compression diseconomies (Pacheco-de-Almeida et al. 2008). These and other avenues of inquiry are left for future research.

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FIGURE 1
Value-Based Competition

Monopoly	Firm 1 with Vertical Differentiation Advantage	Neither Firm with Vertical Differentiation Advantage

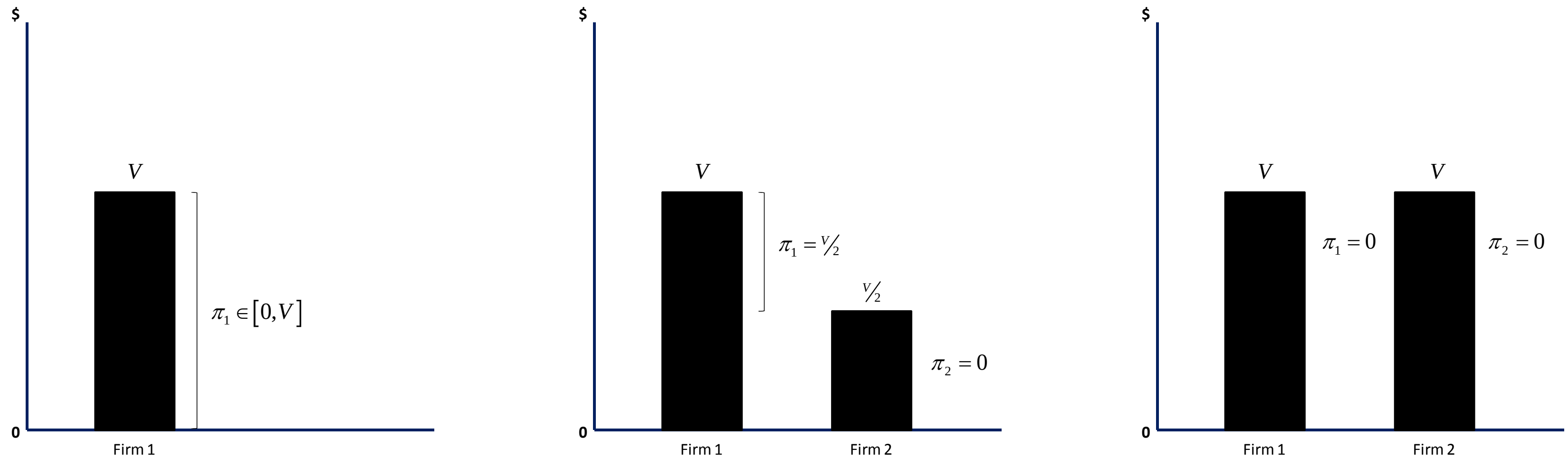


FIGURE 2
Value-Based Competition: Firm 1 Has Random Value Creation Strategy

Firm 1 Has Favorable Outcome	**Firm 1 Has Unfavorable Outcome**

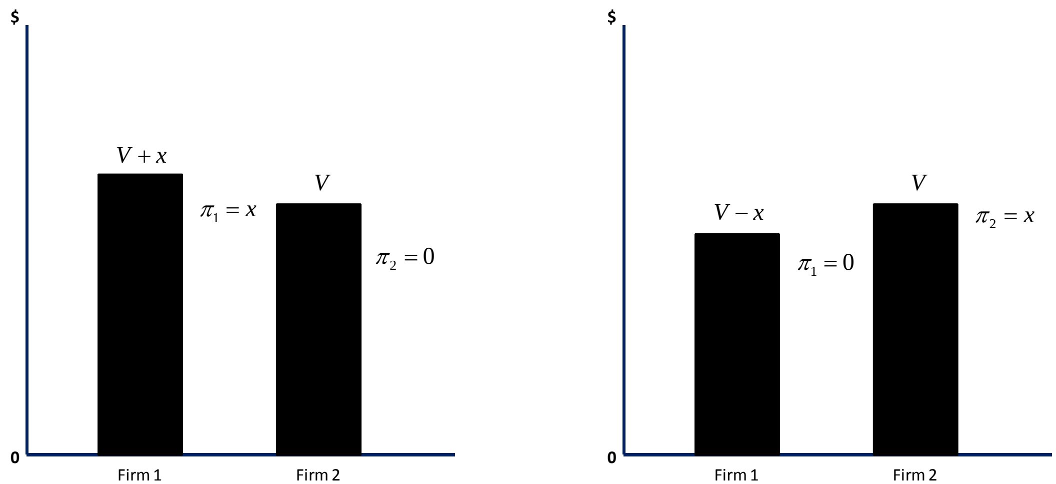


FIGURE 3
Value-Based Competition: Both Firms Have Random Value Creation Strategies

	Firm 1 Has Favorable Outcome	Firm 1 Has Unfavorable Outcome
Firm 2 Has Unfavorable Outcome		
Firm 2 Has Favorable Outcome		

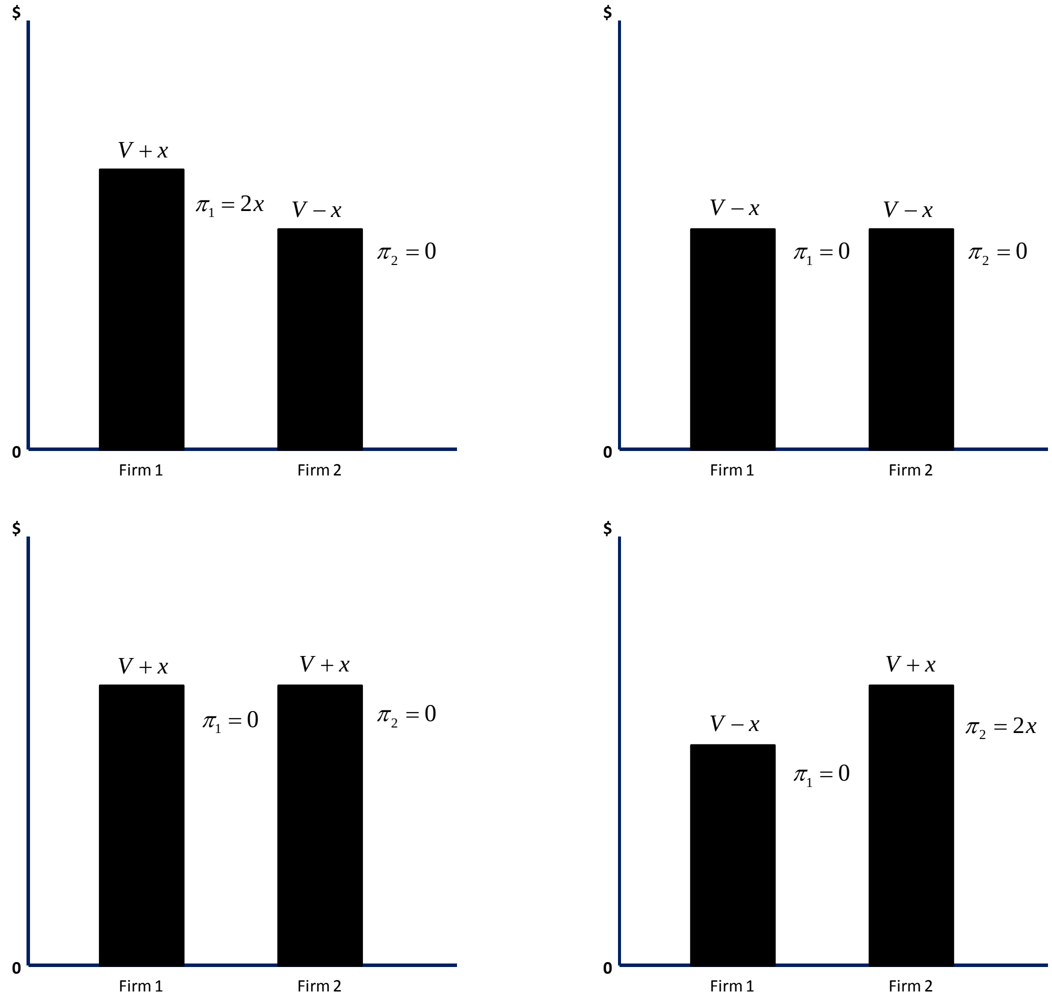


FIGURE 4
Elementary Increases in Risk

Symmetric Value Creation Strategy	Home Run Value Creation Strategy

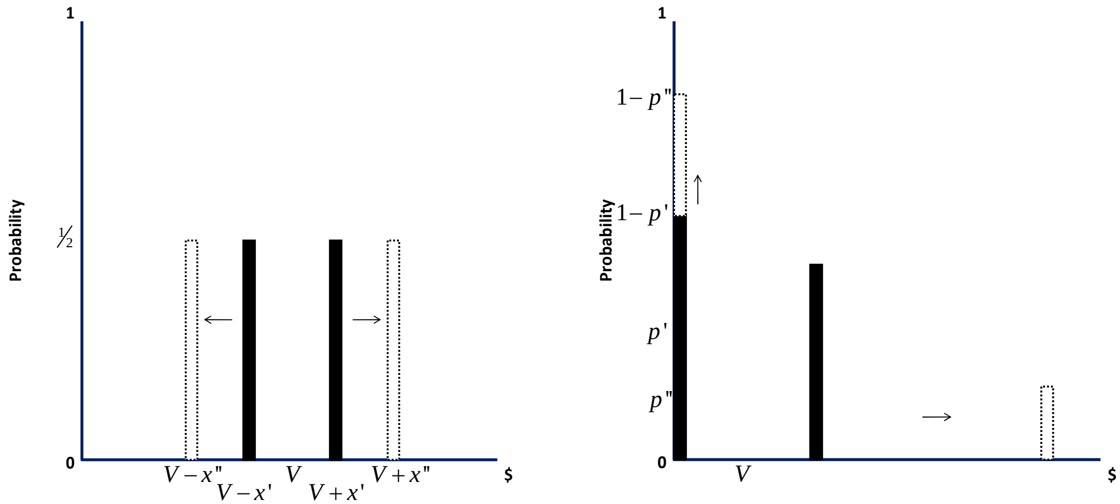
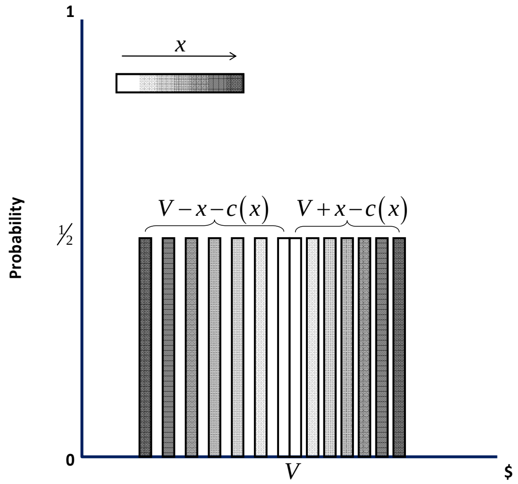


FIGURE 5
Selecting the Level and Type of Variability in Value Creation

Costly Variability



Constant Variability & Mean of Value Creation

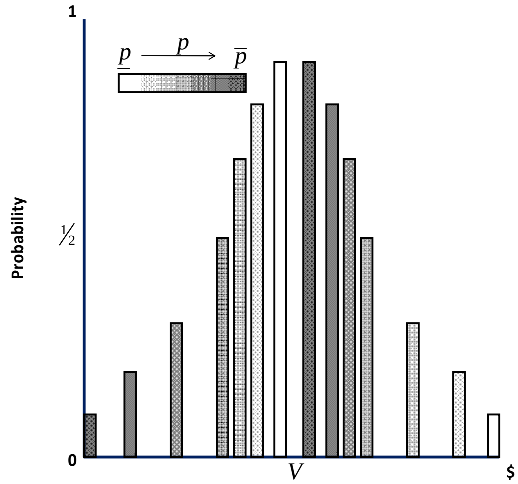
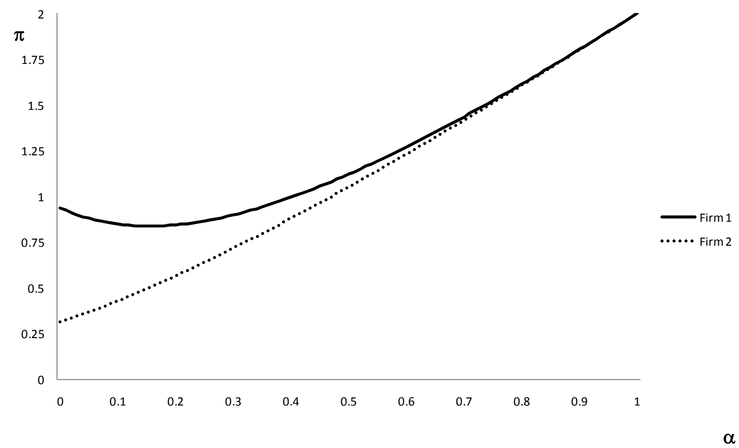
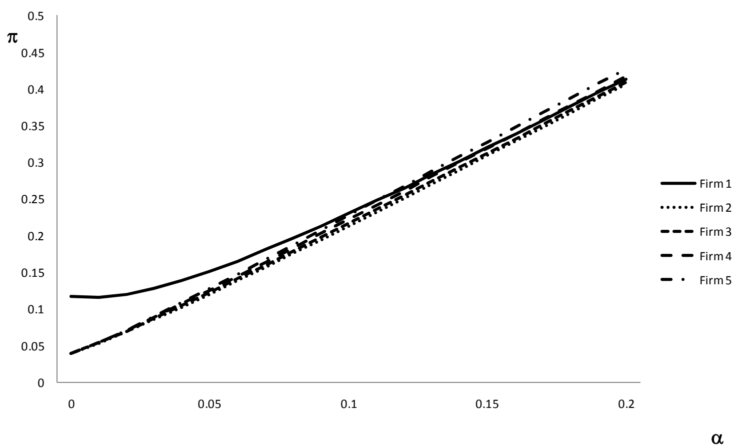


FIGURE 6
Costly Variability with Horizontal Differentiation

Firm π as α Varies
$V = 2, N = 2, \beta = 0.4$



Firm π as α Varies
$V = 2, N = 5, \beta = 0.4$



Firm π as β Varies
$V = 2, N = 2, \alpha = 0.15$

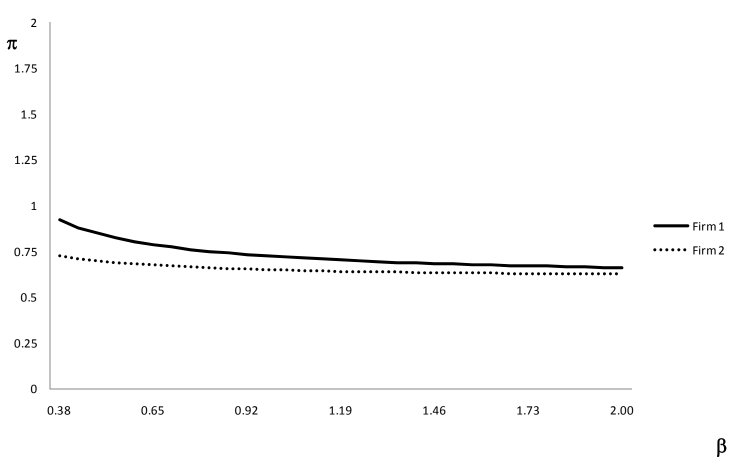
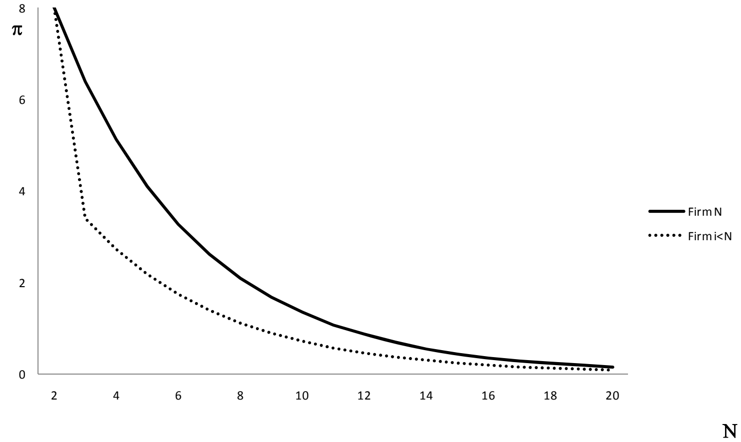


FIGURE 7
Different Types of Variability

Firm π as N Varies
$\mathbf{V = 100, x = 10, \overline{p} = 0.8, \underline{p} = 0.2}$



Firm π as Δp Varies
$\mathbf{V = 100, x = 10, N = 5}$