Taking a Chance:

How Firms Differentiate in Risk

David Gaddis Ross
Columbia Business School
Columbia University
Uris Hall 726
New York, NY 10027
212-854-5606
dr2175@columbia.edu

First draft: February 2010
This draft: April 2012

Taking a Chance:
How Firms Differentiate in Risk

This paper provides a formal analysis of the interrelationships among risk in the development of a firm’s value proposition and the fundamental profit-generating mechanisms of competitive advantage and rivalry restraint. Building on the insight from strategy theory that risk may be a good not a bad in value creation, the paper shows that (a) the tradeoff between risk and expected value creation and (b) the shape of risk each define a different and previously unexplored dimension of differentiation along which firms choose distinctive competitive positions. The analysis also shows how two known drivers of rivalry restraint – the number of competing firms and their product market overlap – affect where firms position themselves and which firms are more profitable than others. The results have a number of implications for theoretical and empirical research in strategy.

Understanding the causal mechanisms underlying firm profitability is a central concern of the strategic management field. Although the field has historically studied these mechanisms in isolation, some important interactions have been identified. For instance, the pursuit of competitive advantage may conflict with rivalry restraint due to potential contradictions in the choice of activities (Porter, 1998) and because rivalry restraint is less valuable for firms with a competitive advantage (Chatain & Zemsky 2011; Makadok, 2010). Likewise, having a competitive advantage in complementary resources has implications for commitment timing (Narasimhan & Zhang, 2000; Teece, 1986), itself another causal mechanism for generating profit. Other work demonstrates that resource picking ability complements good governance (Makadok, 2003) and the ability to develop existing resources (Makadok, 2001, 2002) and that rent appropriation is jointly affected by (a) information asymmetry over what human assets and capabilities generate rent and (b) the degree to which firms are rivals for the same customers and employees (Coff 1997, 2010). Despite these important contributions, however, the interrelationships among the causal mechanisms for generating profit remain largely unexplored, leading to calls for more research on this topic (Makadok, 2011).

This paper responds to this call by providing a formal game-theoretic analysis of how the causal mechanisms of competitive advantage and rivalry restraint are inextricably intertwined with another fundamental mechanism for generating profit, the risk inherent in the development of a firm's value proposition for consumers. The analysis reveals two previously unexplored dimensions along which firms differentiate from each other – akin to the horizontal and vertical dimensions of differentiation from the literature on competitive positioning (e.g, D'Aspremont, Gabszewicz, & Thisse, 1979; Hotelling, 1929; Mussa & Rosen, 1978) – as well as the contingencies determining which competitive positions are most profitable.

Our starting point is the insight from strategy theory that risk in the development of a firm's value proposition for consumers (its *value creation strategy*) is frequently a good not a bad, unlike in many contexts where risk would be perceived as undesirable (e.g., personal investing) (Lippman & Rumelt, 1982).[1] The intuition is that risk creates scope for favorable and unfavorable realizations with respect to an average future outcome, and a firm may be able to capture the benefits from favorable realizations while mitigating the losses from unfavorable realizations. For example, shareholders increase the value of their equity by pursuing projects with riskier future cash flows, because the full benefits of favorable realizations accrue to equity, whereas the losses from unfavorable realizations are shared with debtholders (John & John, 1993; Stiglitz & Weiss, 1981). A similar asymmetry arises when investing in new projects. If a firm waits until the risk associated with a project is resolved favorably before making a follow-on commitment, the firm may capture the profits from the upside while mitigating the losses from the downside (Bowman & Hurry, 1993; Dixit & Pindyck 1994); specific contexts studied in the literature include entrepreneurship (McGrath, 1999), research and development (Chan, Nickerson, & Owan, 2007; Kogut & Kulatilaka, 2004), and multinational management (Kogut & Kulatilaka, 1994).

In the context of strategic interaction specifically, the asymmetry arises because competition for a given consumer has a winner-takes-it-all quality. If a firm is able to generate a greater value proposition than its rival for that consumer, the firm should have a competitive advantage and capture as profit a reasonable portion of the difference between its value proposition and that of its rival according to standard theories of market interaction like Bertrand competition and the value-based approach (Brandenburger & Stuart, 1996). Conversely, if a firm does not generate the greatest value proposition for that consumer, the firm simply fails to make the sale but suffers no additional penalty for having a particularly low value proposition. To see

[1] Lippman & Rumelt (1982) use the term *uncertainty* to denote variation about a future "average" outcome. This usage is analogous to our use of *risk* herein.

the implications of this, imagine two firms with equivalent value propositions that are competing for the same consumers. Without collusion on price, which is illegal in many markets, the two firms would be trapped in low-profit Bertrand-like competition. Suppose, instead, that one of the firms has a risky value creation strategy with the same expected value proposition as that of the rival, i.e., suppose the firm might end up with a higher value proposition than the rival firm or a lower value proposition than the rival firm even though the "average" value proposition of the two firms is the same. If the focal firm enjoys a favorable realization from its value creation strategy (e.g., its product is a hit), that firm will have a competitive advantage; if the focal firm has an unfavorable realization (e.g., its product is a failure), the rival will have a competitive advantage. By creating the opportunity for both the focal firm and its rival to have a competitive advantage in a different state of the world, the focal firm's risky value creation strategy has restrained the two firms' rivalry, allowing each firm to make a profit in *expectation*.

It follows that more risk in value creation is better, but this basic prescription leaves a number of questions answered. One question relates to boundary conditions, which have recently received scholarly attention. For example, where the payoff from a successful new product is convex-concave, more risk in certain aspects of the development process may not increase profit (Huchzermeier & Loch, 2001; Santiago & Vakili 2005). Likewise, greater risk in final product demand may not increase a firm's profits, because it not only increases the value of a firm's competitive advantage but also makes entry by a rival more likely (Kulatilaka & Perotti, 1998). Other authors have pointed out that managing investment opportunities across time may give rise to a more complex process of experimentation than is implied by the discrete choice sets typically considered in the analysis of risk in strategic investment (Adner & Levinthal 2004a, 2004b). This paper is similar in spirit but different in approach. Specifically, we consider a setting where, *ceteris paribus*, more risk *is* unambiguously better to focus on two related questions that the literature has not addressed: (a) What is the value of risk in value creation, i.e., how much should a firm sacrifice in terms of mean value creation for more risk? (b) Is risk itself, i.e., variation about the mean, all that matters or does the shape of the risk matter, for example, the skewness of possible outcomes? We address each question using a different formal model.[2]

The first model considers situations like the following. Suppose a firm is considering two value creation strategies with very different levels of risk. For example, a firm may have the opportunity to boldly reposition its flagship product, as Coca-Cola did unsuccessfully with New Coke and Asahi did successfully with its dry beer in the 1980s; these are high-risk strategies. Conversely, the firm could maintain its flagship product in its current form, which is a low-risk strategy. While extant theory tells us that a firm should opt for the riskier strategy if it has the *same* expected value proposition as that of the less risky strategy, we do not know which strategy the firm should choose if the riskier strategy has a *lower* expected value proposition. The theory developed in this paper shows that, in competition among firms, each firm will answer this question in a different way. In fact, the tradeoff between expectation and risk defines a dimension of differentiation. Rational, profit-maximizing firms will choose different positions along this dimension, with some firms adopting value creation strategies with high risk but a low expectation and other firms adopting value creation strategies with low risk but a high expectation. Two other drivers of rivalry restraint – the number of competing firms and their market overlap – play a key role in determining how firms arrange themselves along this dimension and which firms are more profitable. Intriguingly, the most profitable positions are those representing either very high risk or none, whereas the least profitable positions are those "stuck in the middle" (Porter 1998) with only a modest level of risk.

The second model holds the expected value proposition and risk fixed to address the

[2] Using separate models allows for analytic solutions, which in turn allows for greater expositional clarity.

shape of risk, that is, whether a firm should choose a strategy with symmetric or asymmetric outcomes. For instance, a highly speculative new technology may have a small probability of becoming a blockbuster and a large probability of failing altogether, leaving the firm with only its old technology; this is a value creation strategy with a long positive tail. Conversely, a firm may cut corners in regulatory compliance or product safety to improve the firm's value proposition in most states of the world, while risking a small probability of a disastrous outcome if there is reputational damage; this is a value creation strategy with a long negative tail. Again, we find that firms will not make the same choice; rather, the shape of risk defines another dimension of differentiation along which firms tend to move apart from each other. Specifically, every firm but one will choose a strategy with a long positive tail, whereas one and only one firm will choose a strategy with a long negative tail. Somewhat remarkably, the lone firm whose strategy has a long negative tail is always the most profitable if there are more than two firms.

The paper proceeds as follows. The next two sections each present a formal model, the first on the tradeoff between expectation and risk in value creation, and the second on the shape of risk. The final section considers implications for research and concludes.

MODEL 1: RISK VERSUS EXPECTATION IN VALUE CREATION

This paper uses a simple and intuitive model of how competitive advantage translates into profitability with intellectual roots in Bertrand competition and cooperative game theory (Aumann, 1985). Let there be $N > 0$ firms indexed by i. We denote Firm i's value proposition by V_i and define it as the difference between consumers' willingness to pay for Firm i's product and the firm's cost to produce it. We denote the maximum value proposition of every firm except Firm i as V_{-i}. Just as in Bertrand competition, each consumer purchases from the firm with the greatest value proposition (from that consumer's point of view) and pays a price equal to the difference between that firm's value proposition and the next greatest value proposition.[3]

N, the number of competing firms, is one important driver of rivalry restraint, with a smaller number representing greater restraint. Product differentiation is another classic strategy to restrain rivalry and reduce competitive pressure. Firms differentiate in the product market by providing a unique product or service (location, brand, product attributes, etc.) that some consumers 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, so for these consumers, the two firms' products have overlapping markets.

Our approach for capturing such market overlap is similar to the models of Stuart (2004) and Chatain and Zemsky (2011). Specifically, let $\alpha \in [0,1]$ represent the portion of consumers with respect to which a given firm has a monopoly by virtue of being the only firm whose product or service is suitable for those consumers; and let $1-\alpha$ represent the overlapping portion of consumers for whom the firms must compete. Thus, α of 0 is unrestrained competition and α of 1 is a monopoly firm. Note that α could be interpreted probabilistically in the sense that there is only one consumer 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 consumer.

We define risk in value creation as the probability-weighted sum of the absolute

[3] In the value-based framework, this is equivalent to assuming that firms capture all of their added value, as in the model of Adner and Zemsky (2006).

deviations about the expected value proposition.[4] We know from strategy theory that of two value creation strategies of the same shape and with the same expected value proposition, the riskier strategy is more profitable. We also know that of two value creation strategies of the same shape and risk, the strategy with the higher expected value proposition is more profitable. These two criteria establish an efficient frontier of possible value creation strategies along which the expected value proposition declines as risk increases. This is depicted in Figure 1. The vertical axis represents expected value creation, and the horizontal axis represents risk. Possible strategies are represented by dots. Efficient strategies are on the frontier, whereas all strategies inside the frontier are dominated.

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

We now turn to the question of how firms choose strategies along this frontier. Formally, we assume that each firm chooses a value creation strategy by selecting a parameter $x > 0$ such that the firm's value proposition will be $V + x - \beta x^2$ with probability $\frac{1}{2}$ (favorable realization) and $V - x - \beta x^2$ with probability $\frac{1}{2}$ (unfavorable realization), where $\beta \geq \frac{3}{4V}$.[5] βx^2 is a cost of risk that increases with x, reflecting the tradeoff along the efficient frontier between expectation and risk in value creation. Thus, the expected value creation of a strategy is $V - \beta x^2$, which declines with x, and the risk is

$$\tfrac{1}{2}\left|V + x - \beta x^2 - \left(V - \beta x^2\right)\right| + \tfrac{1}{2}\left|V - x - \beta x^2 - \left(V - \beta x^2\right)\right| = x \qquad (1)$$

which increases with x. (The distribution of possible value propositions is symmetric. We consider asymmetric distributions in Model 2 below.)

The left panel of Figure 2 provides an alternative depiction of the strategy space. Bars

[4] We do not use the sum of squared deviations (as in linear regression or the variance of a distribution), because a firm's profit grows linearly in the positive difference between its value proposition and that of its rival, not at a quadratic rate as implied by the sum of squared deviations.

[5] The lower bound on β ensures that a firm's value proposition is always nonnegative in equilibrium.

with lighter shading (low x) have relatively low risk and a relatively high expected value proposition. As x increases, risk increases and the expected value proposition decreases. So, as the gap between bars of the same shading increases, the location of the midpoint between the two bars moves towards 0.

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

Without loss of generality, we order the N firms from lowest to highest according to the risk in their value creations strategies such that $x_1 \le x_2 \le \ldots \le x_N$. We now identify the competitive Nash equilibrium where each Firm i chooses its competitive position $\left(x_i\right)$ to maximize profits, taking the competitive positions of other firms as given.

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

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

where the term on the left represents the portion of consumers for whom Firm i has a monopoly by dint of being the only firm to provide a suitable product. Differentiating with respect to x_i yields a global maximum of

$$x_i = \left(\frac{1}{2\beta}\right)\left(\frac{1-\alpha}{1+\left(2^{N-i+1}-1\right)\alpha}\right) \tag{3}$$

Intuitively, Firm i faces a tradeoff. The greater the risk in Firm i's value creation strategy, the more that Firm i trades a larger competitive 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 βx_i^2. Firm N, which has the greatest risk in value creation, benefits the most from risk because a favorable realization from its value creation strategy always results in a competitive advantage. The marginal value of risk equals the marginal cost at precisely $x_N = \left(\frac{1}{2\beta} \right) \left(\frac{1-\alpha}{1+\alpha} \right)$. Firm $N-1$, by contrast, earns positive profits if and only if it enjoys a favorable realization *and* Firm N does not. The marginal value of risk for Firm $N-1$ is accordingly lower, so it chooses a lower level of risk, $x_{N-1} = \left(\frac{1}{2\beta} \right) \left(\frac{1-\alpha}{1+3\alpha} \right)$. This pattern continues for Firm $N-2$ with the level of risk 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

$$\pi_1 = \alpha \left(V - \beta x_1^2 \right) + (1-\alpha) \left(\frac{V + x_1 - \beta x_1^2 - V_{-1}}{2^N} + \frac{V - x_1 - \beta x_1^2 - V_{-1}}{2^N} \right) \quad (4)$$

This function is clearly maximized at $x_1 = 0$, i.e., Firm 1 sets risk to zero. The reason is that Firm 1 only enjoys a competitive advantage if Firms $2, \ldots, N$ all have unfavorable realizations from their own value creation strategies. Risk 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 βx_1^2. The implication is that if there is only one firm in the market, $(N = 1)$, then Firm 1 sets risk to zero. If there are two firms, $(N = 2)$, Firm 1 sets risk to zero, whereas Firm 2 (i.e., Firm N), sets a high level of risk. 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 risk along the efficient frontier. See Figure 1.

Proposition 1: Firms differentiate from each other along the efficient frontier defined by the tradeoff between risk and expected value creation. Firm 1 *has no risk in its value* *creation strategy. Firm N (if there is more than one firm) has a very high level of risk. Firms $N-1, N-2$, etc. choose progressively lower levels of risk.*

The more that markets overlap (lower is α), the greater the benefits of risk 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 risk, $x_i = 1/2\beta$. If $\alpha=1$, the firms are monopolies serving distinct market niches, do not benefit from risk, and accordingly set risk to zero.

Proposition 2: Market overlap (α) moderates how firms differentiate from each other along the efficient frontier defined by the tradeoff between risk and expected value creation. The more markets overlap, the greater the risk in the value creation strategies of every firm (but Firm 1).

The implications of this for profitability are as follows. 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 rewrite the equilibrium profit functions of the two firms as follows:

$$\begin{aligned} \pi_1 &= \alpha V + \frac{(1-\alpha)\left(x_2+\beta x_2^2\right)}{2^{N-1}} \\ \pi_2 &= \alpha\left(V-\beta x_2^2\right) + \frac{(1-\alpha)\left(x_2-\beta x_2^2\right)}{2^{N-1}} \end{aligned} \tag{5}$$

Firm 2 benefits from risk but also pays a cost, βx_2^2, in the form of a lower expected value proposition. Firm 1 benefits from the risk 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 competitive advantage over Firm 2 if Firm 2 has a negative realization 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: $x_2+\beta x_2^2$. The top panel of Figure 3 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 market overlap among the firms shrinks to the point where they are monopolies serving distinct niches $(\alpha = 1)$.

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

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

$$\pi_N = \alpha\left(V - \beta x_N^2\right) + (1-\alpha)\left(\frac{x_N - \beta x_N^2}{2} - \sum_{i=2}^{N-1}\frac{x_i - \beta x_i^2}{2^{N-i+1}}\right) \tag{6}$$

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 (5) 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 risk 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 risk or to have none and the least profitable position is to be "stuck in the middle" with low but non-zero risk. The middle panel of Figure 3 depicts an example with 5 firms. When α is near 0, Firms 2 through 5 crowd around high levels of risk, depressing each other's profits just as locating at similar places in a geographic model of product differentiation reduces rivalry restraint among firms and thus their profitability. As α rises, Firm 2 and Firm 3 reduce their risk, creating breathing room for Firm 4 and Firm 5 but crowding closer to Firm 1. For α large enough but less than 1, Firm 5 (as well as Firm 4, eventually) is more profitable than Firm 1.

Proposition 3: The least profitable positions along the frontier defined by the tradeoff between risk and expected value creation are those with a low but positive level of risk. Firm 1 *(with no risk in its value creation strategy) is the most profitable if there are a small number of competing firms or the market overlap of firms is high. Firms with a high level of risk in their value creation strategies (like Firm* N *) are most profitable if market overlap is at an intermediate level and the number of competing firms is large. As product market overlap approaches zero, the profit of each firm converges to a common monopolistic level.*

The lower is β, the less costly is risk, so firms pursue more of it, spreading out the x_i. Since risk is good not bad, the lower is β, the higher are all firms' profits, but especially those of Firm 1, which benefits doubly from the risk in the value creation strategy of Firm 2. The bottom panel of Figure 3 illustrates how the profits of Firm 1 and Firm 2 converge as β rises.

Proposition 4: The lower the cost of implementing high risk strategies, the greater the average risk in firms' value creation strategies and the higher are firms' profits, especially of those firms with relatively little risk in their value creation strategies.

MODEL 2: THE SHAPE OF RISK IN VALUE CREATION

We now hold the expected value proposition and level of risk fixed to consider different shapes of risk. Formally, 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 and risk are the same for all p[6]; as p approaches $\underline{p}$, however, the distribution of value propositions has a longer positive tail; and as p approaches $\overline{p}$, the distribution has a longer negative tail.

This is depicted graphically in the right panel of Figure 2. Darker-shaded bars are associated with higher values of p. For $p = 1/2$, 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. Without loss of generality, we index the $N > 1$ firms[7] by the p each chooses such that $p_1 \le p_2 \le \ldots \le p_N$. We continue to use Nash equilibrium as the solution concept.

In general, a firm's profit increases by choosing a value creation strategy that puts more weight on realizations that are more likely to exceed the highest value proposition of competing firms. 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 the next highest value proposition whenever Firm 1 receives a favorable realization 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 realization from its value creation strategy. Thus, Firm i 's profit (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

---

[6] The expected value proposition is $p\left(V + x/_{2p}\right) + (1-p)\left(V - x/_{2(1-p)}\right) = V$, and risk is $p\left|V + x/_{2p} - V\right| + (1-p)\left|V - x/_{2(1-p)} - V\right| = x$.

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

outcome where Firm N makes positive profits, i.e., where it has a favorable realization and no other firm does. Taken together, these arguments imply that every firm either chooses $\underline{p}$ or $\overline{p}$, that at least one firm chooses $\underline{p}$, and that at least one firm chooses $\overline{p}$.

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:

$$\pi_i = p_i\left(1-\underline{p}\right)^{N-Z-1}\left(\left(1-\overline{p}\right)^Z\left(\frac{x}{2p_i}+\frac{x}{2\left(1-\underline{p}\right)}\right)+\left(1-\left(1-\overline{p}\right)^Z\right)\left(\frac{x}{2p_i}-\frac{x}{2\overline{p}}\right)\right) \tag{7}$$

Differentiating yields

$$\frac{\partial\pi_i}{\partial p_i}=\frac{x\left(1-\underline{p}\right)^{N-Z-1}}{2}\left(\left(1-\overline{p}\right)^Z\left(\frac{1}{1-\underline{p}}+\frac{1}{\overline{p}}\right)-\frac{1}{\overline{p}}\right) \tag{8}$$

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 $\overline{p}$.

In other words, one firm chooses the value creation strategy with the most extreme negative tail, whereas every other firm chooses the value creation strategy with the most extreme positive tail. The intuition for this result relates to the way that risk creates the opportunity for competitive advantage. 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 realizations that are almost certainly far below or far above whatever realization arises from competing firms' value creation strategies.

Proposition 5: Firms differentiate in the shape of the risk in their value creation strategies. All but one firm chooses the value creation strategy with the longest positive tail, whereas one firm chooses the value creation strategy with the longest negative tail.

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

$$\begin{aligned}\pi_1 &= \underline{p}\overline{p}\left(\frac{x}{2\underline{p}} - \frac{x}{2\overline{p}}\right) + \underline{p}\left(1-\overline{p}\right)\left(\frac{x}{2\underline{p}} + \frac{x}{2\left(1-\overline{p}\right)}\right) + \left(1-\underline{p}\right)\left(1-\overline{p}\right)\left(\frac{x}{2\left(1-\underline{p}\right)} + \frac{x}{2\left(1-\overline{p}\right)}\right) \\ &= \frac{x}{2}\left(1-\underline{p}+\overline{p}\right)\end{aligned} \tag{9}$$

while the equilibrium profits of Firm 2 are

$$\pi_1 = \left(1-\underline{p}\right)\overline{p}\left(\frac{x}{2\overline{p}} + \frac{x}{2\left(1-\underline{p}\right)}\right) = \frac{x}{2}\left(1-\underline{p}+\overline{p}\right) \tag{10}$$

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

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

The equilibrium profits of Firm N are

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

We then have that Firm N is the most profitable:

$$\pi_N - \pi_i = \frac{x}{2}\left(1-\underline{p}\right)^{N-2}\left(\left(1-\underline{p}+\overline{p}\right) - \left(1 + \frac{\underline{p}\left(1-\overline{p}\right)}{1-\underline{p}} - \underline{p}\right)\right) = \frac{x}{2}\left(1-\underline{p}\right)^{N-3}\left(\overline{p}-\underline{p}\right) > 0 \tag{13}$$

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 realization from its value creation strategy, and this profit is especially large on the rare occasions when Firm 2 has a very low realization from its value creation strategy. On the more common occasions when Firm 1 has an unfavorable realization from its value creation strategy, Firm 2 usually enjoys modest profits, except on those rare occasions when Firm 2 also has an unfavorable realization, in which case Firm 1 makes a profit.

With more than two firms, the symmetry breaks down, because if more than one firm adopted the strategy with the longest negative tail, they would drive each other's profits to zero most of the time. Thus, with more than two firms, only one firm chooses $\overline{p}$ and the other $N-1$ firms 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 has the very low unfavorable realization from its value creation strategy, $\left(V - x/2(1-\overline{p})\right)$, every other firm generates a value proposition 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 4 presents an example.

Proposition 6: The most profitable position along the dimension defined by the shape of risk is to be the lone firm that has the value creation strategy with the longest negative tail.

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

Our equilibrium has the feature that firms move to opposite ends of the space of possible value creation strategies, in a sense restraining their rivalry with each other along this dimension. One might then expect that profits would be increasing in the difference between the maximum and minimum $\underline{p}$, which we denote by $\Delta p = \overline{p} - \underline{p}$. The bottom panel of Figure 4 illustrates how firm profitability increases as Δp grows for a particular example.

CONCLUDING REMARKS

This paper has provided a formal theoretical analysis of the relationships among the risk in a firm's value creation strategy and the fundamental profit-generating mechanisms of competitive advantage and rivalry restraint. We observed that in strategic interaction, risk restrains rivalry by giving rival firms the opportunity to enjoy a competitive advantage in different states of the world. In this way, risk allows firms to escape the Bertrand trap of zero profits, even without product market differentiation or different a priori levels of competitive strength.

We then considered two related questions the literature had not addressed. The first is the tradeoff between risk and expected value creation along the efficient frontier defined by choosing the value creation strategy with the highest risk for any level of expected value creation. In equilibrium, firms align themselves along the efficient frontier akin to choosing different positions in a dimension of product differentiation. Two similarities with conventional strategic positioning were noted. First, the most profitable positions are either those with the most or the least risk, whereas being "stuck in the middle" with an intermediate level of risk is less profitable. Second, a firm tends to be more profitable when there are fewer rival firms near its position. Two drivers of rivalry restraint – the number of competing firms and market overlap – play a key role in determining which positions firms adopt and which positions are most profitable.

The second question relates to the shape of risk, holding its level and the expected value proposition fixed. Again, we found that firms will tend to differentiate from each other along this dimension, with most adopting a strategy with a small chance of a very high outcome versus a large chance of a modestly low outcome (positive tail) and one adopting a strategy with a small chance of a very low outcome versus a large chance of a modestly high outcome (negative tail).

Thus, being "stuck in the middle" is so unprofitable along this dimension that no profit-maximizing firm adopts this position. Remarkably, the lone firm that adopts the strategy with the longest negative tail is always the most profitable if there are more than two firms.

The horizontal and vertical differentiation typology has dominated the study of competitive positioning in strategy, economics, and marketing for decades. While scholars have focused on *deepening* our understanding of differentiation by exploring how and even whether horizontal and vertical differentiation differ (e.g., Cremer & Thisse, 1991; Wauthy, 2010), this study *broadens* our understanding of differentiation by theorizing about the existence of two new dimensions arising from the interrelationships among risk in value creation, rivalry restraint, and competitive advantage. Moreover, rivalry restraint is usually presented as a unitary mechanism denoting the degree to which firms' relative competitive positioning softens price competition (e.g., Makadok, 2010). In this paper, we found that two different drivers of rivalry restraint – the number of competing firms and market overlap – had distinct individual and joint effects on firm profitability, suggesting that the way in which rivalry restraint manifests itself has important strategic implications.

Much research has been devoted to explaining the "Bowman Paradox," i.e., the 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 strategy formulation and implementation, and statistical artifacts (Andersen, Denrell, & Bettis, 2007). In this paper, the Bowman Paradox is a natural consequence of the relationship between the value of risk and market overlap. Where market overlap is low, risk has less value, so firms pursue little of it in their value creation strategies and enjoy high profits. Where market overlap is high, at least some firms pursue a fairly high level of risk in value creation, which increases the variance of all firms' profits, even those that pursue low or no risk. In this case, firm profits are lower (due to competition) and exhibit higher variance.

A tenet of the resource-based view is that the cost of strategic resources should reflect the profits they are expected to generate (Barney, 1986; Peteraf, 1993). Given that risk is a good not a bad in strategic interaction, it follows that resources that generate optimal levels and shapes of risk should cost more. Thus, resources that generate particularly asymmetric outcomes or extremely high or low levels of risk should cost more than resources that generate intermediate levels of risk, and this relationship should be moderated by market overlap and the number of competing firms.

Despite extensive research, empirical evidence on the business case for corporate social responsibility remains inconclusive (Barnett, 2007). Our analysis of the shape of risk may shed light on this. One natural interpretation of the value creation strategy with a long negative tail is the undertaking of anti-social activities like violating labor and environmental regulations. These activities lower a firm's costs of production and thus raise its value proposition (willingness-to-pay minus costs) in most states of the world but risk severe reputational damage and thus a dramatically lower value proposition if the firm has the misfortune to be caught. On the one hand, we found that the long negative tail is the most profitable value creation strategy. On the other hand, we also found that only one firm adopts this strategy in equilibrium, if firms are rational, because if two firms do so simultaneously, they will drive each other's profits down to very low levels. This suggests a rather complex relationship between anti-social activities and profitability, where the business case for corporate social responsibility (or irresponsibility) for a given firm cannot be determined without evaluating what other firms are doing. Simple regressions of financial results on corporate social performance may not be illuminating.

The analysis herein could be productively extended and generalized in a number of directions. Clearly, firms choose from a richer set of value creation strategies than those depicted in the paper’s 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 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 be incorporated as part of the cost of risk and thus would not qualitatively change the paper’s results. Another issue is the optimistic propensity of some managers (e.g., entrepreneurs), which has been shown to influence the optimal venture capital contract (Dushnitsky, 2010) and could well influence equilibrium behavior in the model herein.

Our analysis assumed for simplicity that firms’ value creation strategies were uncorrelated, but this is not always true in practice. To wit, an open innovation strategy may allow a firm to discover value creation possibilities that it could not have envisioned on its own (Almirall & Casadesus-Masanell, 2010) but may also reduce risk by moving the firm’s value creation strategy closer to an industry average trajectory. These and other avenues of inquiry are left for future research.

REFERENCES

Adner, R., D. Levinthal. 2004a. What is *not* a real option: Identifying boundaries for the application of real options to business strategy. ***Academy of Management Review,*** 29(1): 74–85.

Adner, R., D. Levinthal. 2004b. Real options and real tradeoffs. ***Academy of Management Review,*** 29(1): 120–126.

Adner, R., P. Zemsky. 2006. A demand-based perspective on sustainable competitive advantage. ***Strategic Management Journal,*** 27(3): 215–239.

Almirall, E., R. Casadesus-Masanell. 2010. Open versus closed innovation: A model of discovery and divergence. ***Academy of Management Review,*** 35(1): 27–47.

Andersen, T.J., J. Denrell, R. A. Bettis. 2007. Strategic responsiveness and Bowman's risk-return paradox. ***Strategic Management Journal,*** 28(4): 407–429.

Aumann, R. J. 1985. What is game theory trying to accomplish? K. J. Arrow, S. Honkapohja, eds. **Frontiers of Economics.** Basil Blackwell, Oxford, 28–76.

Barney, J. B. 1986. Strategic factor markets: expectations, luck, and business strategy. ***Management Science,*** 32(10): 1231–1241.

Barnett, M. L. 2008. An attention-based view of real options reasoning. ***Academy of Management Review,*** 33(3): 606–628.

Bowman, E. H. 1980. A risk/return paradox for strategic management. ***Sloan Management Review,*** 21(3): 17–31.

Bowman, E. H., D. Hurry. 1993. Strategy through the options lens: An integrated view of resource investments and the incremental choice process. ***Academy of Management Review,*** 18(4): 760–782.

Brandenburger, A. M., H. W. Stuart. 1996. Value-based business strategy. ***Journal of Economics & Management Strategy,*** 5(1): 5–24.

Chat, T., J. A. Nickerson, H. Owan. 2007. Strategic management of R&D pipelines with cospecialized investments and technology markets. ***Management Science,*** 53(4): 667–682.

Chatain, O., P. Zemsky. 2011. Value creation and value capture with frictions. ***Strategic Management Journal,*** 32(11): 1206–1231.

Coff, R. W. 1997. Human assets and management dilemmas: Coping with hazards on the road to resource-based theory. ***Academy of Management Review,*** 22(2): 374–402.

Coff, R. W. 2011. The coevolution of rent appropriation and capability development. ***Strategic Management Journal,*** 31(7): 711–733.

Cremer, H., J.-F. Thisse. 1991. Location models of horizontal differentiation: A special case of vertical differentiation models. ***Journal of Industrial Economics,*** 39(4): 383–390.

D'Aspremont, C., J. J. Gabszewicz, J.-F. Thisse. 1979. On Hotelling's “stability in competition”. ***Econometrica,*** 47(5): 1145–1150.

Dixit, A. K., R. S. Pindyck. 1994. **Investment under Uncertainty.** Princeton University Press: Princeton, NJ.

Dushnitsky, G. 2010. Entrepreneurial optimism in the market for technological innovations. ***Organization Science,*** 21(1): 150–167.

John, K., T. A. John. 1993. Top-management compensation and capital structure. ***Journal of Finance,*** 48(3): 949–974.

Hotelling, H. 1929. Stability in competition. ***Economic Journal,*** 39(153): 41–57.

Huchzermeier, A., C. H. Loch. 2001. Project management under risk: Using the real options approach to evaluate flexibility in R&D. ***Management Science,*** 47(1): 85–101.

Kogut, B., N. Kulatilaka. 1994. Operating flexibility, global manufacturing, and the option value of a multinational network. ***Management Science,*** 40(1): 123–139.

Kogut, B., N. Kulatilaka. 2004. Real options pricing and organizations: The contingent risks of extended theoretical domains. ***Academy of Management Review,*** 29(1): 102–110.

Kulatilaka, N., E. C. Perotti. 1998. Strategic growth options. ***Management Science,*** 44(8): 1021–1031.

Lippman, S. A., R. P. Rumelt. 1982. Uncertain imitability: An analysis of interfirm differences in efficiency under competition. ***Bell Journal of Economics,*** 13(2): 418–438.

Makadok, R. 2001. Toward a synthesis of the resource-based and dynamic capability views of rent creation. ***Strategic Management Journal,*** 22(5): 387–401.

Makadok, R. 2002. A rational-expectations revision of Makadok's resource/capability synthesis. ***Strategic Management Journal,*** 23(11): 1051–1057.

Makadok, R. 2003. Doing the right thing and knowing the right thing to do: Why the whole is greater than the sum of the parts. ***Strategic Management Journal,*** 24(10): 1043–1055.

Makadok, R. 2010. The interaction effect of rivalry restraint and competitive advantage on profit: why the whole is less than the sum of the parts. ***Management Science,*** 56(2): 356–372.

Makadok, R. 2011. The four theories of profit and their joint effects. ***Journal of Management,*** 37(5): 1316–1334.

McGrath, R. G. 1999. Falling forward: Real options reasoning and entrepreneurial failure. ***Academy of Management Review,*** 24(1): 13–30.

Mussa, M., S. Rosen. 1978. Monopoly and product quality. ***Journal of Economic Theory,*** 18(2): 301–317.

Narasimhan, C., Z. J. Zhang. 2000. Market entry strategy under firm heterogeneity and asymmetric payoffs. ***Marketing Science,*** 19(4): 313–327.

Peteraf, M. A. 1993. The cornerstones of competitive advantage: a resource-based view. ***Strategic Management Journal,*** 93(14): 179–191.

Porter, M. E. 1998. **Competitive Strategy: Techniques for Analyzing Industries and Competitors.** The Free Press: New York, NY.

Santiago, L. P., P. Vakili. 2005. On the value of flexibility in R&D projects. ***Management Science,*** 47(1): 85–101.

Stiglitz, J.E., A. Weiss. 1981. Credit rationing in markets with imperfect information. ***American Economic Review,*** 71(3): 393–410.

Stuart, H. W. 2004. Efficient spatial competition. ***Games and Economic Behavior,*** 49(2): 345–362.

Teece, D. J. 1986. Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy. ***Research Policy,*** 15(6) 285–305.

Wauthy, X. 2010. Market coverage and the nature of product differentiation: a note. ***Economics Bulletin,*** 30(2): 1129–1136.

FIGURE 1
Tradeoff between Expected Value Creation and Risk

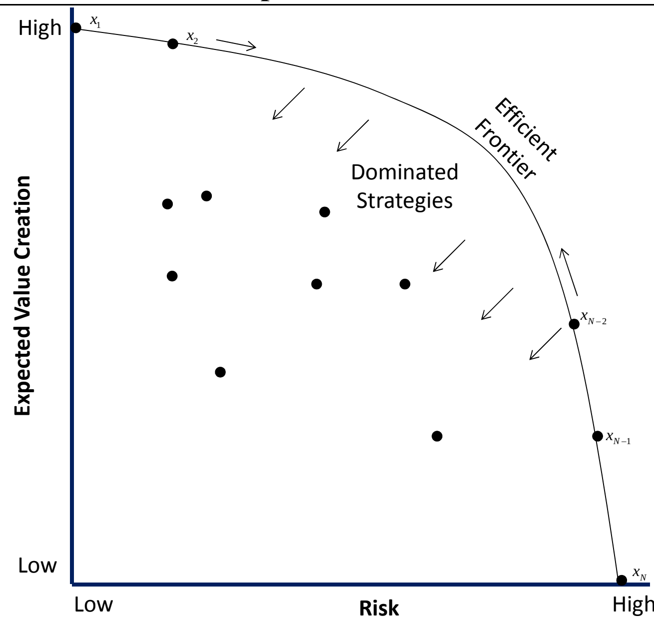


FIGURE 2
Strategy Spaces for Models 1 & 2

Model 1 **Risk vs. Expectation**	**Model 2** **Shape of Risk**

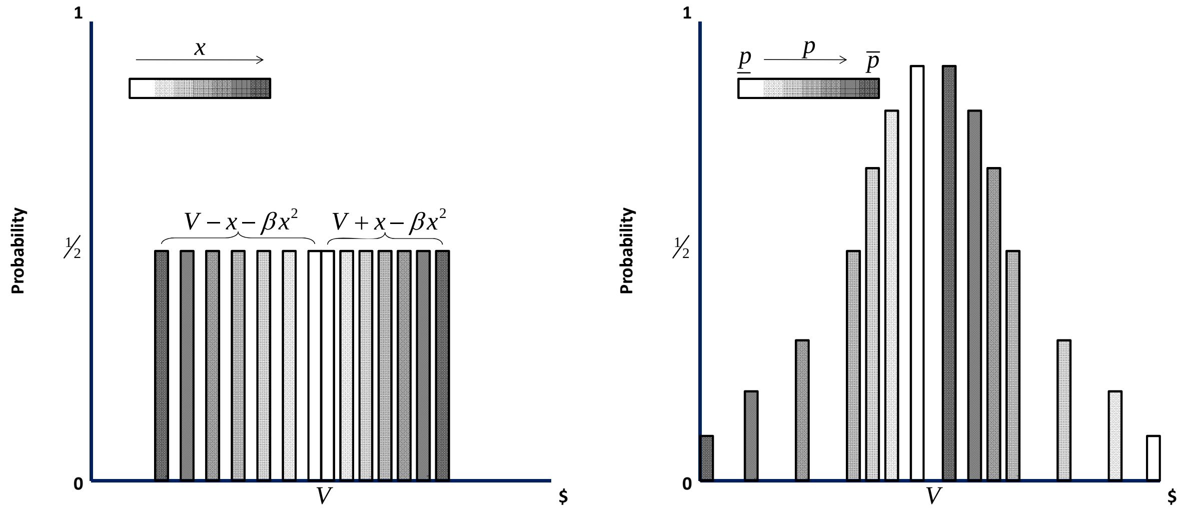
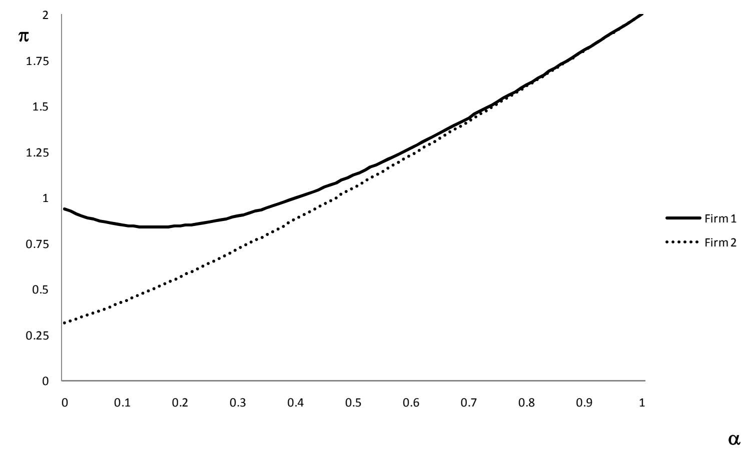
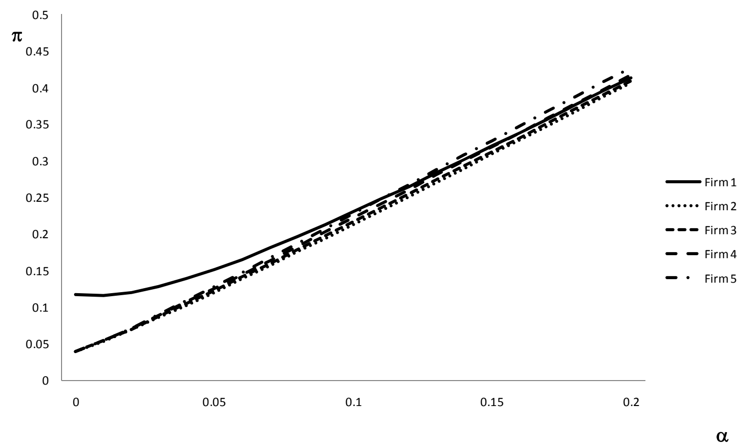


FIGURE 3
Firm Profit (π) in Model 1: Risk vs. Expectation

Firm π as α Varies
V = 2, N = 2, β = 0.4



Firm π as α Varies
V = 2, N = 5, β = 0.4



Firm π as β Varies
V = 2, N = 2, α = 0.15

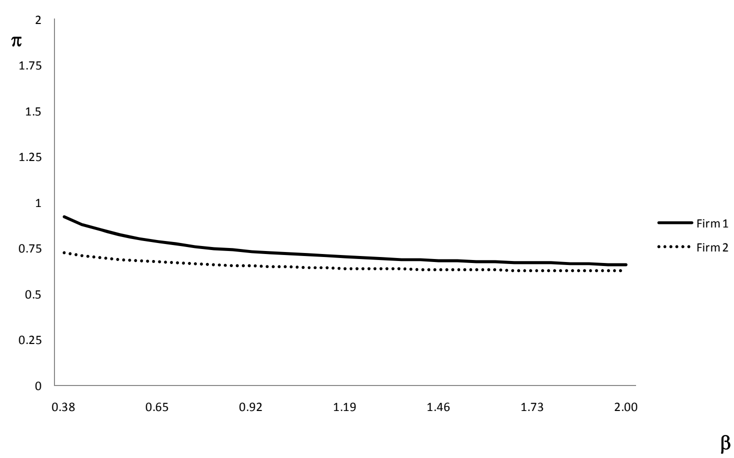
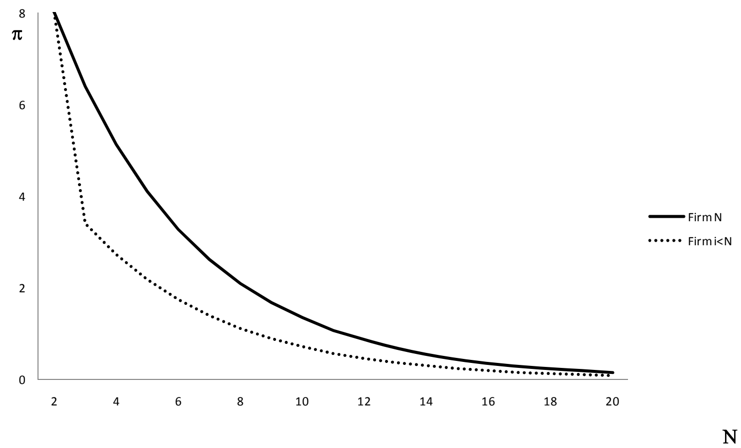


FIGURE 4
Firm Profit (π) in Model 2: Shape of Risk

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



Firm π as Δp Varies
$V = 100, x = 10, N = 5$