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# RISK, THE LIMITS OF FINANCIAL RISK MANAGEMENT, AND CORPORATE RESILIENCE

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## ABSTRACT

Existing evidence shows convincingly that expected cash flows of non-financial firms can be negatively affected by their total risk, so that non-financial firms can create shareholder wealth by managing their total risk. After reviewing theories that demonstrate links between firm value and total risk, I examine how financial risk management is used to manage firm total risk. I conclude from the evidence that the use of financial risk management is mostly limited to near-term risk in non-financial firms. I offer explanations for this limited role of financial risk management. I argue that the limitations of financial risk management make it important for firms to also focus on resilience and call for more research on the costs and benefits of resilience.

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## 1. Introduction.

Students taking beginning corporate finance courses are typically taught that the only risk that matters for the value of widely held firms and expected stock returns is priced risk and idiosyncratic risk is not priced and hence does not matter. The intuition is that idiosyncratic risk is diversifiable for shareholders, so that they cannot charge for bearing it. Unfortunately, what students learn is wrong because, in general, the level of expected cash flows depends on the risks a firm is exposed to. This is so whether investors can diversify these risks or not. In this paper, I explain how our understanding of why risk management can create value for widely held non-financial firms has evolved over time and why the practice of risk management appears so limited compared to its promise in the corporate finance literature.[1] I address implications of the current state of our understanding of risk management both for academic research and for practice.

Arguing that firms should not manage the risks they are exposed to because investors are diversified amounts to saying that firms should not have fire sprinkler systems because they are costly, and investors can diversify the damage from fires. The decision with respect to installing fire sprinkler systems is straightforward: install them if their costs is less than the present value of the fire damage avoided because of having the system. Doing so increases the value of the firm when the sprinkler system is installed by the difference between the benefit and the cost. Consequently, when the firm makes the correct decision, it increases the wealth of diversified shareholders. This decision rule applies to all risks a firm is exposed to. It is the foundation of corporate risk management. To maximize firm value through risk management, the firm must identify the value-relevant risks it is exposed to, measure its exposures, and assess benefits and costs of mitigating these risks. Once the firm has gone through that work, it has to decide whether it wants to bear these risks fully, partly, or not at all.

Firms that do not take risks seriously in their decision-making are unlikely to maximize shareholder wealth. First, if knowable risks are not assessed properly and managed, the most likely outcome is that

[1] Since the literature so vast (a Google Scholar search for risk management returns more than 3 million items), I can only cite papers that are directly related to the themes of this paper given its limited objective and length.

management acts too risk-averse when it makes decisions. For instance, it might decide not to take a project because it views it as too risky when in fact the most concerning risk could be mitigated, and the project would then be highly valuable. Second, because risks are not assessed properly, management can take projects that destroy shareholder wealth. For example, a firm might accept a project with an existential risk that it failed to identify correctly.

When a firm considers how to mitigate risks associated with a project, it can do so operationally, and at times it can use financial instruments.[2] In this article, financial risk management is the management of risk using financial instruments. The most used financial instruments to mitigate risk are derivatives. Mitigating risks operationally can be extremely expensive. Mitigating risks using financial instruments can be extremely cheap. As a result, using financial instruments, such as derivatives, can at times be the best approach to risk mitigation. The reason mitigating risk with financial instruments can be very cheap is that the markets for many financial products are very competitive, so that transaction costs are low. For instance, if a firm decides to sell a product abroad and will be paid in foreign currency, it could end up making a loss on its sale if the foreign currency depreciates. However, it can sell the currency forward when it agrees to the sale, so that the exchange rate risk is off the table and can do so generally at low cost.

Financial risk management for non-financial corporations has been studied extensively. There is a large literature that examines how firms manage risks using derivatives. The main lesson from this literature is that firms use derivatives extensively to manage risk, but financial risk management is mostly, but not exclusively, used for the management of well-defined near-term risks. As a result, financial risk management is quite limited as a tool to manage firm-wide risk. There are several reasons for this. The first reason is that short-term risks are much easier to assess and quantify. A firm often knows the precise date of a payment to be received in foreign currency. This makes it easy to sell the receipt forward. A firm typically knows little about what its foreign currency exposures will be five or ten years from now. If a foreign currency depreciates too much, it may exit a market. Innovation and competition may increase a

[2] The firm can further mitigate some well-defined idiosyncratic risks with insurance contracts (Mayers and Smith, 1982). Discussion of such contracts is beyond the scope of this article.

firm's exports or decrease them. Firms find it much harder to plan as the time horizon lengthens, but without knowing what the firm intends to do, it is extremely challenging, if possible at all, to quantify the risks to which it is exposed. The second reason is that financial hedges that reduce the long-run exposure of a firm can create short-run volatility in a firm's accounting performance and liquidity. In addition to these two reasons, I discuss explicitly, managerial incentives can also make hedging long-term risks unattractive for management. For instance, the associated earnings volatility is problematic if management's compensation depends explicitly or implicitly on earnings, as it often does.

Optimal risk management for risks that are hard to quantify or even identify must focus on policies that build corporate resilience. Corporate resilience is the ability of a firm to absorb adverse shocks in such a way that it can keep pursuing its strategy. If an adverse outcome occurs, policies exist to minimize the adverse effect of that outcome that do not involve using financial instruments. Some of these policies are financial policies. They involve the choice of cash holdings and the choice of leverage. A highly levered firm can easily become financially distressed if there is an adverse outcome. With financial distress, the firm may have to sell valuable assets and cancel valuable projects, in part because it will face difficulties raising funding. A firm with low leverage may not be distressed and may find the necessary funding. Similarly, a firm can hold liquid assets as a buffer. Other policies involve the firm's operations. For instance, a firm can address the risk of supply chain disruptions by holding more inventories or developing relationships with multiple suppliers. Generally, this means that the firm wants to develop both financial and operational flexibility to manage risks. This area of risk management is critically important, but as I will show, research is vastly underdeveloped.

This article is organized as follows. In Section 2, I briefly review the language of risk. In Section 3, I review the main theories as to why risk affects firm value. I then turn to financial risk management and the empirical evidence in Section 4. In Section 5, I address the limits of financial risk management. I then conclude by discussing how making corporations more resilient helps address the limits of financial risk management and create shareholder wealth through risk management.

**Section 2. The language of risk.**

Financial economists generally think of outcomes as random variables that have a statistical distribution. For instance, the return of a stock over a period is a random variable. The return over a future period is not known today. The fact that it is not known means that it is risky. The most used statistical distribution for returns is the normal distribution. With that distribution, the risk is symmetric. There is an equal chance of observing an outcome above the expected value as observing an outcome below the expected value. The volatility of the return describes the distribution of the spread of the return around the expected value. A high volatility means that realizations far from the mean are more likely. The volatility of the return is often called a stock's total risk. Some of the risk of the stock is diversifiable in portfolios. This risk is often called the unsystematic risk, the non-priced risk, or the idiosyncratic risk. With the capital asset pricing model (Sharpe, 1964), the diversifiable risk is not priced and hence does not affect the expected return. The risk that is priced is called the systematic risk. With this approach to risk, random outcomes can be good or bad. Eliminating idiosyncratic risk does not affect the expected return of a portfolio.

In a corporate context rather than a stock return context, risk is still the existence of random outcomes that, in general, can be positive or negative relative to the expected value. However, such a definition does not account for materiality. The International Standard ISO 31000 for Risk Management defines risk as the effect of uncertainty on the firm's ability to achieve its objectives (ISO, 2018). Hence, the realization of a random variable away from its mean represents a risk if it affects the firm's ability to achieve its objectives. The Standard explicitly notes that the deviation from expected can be positive or negative, that it can result in opportunities or threats.

While financial economists approach risk from the perspective that randomness can lead to good and bad outcomes, it is common outside of financial economics to define risk as the possibility of loss. In this case, risk is defined asymmetrically. Dictionaries define risk as the "possibility of loss or injury." This definition is also commonly used in the law. I will not use this definition in this article because it is inappropriate in a setting where one is concerned about maximizing firm value. Looking only at the adverse outcomes of random variables that affect cash flows means ignoring the total impact of randomness on the

value of the firm and overstating that impact. Hence, it is an approach that is inherently biased and leads to the wrong decisions.

An important distinction is often made in economics between risk and uncertainty. Knight (1921) introduced this distinction. He wanted to distinguish between randomness to which we can assign probabilities versus randomness where it is not reasonable to think of probabilities. This distinction is important. The probability of a drop of 5% in the value of the Euro over the next year can be assessed well; an estimate of the probability of having a pandemic next year is unlikely to be helpful. The fact that some randomness cannot be assigned probabilities does not mean that it can be ignored. As I will argue, risk management means devising policies that enable the firm to cope with the realization of unknown risks as well as known risks. However, the literature on known risks is extremely large while the literature on unknown or partially known risks is extremely small.

**Section 3. Risk, firm value, and financial risk management.**

In this article, I am restricting my attention to risk management when shareholders are diversified, and the objective of the firm is to maximize shareholder wealth. To make clear why risk management can increase firm value, I focus on the case where shareholders are risk neutral. In other words, they do not charge for risk. Hence, if the firm's risk changes, it does not change the rate at which shareholders discount its expected cash flows. I therefore assume that the discount rate is zero for simplicity. With this assumption, I can focus on how risk affects expected cash flows. To make things simple, I consider a one-period firm, so that the end-of-period cash flow is the terminal cash flow and assume that cash flow is normally distributed.[3] The value of the firm, V, is then a function of expected cash flow, C, and the volatility of cash flow, σ:

$$V = C(\sigma) \tag{1}$$

[3] The results I focus on hold if the assumptions made to simplify the presentation are removed (see Stulz, 2003).

With this formulation, firm value does not depend on firm risk if C does not depend on σ. In other words, if expected cash flow is the same regardless of volatility, firm risk is irrelevant for value and risk management does not create value. For risk management to affect value, it must be that risk affects future expected cash flows. Empirically, investment is lower when cash flow volatility is higher, which implies a direct link between risk and expected future cash flows (Minton and Schrand, 1999). In this case, if there is a level of risk that maximizes firm value, risk management that makes it possible for the firm to choose that level of risk enables it to maximize its value.

Early in their training in corporate finance, students learn that investors can adjust the risk of their position in a firm on their own through homemade risk management, so that the firm cannot create value out of risk management if it does the same as what investors could do on the same terms. In this setting, it should be obvious why that argument is not correct. Here, investors do not care about risk. They have no incentives to change the risk of their position in the firm. However, if the firm chooses the wrong amount of risk, shareholders are poorer because their portfolio has a lower value. In other words, having the wrong amount of risk has a deadweight cost. Go back to the example of fire sprinklers. Suppose that a fire makes a loss of $1 billion without sprinklers, $100 million with sprinklers, sprinklers cost $5 million, and the probability of a fire is 5%. The NPV of sprinklers is $40 million. If the firm does not install sprinklers, firm value is lower by $40 million. The brokerage statement of the shareholders is then lower by $40 million. There is nothing that shareholders could do on their own to get that $40 million back. Installing sprinklers in their house will not help.

This perspective leads to the foundational proposition for the role of risk management in corporate finance developed in Smith and Stulz (1985):

**Foundational proposition of risk management**: For a firm where management maximizes the wealth of diversified shareholders, management of total risk creates value if adverse outcomes have deadweight costs.

Consider some risk that is traded in financial markets, like a foreign exchange risk. Suppose that the exchange rate has a symmetric distribution, so that it has a 20% probability of falling (increasing) by 10% which creates a loss (gain) to the firm of $10 million. With my assumptions, the exchange risk neither adds nor subtracts to the value of the firm when the firm takes on the risk because the expected loss from foreign exchange is zero. If the firm protects itself fully against the exchange rate risk, it does not create value. Suppose now that if the exchange rate falls, the firm incurs an additional loss of $5 million because it will not be able to fund an investment opportunity as it is financially weaker. In this case, the expected loss from the exchange rate exposure becomes $1 million. Shareholders could protect themselves against the risk of additional loss on their own. However, they can do nothing about the fact that firm value is lower because of that risk. Their brokerage statement is directly affected. This $1 million is the deadweight cost of the exchange rate risk. It is incorporated in firm value when the firm takes the risk, not when the risk materializes, and can only be mitigated by the firm. If the shareholders have an additional $5 million in their brokerage accounts to offset the loss when it materializes because of their homemade hedge (which would come at a cost), that does not help the firm to raise funding because potential investors look at the financial strength of the firm and it is that strength that suffers because of the loss.

Why would expected cash flows depend on risk? Why would risk management affect the level of expected cash flows? The financial economics literature has identified many reasons for why expected cash flows can depend on risk. I am not going to address all of them. Instead, I will focus on the most important ones:

1) **Managerial risk aversion and incentives.** For simplicity, I focus on the CEO. The CEO has his own utility function and his own objectives. The CEO will make risk choices that maximize his own utility (Stulz, 1984). That utility will depend on his compensation and incentives set by the board. Different types of compensation plans have different implications for the CEO's risk choices. It is now well-established that management's willingness to take risks is closely tied to its compensation incentives (Coles, Daniel, and Naveen, 2006). Option compensation will often, but not always, increase the CEO's willingness to take risks (Smith and Stulz, 1985; Ross, 2004;

Lewellen, 2006). The reason is that options increase in value when the firm becomes more volatile. Most recently, Coles, Sandvik, and Seegert (2023) show that the tax exposure of the CEO and his compensation plan affect his incentives to engage in risky mergers and acquisitions. If the board is less well-informed than the CEO about the firm's risk choices and their relation to firm value, the board cannot order the CEO to choose the optimal level of risk. The CEO will choose the level of risk that is optimal for him subject to the constraints and incentives imposed by the board. The resulting level of risk may not be the one that would maximize shareholder wealth. However, risk management can make it optimal for a risk-averse CEO to take a project that is advantageous to shareholders by mitigating some risks of the project so that it is not too risky for the CEO. Risk management also affects the informativeness of earnings about the performance of management as risk mitigation can be used to hedge risks that are extraneous to management performance (DeMarzo and Duffie, 1995; Breeden and Viswanathan, 2016).

2) **Risk of financial distress.** Financial distress occurs when a firm's financial situation prevents it from pursuing the plans it would pursue if it were financially healthy. There is a vast literature that addresses issues related to financial distress (see Senbet and Wang, 2012, for a review of the literature). Because the firm is constrained in its actions by its financial situation, shareholder wealth is destroyed when the firm is in financial distress. An example of deadweight costs of financial distress is the case of a manufacturer that sells products with warranties. If customers become worried that the firm's warranties may no longer be reliable because of the risk that it will become financially unhealthy, demand for the firm's products may fall (Titman, 1984). As a result, the firm may lose market share or even become unable to sell its products. By reducing the probability of distress, the firm could increase shareholder wealth by increasing the demand for its products. Generally, there is an optimal probability of financial distress from the perspective of shareholders (Robichek and Myers, 1966). If the probability is above the optimum, the firm can benefit from reducing it through risk mitigation and doing so will increase expected cash flows (Smith and Stulz, 1985). With equation (1), risk affects only one period's cash flow. Obviously, if

the firm is in financial distress, the distress will affect future cash flows as well. Froot, Scharfstein, and Stein (1993) focus on the intertemporal relation between cash flow risk and future investment. The case they model is one where the firm has to rely on internal cash flow to finance future cash flow because the firm does not have access to external finance. Because adverse realizations of risk prevent the firm from investing optimally, expected future cash flows depend on firm risk. More recently, Bolton, Chen, and Wang (2011) present a dynamic model where the firm can be financially constrained because there is a fixed cost to raise external funds. The firm may find it optimal to invest less to avoid raising external funds, so that risk decreases expected future cash flows in their model.

3) **Capital structure and tax optimization.** A firm may have an optimal level of leverage. It may choose to have debt because it benefits from the tax shield of debt (Robichek and Myers, 1966). Alternatively, debt may be valuable in constraining management (Jensen, 1986; Stulz, 1990). As a firm's level of debt increases, the firm's risk of financial distress increases. Hence, the optimal amount of debt will generally be lower for riskier firms and the benefits of debt will be lower. The tax shield of debt is worth less for a firm that may make losses since in loss years it would not benefit from the tax shield. It follows that risk management that mitigates risk may help the firm reach a level of leverage that corresponds to higher shareholder wealth (Smith and Stulz, 1985; Stulz, 1990; Leland, 1998).
4) **Stakeholders.** I am assuming that managers maximize shareholder wealth. However, the risk of the firm can affect stakeholders as well. I already discussed the case of warranty holders. A firm's employees are affected by the risk of the firm. The incentives for employees to join a firm and invest in firm-specific capital depend on the firm's financial health. For instance, Brown and Matsa (2016) find that firms in poor financial health attract worse employees than firms in better financial health. Further, Agrawal and Matsa (2013) find that firms must pay employees more if the risk of unemployment is higher and that, as a result, they choose more conservative financial policies. It follows from this that a firm's risk can affect expected cash flows through the productivity of its

employees. Further, if a firm's financial health is seriously at risk, employees may also require compensation for the risk, which increases the compensation costs of the firm. In general, the firm is in a better position to manage the risk that stakeholders bear because of their relationship with the firm than the stakeholders themselves (Smith and Stulz, 1985).

There are many reasons why a firm's total amount of risk affects its value through the expected value of future cash flows. This means that a firm that wants to maximize shareholder wealth will want to take actions to bring the total amount of risk of the firm to a level that maximizes firm value. Importantly, this does not necessarily mean reducing the firm's total risk. If management is too risk-averse, firm policies that align the risk-taking incentives of managers better with those of shareholders will bring about an increase in total risk.

A firm can use many tools to achieve the level of risk that maximizes shareholders wealth. The most obvious tool is project choice. A firm that has too much risk can turn down projects that increase firm total risk and even abandon existing projects that have a high level of risk. However, managing risk by turning down projects is costly if these projects have value absent their impact on risk. Instead of turning down projects because of their risk, a firm could instead choose to change the risk of projects. For instance, the firm could reduce the scale of a project so that if the project evolves poorly, the firm will lose less. A firm can design its operations so that its risk level will be optimal. In risk management practice, the term of operational risk management is used to denote risk management policies that are focused on measuring, monitoring, and controlling the risk of operations. For our purpose, we will use the term of operational risk management in the widest possible sense, so that it includes all actions that firms take to manage risk on the real side of their activities as opposed to the financial side of their activities. As a result, with our definition, operational risk management includes what is at times called strategic risk management, namely firm's management of the risks resulting from the strategies they choose.

There are many financial tools that firms can use to reduce their risk. These tools can also be used to reduce the risk of specific projects. While giving up a profitable project because it is too risky is a costly

form of risk management, there are many low-cost ways of reducing risk that use financial instruments, especially derivatives. Often, firms that start a risk management program will have low-hanging risk management fruit, namely risks that can be mitigated with the cheapest derivatives. However, as we will discuss, not all risks can be mitigated with derivatives, so that financial risk management has important limits.

Though derivatives have a long history, their availability, cost, and ease of use increased dramatically because of two separate developments in the early 1970s. First, the world moved away from the Bretton Woods system for exchange rates, where exchange rates were constant except for occasional parity adjustments, and moved towards floating exchange rates. This evolution meant that exchange rate risk is always present for cross-border transactions, must be taken into account, and may have to be hedged.[4] Second, financial economists developed tools that made it possible to price derivatives and create new derivatives, so that the universe of available derivatives could be increased easily, and bespoke solutions could be designed and implemented on demand (Merton, 1992). With this evolution in the availability of derivatives tools for risk management, firms increasingly used derivatives, especially for foreign exchange and interest rates initially. Firms could use other financial instruments to reduce risk as well.

With the growing availability of derivatives, in some cases, it became much cheaper and more effective for firms to adjust their risk with derivatives than through operational decisions. This led to the growing importance for firms of financial risk management. The core concept in the use of derivatives for risk management is the concept of hedging. Hedging does not require derivatives. Other financial instruments can be used to hedge, and operations can be used to hedge as well. To mitigate a specific risk such as a foreign exchange risk, many solutions are available. For simplicity, I will refer to the use of derivatives, but when I do so I really mean the use of financial instruments for risk management. A hedge is a transaction that creates a gain for a corporation that offsets in part or in whole a loss that it incurs in its business

[4] See Leo Melamed, The Birth of FX Futures, CME, https://www.cmegroup.com/content/dam/cmegroup/education/interactive/fxproductguide/birthoffutures.pdf .

activities. For instance, if a firm sells a good abroad at a fixed price in foreign currency, it makes a loss if the currency depreciates. A hedge would be a transaction that produces a partly or completely offsetting cash flow for that loss.

If a firm has a suboptimal level of risk, it can use financial instruments to adjust its level of risk and bring it closer to the optimal level. We would then expect that firms that use derivatives to manage risk would take into account the various factors that affect a firm's optimal level of risk discussed in this Section. However, firms might use derivatives for other purposes than to manage risk and could use them to speculate instead. A large literature developed starting in the late 1980s to examine the extent to which firms use derivatives, whether they use them to manage risk or to speculate, whether their use can be explained by the various factors that affect a firm's optimal level of risk, and whether firms create value managing risk using derivatives. I address how the literature answers these questions in the next section.

**Section 4. Financial risk management and derivatives use.**

Much of the research on how firms practice financial risk management uses data on firms' use of derivatives. This is in part because there is data to assess firms' use of derivatives but not necessarily on the use of other financial instruments to hedge. As a result, understanding the extent and the reasons for financial risk management amounts requires assessing the extent and the reasons for derivatives use. There are, however, studies that are important exceptions that I cannot address given the limitations of this article. For instance, Bartram, Brown, and Minton (2010) show that foreign currency debt plays an important role in reducing the exposure of car producers to foreign exchange. In this section, I first address the question of how much firms use derivatives. I then discuss what we know about why firms use derivatives. In the last part of this section, I focus on what we know about whether derivatives usage increases firm value.

**Section 4.1. Is derivatives use economically important for non-financial corporations?**

Over time, disclosure requirements for derivatives use have increased across the world. The earliest research had access to less information than is available now. As a result, researchers looked at annual

reports and, in the US, 10-K footnotes. An example of such a study for the US is Geczy, Minton, and Schrand (1997). They started from a sample of Fortune 500 firms in 1991, dropped the ones with no foreign exchange exposure the previous year, and then found which ones among those with foreign exchange exposure used foreign exchange derivatives. They found 371 firms that had some form of foreign exchange exposure; 41.4% of these firms used currency derivatives and 59.1% used some type of derivatives. This frequency of close to 60% is similar to the global frequency found by Bartram, Brown, and Fehle (2009) for a sample of global firms. They construct their sample by collecting annual reports and then parsing these reports for statements that would reflect use of derivatives. They use annual reports from 2000 and 2001, but each firm is included only once. They have 7,319 firms from 50 countries. They only include non-financial firms. The 50 countries represent 99.3% of global market capitalization in 2000 and the sample firms represent 82.2% of the global market capitalization of non-financial firms. They find that 60.3% of firms use derivatives and that foreign exchange derivatives are the most widely used derivatives.

These two studies indicate that the use of derivatives is widespread. Other studies support that conclusion. However, studies find considerable variation in the use of derivatives across firms. Likelihood of derivatives use increases with size (e.g., Mian, 1996). Such an outcome indicates that there are economies of scale in using derivatives. Derivatives use has fixed costs as it involves accounting, legal, IT, and personnel setup expenses. These setup expenses may exceed the possible benefit from using derivatives for firms with low hedgeable exposures.

Evidence that there is extensive use of derivatives, especially among large firms, does not tell us whether the use of derivatives is economically important and conforms with predictions of risk management theories. If the use of derivatives is economically important, one would expect it to change the risk and the value of firms. The early literature could only focus on whether firms used or did not use derivatives because firms did not provide more detailed usable data about derivatives positions. Studies that assess whether a firm does or does not use derivatives have at best limited ability to show that the use of derivatives is economically important for a firm. For instance, a firm with sales of $1 billion having a forward contract of $1 million is using derivatives but it is quite unlikely that the forward contract is economically important.

Some studies have used the notional amount of derivatives as a measure of the economic importance of derivatives use. This measure can be problematic as well. In particular, firms can cancel a derivatives position by opening a new offsetting derivatives position, so that an increase in the gross notional amount of derivatives can correspond to a decrease in hedging. Other studies have used the economic value of derivatives. This measure would seem to be the most problematic. A forward contract that might be almost a perfect hedge for a foreign exchange exposure has zero value when entered.

A good measure of the economic importance of a firm's use of derivatives to hedge a given risk would be the fraction of its exposure it hedges. This approach has two potential problems. First, it requires data on specific exposures. Such data is typically not available. Second, the most important question is not how much a firm hedges a specific exposure, but how much it affects its overall risk through derivatives use. Having one type of exposure for a firm may not really answer that question. However, there are firms that have a critical exposure that affects their value directly and in an important way. These are firms that are in the production or extraction of a single commodity. The value of gold mining firms is tied to the price of gold. The value of an oil producer is tied to the price of oil. As a result, studies that focus on industries where the value of firms is strongly tied to a specific risk factor can hope to answer the question of whether the use of derivatives is economically important as they may be able to measure the use of derivatives with precision.

The classic study that uses that approach is Tufano (1996). Tufano (1996) studies gold mining firms. For these firms, analysts estimate the exposure of the firm to the gold price, and it is important for them to understand how much of that exposure is hedged. As a result, Tufano (1996) has good data. His database is from 1990 to 1993. He measures a firm's production for the remainder of the current year and the next two years. He then aggregates financial risk management transactions that mature over the same period. He finds that 85% of firms hedge to some extent. The average of the exposure they hedge is 25%. The most a firm hedges is 86%. There is considerable variation in the amount of hedging of firms. The approach of Tufano has been used in the oil and gas industry as well as in other industries where exposures and hedges can be identified with precision. Jin and Jorion (2006) investigate hedging for oil and gas producers. Their

conclusions are not dissimilar from those of Tufano (1996) in terms of the extent of hedging. They find that oil producers on average hedge 45% of firm sample years. When they hedge, on average they hedge 33% of production. Strikingly, their hedging represents an extremely small percentage of reserves – just 4%. Both Tufano (1996) and Jin and Jorion (2006) find that firms hedge production, not reserves.

A firm's total risk from the perspective of shareholders is the volatility of equity. Hence, if the use of derivatives decreases total risk, one would expect total risk to be less for derivatives users that are otherwise similar to non-derivatives users. Bartram, Brown, and Conrad (2011) perform such a comparison. They use propensity score matching to match users to non-users that have a similar propensity of using derivatives based on many firm characteristics. When they do that, they find that the volatility of equity is less for users than non-users by 5% to 10% depending on the specification. Another approach to evaluate whether the use of derivatives changes the risk of equity is to investigate whether the exposure of equity to risk factors is affected by the use of derivatives. There is evidence in the literature that this is the case (e.g., Allayannis and Ofek, 2001; Jin and Jorion, 2006; Bartram, 2017).

Instead of studying the impact of derivatives positions on exposures, Guay and Kothari (2003) assess the importance of derivatives cash flows to firms. Their sample consists of 234 large non-financial firms that use derivatives. They conclude that while firms use derivatives to reduce risk, their derivatives activities play a relatively small role. In particular, they assume a simultaneous three standard deviation simultaneous change in interest rates, exchange rates, and commodity prices. They find that the derivatives portfolio of the median firm generates $15 million in cash and $31 million in value for such a change. The most striking evidence concerns the change in the value of the derivatives portfolio as a percentage of market value. It is 1% at the median and 3% at the mean. This is for a change that has an exceedingly small probability of occurring.

**Section 4.2. Why do firms use derivatives?**

The use of derivatives was quite controversial for a long time. It led to the widely misinterpreted quote of Warren Buffet that derivatives are weapons of "mass destruction."[5] Their use is no longer as controversial. However, it is legitimate to ask whether firms use them to manage risk or to speculate. A number of studies focused on that question. The evidence seems almost unanimous that on average firms use derivatives to reduce risk rather than to speculate. However, some papers do uncover instances where firms use derivatives to speculate or take a view (Geczy, Minton, and Schrand, 2007; Faulkender, 2005; Chernenko and Faulkender, 2011). Faulkender (2005) reaches the rather strong conclusion that interest rate risk management practices are "primarily driven by speculation or myopia, not hedging considerations." A concern with the conclusion is that many firms' interest rate risk management practices are dictated by lenders as discussed later.

Speculation means taking a position without an underlying exposure. When firms hedge, they often size the hedge taking into account their views on the evolution of the risk factor they are hedging. For instance, a firm that will receive a payment in Euros might sell forward only a fraction of the projected receipts if it expects the euro to appreciate more than the market expects. Such an approach is often called selective hedging. If a firm expects the euro to appreciate more than the market expects, it means that the cost of hedging for the firm is higher, so that hedging less could be economically rational (Stulz, 1996). There is much evidence that firms engage in selective hedging (e.g., Brown, Crabb, and Haushalter, 2006), but selective hedging is not speculation.

Much of the risk management literature has used a firms' derivatives positions to measure the extent to which they use financial risk management to manage risk. As a result, there is a vast empirical literature that examines the extent to which the various theories of why firm value depends on total risk discussed in Section 3 help explain how firms manage risk using firms' positions in derivatives. In Section 3, I focused on four main types of risk management theories. I now summarize the evidence on how these theories help

[5] From private correspondence, his statement did not apply to plain vanilla derivatives.

explain the use of financial risk management. The literature has little to say about the use of risk management by firms to reduce the cost of their interactions with stakeholders, so I do not address empirical evidence concerning this reason to manage total risk.

**Section 4.2. a. Managerial risk aversion and incentives.**

The Tufano (1966) study discussed in Section 4.1. also investigates which theories of risk management explain the risk management practices of gold producers. The overwhelming conclusion he reaches from his data is that the main determinant of the extent to which a firm hedges is the incentives of management. Specifically, a firm hedges more if management has a larger share ownership and hedges less if the compensation of management includes more options. These results are exactly what one would expect with theories that emphasize the role of managerial incentives in the determination of the extent to which a corporation hedges. Knopf, Nam, and Thornton (2002) find results consistent with those of Tufano (1966) using the notional amount of derivatives held by firms in a large sample study. Bodnar, Giambona, Graham, and Harvey (2019) exploit data from a survey of executives that they question about risk management practices. Their overwhelming conclusion is that the personal risk aversion of executives who make risk management decisions is of first-order importance. However, other attributes of these executives play a role as well. For instance, they find that career concerns and education modify the effects of risk aversion on hedging.

The literature has pointed out that the impact of options on risk-taking is complicated by the fact that options can be in-the-money or out-of-the-money. Deep in-the-money options can lose considerable value with adverse movements in the stock price, so that a CEO with a deep-in-the-money package of options may actually want to decrease volatility to preserve the value of the options in the package. Nevertheless, there is much evidence that firms where managers hold more options are less risk-averse and, importantly, that this effect is causal. In other words, this effect is not explained by a common firm or manager attribute that affects both the choice of options in the compensation package and the level of risk of the firm. For instance, Bakke, Mahmudi, Fernando, and Salas (2016) use the passage of Financial Accounting Standard

(FAS) 123R which required firms to expense options to show that an increase in the cost of using options results in a large increase in hedging intensity.

Tufano (1996) concludes from his study that he does not find support for the proposition that financial risk management increases firm value. This is correct if one thinks of management as having an exogenously given position in the firm's equity and then maximizing its utility given this position. However, management's incentives are not exogenously given. If one takes the view that the board sets incentives for management to maximize firm value, then the level of risk the firm has is the product of choices made by the board. In this case, the use of derivatives to achieve the level of risk that the board hopes for would make it possible for firm value to be maximized as management would then make decisions more in conformity with what the board hopes for. There is clear evidence in the literature that boards adjust managerial incentives when the risk of the firm changes. For instance, Gormley, Matsa, and Millbourn (2013) consider the impact on managerial risk-taking and firm incentives of a firm having a chemical to which workers have already been exposed classified as a carcinogen. Such a determination creates tail risk for the firm as it might have to compensate these workers. They find that after the determination the board reduces managers' exposure to stock price movements and decreases options-based pay, so that the firm engages in greater risk-reducing activities.

**Section 4.2. b. Financial distress risk.**

The rationale for using financial instruments to reduce the risk of financial distress is straightforward. If financial distress is costly in that it has deadweight costs, expending resources to make it less likely that these costs will be incurred is worthwhile as long as the costs are less than the present value of the reduction in deadweight costs. A meta-analysis of 132 published studies as of 2017 finds that there is considerable support among these studies for the role of financial distress risk in risk management but, interestingly, US studies find less of an effect of leverage than studies for other countries (Geyer-Klingeberg, Hang, Rathgeber, Stöckl, and Walter, 2018). However, it is important to note that the benefit of risk management is in reducing the probability that the firm will have to pay these costs. If the firm is in financial distress, it

is too late to manage risk. In fact, if it is in financial distress, the firm may have to take risks to become less distressed. Consequently, the relation between financial distress and risk management is not necessarily monotone.

We would expect firms for which financial distress is more costly if it occurs to be firms that reduce their total risk from what it would be absent risk management. However, agency costs of debt further complicate predictions. A firm that issues debt has incentives to convince the investors in its debt that it will reduce risk since that enables it to sell the debt at a higher price. Once the debt is sold, the incentives may flip since by increasing risk the firm could transfer wealth from creditors to the equity holders. As a result, for the firm to benefit from selling debt at a higher price, it has to find a way to commit to risk management or creditors have to believe that the firm will find it optimal to keep reducing risk after they have bought the debt. A firm may agree contractually with its lenders to hedge (Campbell and Kracaw, 1990), but it may also be optimal for it to do so ex post without a contractual agreement. Beatty, Reining, and Zhang (2012) find in a sample of 2,449 bank loans that 278 require borrowing firms to enter interest rate swap agreements to hedge interest rate risk. Interestingly, they show that banks charge lower rates for mandatory swap users but not for voluntary swap users.

Purnanandam (2008) develops a theory of corporate risk management in the presence of distress costs that accounts for the issues I just raised and shows support for the predictions of his model. His model implies a nonlinear effect of leverage on hedging, so that firms with low leverage hedge more if leverage increases while firms with high leverage hedge less if leverage increases. The model also has the implication that firms hedge ex post. The intuition of the model is straightforward. An increase in the volatility of cash flows has two separate effects on the firm. First, as cash flow volatility increases, the value of debt falls and hence equity benefits. This is the asset substitution effect (Jensen and Meckling, 1976). Second, an increase in cash flow volatility decreases the present value of future cash flows through the financial distress channel. As a result, there is an optimal amount of cash flow volatility. Because of the distress channel, a firm has incentives to reduce cash flow volatility ex post. When leverage is low, the distress channel dominates; when leverage is high, the asset substitution channel dominates.

To test the predictions of his theory, Purnanandam (2008) examines the use of derivatives for non-financial firms in 1996 and 1997. For foreign exchange derivatives, he uses the notional amount of the derivatives. For commodity derivatives, he can only use information about whether a firm uses these derivatives or not. The prediction of the model is that hedging varies nonlinearly with leverage but leverage itself is endogenously determined. The author uses an instrumental variable approach to obtain exogenous variation in leverage. Using this approach, he finds that the use of foreign exchange derivatives increases with the level of leverage but falls with the squared level of leverage. As a result, when leverage is low the level effect dominates but when leverage is high the squared level dominates.

Another approach to assess the impact of the cost of financial distress on financial risk management is to note that financial distress reduces the return to debt. Consequently, for debtholders to be properly compensated for the risk they take, the yield of debt should increase with the risk of financial distress. We would therefore expect that hedging reduces the cost and increases the availability of debt. Campello, Lin, Ma, and Zou (2011) examine this prediction. They find that hedgers pay lower loan spreads and are less likely to have investment restrictions in their loan agreements. As a result, hedgers invest more.

**Section 4.2. c. Capital structure and tax optimization.**

Capital structure and tax optimization are closely related. In a tradeoff model of capital structure, a firm can increase its value if it can increase leverage while keeping the risk of financial distress constant. A firm that can decrease the risk of financial distress profitably through hedging may therefore be able to increase its leverage to increase the value of its debt tax shield. Graham and Rogers investigate whether firms hedge in response to tax incentives. Smith and Stulz (1985) show that when the tax schedule is convex, i.e., progressive, firms have an incentive to stabilize taxable income through hedging to decrease the present value of future taxes. Graham and Smith (1999) show that for the typical firm the tax schedule is convex. Graham and Rogers (2002) find no support for this theory. However, they do find support for the view that hedging enables the firm to support more debt and hence to have a more valuable debt tax shield.

Shareholders can find it optimal for a firm to have a high level of leverage for other reasons than tax optimization. In particular, leverage can help control agency costs of managerial discretion (Jensen, 1986; Stulz, 1991). Stulz (1991) shows how risk management can increase shareholder wealth by controlling agency costs of managerial discretion through higher leverage. Leverage buyouts increase the leverage of the target firm as a way to control agency costs of managerial discretion. Existing evidence is that they control risk through contracting and financial instruments (Opler, 1993), but we know little about their use of derivatives. However, in their meta-analytical study of 132 studies, Geyer-Klingeberg, Hang, Rathgeber, Stöckl, and Walter (2018) conclude that there is little support that firms use derivatives to control agency costs.

**Section 4.3. Firm value and financial risk management.**

The theories of financial risk management show that financial risk management increases shareholder wealth. It is not surprising therefore that many studies investigate whether risk management increases shareholder wealth. A recent meta-analysis uses 71 previous studies. Aggregating across these studies, Geyer-Klingeberg, Hang, and Rathgeber (2021) find a hedging value premium averaging 1.5% for currency risk hedgers. However, they find a hedging discount for commodity risk hedgers and for interest rate risk hedgers.

Showing that risk management increases shareholder wealth is difficult for many reasons. Even if a researcher is able to measure exactly the extent to which a firm's risk management reduces risk, showing that the risk reduction causes an increase in firm value is fraught with problems. To start with, the core proposition of risk management theories is that a firm has an optimal amount of total risk. It follows that if two firms that appear to be similar have different amounts of total risk, it must be that unobservable characteristics explain this difference. If the firm with more risk has no financial risk management while the firm with less risk has financial risk management, evidence that the firm with less risk has a higher equity value is not evidence that risk management increases firm value. It might just be evidence that the firms are different in ways that are not controlled for. If a firm starts using derivatives and its value is higher

when it uses derivatives than when it does not, it does not follow that using derivatives increases firm value because the firm might just be different when it uses derivatives.

The early studies that examined the relation between shareholder wealth and financial risk management did not generally use approaches that made it possible to have strong confidence that the use of financial risk management affected firm value. This may explain that no consensus emerged from these earlier studies. Since these studies, however, much progress has been made by authors who use changes in the availability of hedging instruments or other changes that affect the benefits of financial risk management but are unrelated to observable or unobservable characteristics of the firms studied. If no derivative was available to a firm to manage an important risk and there is a financial innovation that makes a derivative available, we would expect that firm to start using that derivative if it is optimal to do so. We would then expect the risk of the firm to fall and its value to increase if using that derivative is sufficiently valuable to the firm. The opposite would happen if a change in regulation or in markets leads to existing derivatives becoming less useful to hedge. Gilje and Taillard (2017) conduct such a study. They examine the impact on firms of a change in basis risk in the oil and gas industry that reduced the hedging effectiveness of some contracts. As a result, firms could not manage their risk as effectively. They find that the shock has an adverse effect on shareholder wealth. In addition, firms reduce investment, sell assets, and reduce debt. These effects of an impediment to hedging are consistent with risk management theories that emphasize costs of financial distress.

Other studies that use exogenous variation in the availability or cost of hedging instruments reach similar conclusions. For instance, Perez-Gonzalez and Yun (2013) show that the introduction of weather derivatives caused their sample of weather-sensitive energy firms to have higher valuations, invest more, and increase leverage. Giambona and Wang (2020) use the Safe Harbor Reform of 2005 as a shock. This law made it easier for firms to put up collateral for derivatives, so that it made it easier for companies to use derivatives to hedge. They find that airlines close to distress hedge more after the law and that this has a positive impact on their value. Giambona, Kumar, and Phillips (2022) investigate the impact of a change in life insurance regulation that reduces the cost of hedging. They find the change reduces the risk of

companies. The companies that had higher costs of financial distress appear to benefit most as they increase policy sales, gain market share, and generally become more competitive.

The studies that use exogenous variation to examine the valuation impact of financial risk management agree that financial risk management increases value.

**Section 5. The limits of financial risk management.**

Almost all large firms practice financial risk management, but they do so in a very limited way. The studies that go into the details of how financial risk management is implemented that we have cited all find that firms hedge some risks over a relatively short horizon and the hedge ratios they use are relatively small even for those exposures. For instance, Tufano (1996) shows that firms hedge a small fraction of their gold production over the next two years; Jin and Jorion (2006) show that firms hedge a small fraction of their oil and gas production; Allayannis and Ofek (2001) show that firms hedge mostly foreign exchange transactions. There is no evidence that firms attempt to hedge firm value directly with derivatives. For instance, firms do not hedge reserves with derivatives. In this section, I discuss three of the reasons for why the practice of financial risk management is so limited. The first explanation has to do with the difficulty of assessing exposures. The second explanation concerns the misalignment between accounting and economics. The last explanation concerns costs and frictions in the use of derivatives.

**Section 5.1. Complexity and uncertainty.**

A firm that has a receivable in foreign currency has a well-defined foreign currency exposure that can be hedged in a straightforward way. By hedging that receivable, the firm eliminates a short-term risk and reduces earnings uncertainty. However, consider now the impact of an exchange rate change that occurs tomorrow on the firm's long-run cash flows. To measure that exposure would require understanding how these future cash flows depend on the exchange rate. This would be an extremely complex problem to resolve. For instance, cash flows that are dependent on foreign currency are from sales of a product that might not be competitive in a few years, in which case the firm would have exited the market. Instead of

having a cash flow that is a simple linear function of the exchange rate like an invoiced amount in foreign currency, future cash flows are likely to be highly nonlinear functions of exchange rates with considerable uncertainty about the nature of these functions. A firm might not even know whether it will have an exposure in the future, what sign it will have, and what size it will have. In such a situation, hedging could as likely make the firm worse off as better off. Suppose that the firm thinks it will be long the foreign currency by a large amount, but then that turns out to be wrong and it is short. It means that most likely its derivatives activities will add risk rather than decrease risk. As an example of the impact of complexity and uncertainty, Ghoddusi, Titman, and Tompaidis (2023) examine hedging effectiveness for a commodity processing firm when uncertainty comes both from the demand and from the supply side. They find that in general hedging will not be effective.

As Graham (2022) shows, firms find it difficult to plan beyond a few years ahead and the horizon over which they feel they can plan has fallen over time. If a firm cannot plan, it cannot reliably hedge. A firm that knows that it will have receipts in Euros for one billion has an exposure it can hedge. However, if it has little sense of what its receipts will be, so that it does not have a reliable plan, it has no basis to put on a hedge. It cannot properly assess whether the hedge will decrease risk or not.

Firms bear some risks that are straightforward to hedge. However, they also have many risks that are critical to them that cannot be managed using the tools of financial risk management. The riskiest transformative projects that firms undertake are usually such that the bulk of the risk is business risk for which there is no derivatives solution. Much of that risk may be even hard to define and certainly close to impossible to quantify. For sure, one of the largest value creations of all time is Amazon's development of AWS. I know nothing of how the decision to invest in that project was made over time except what I read in histories of Amazon. However, one would not expect that managers spent much time quantifying the probability of success of the project and the expected cash flows of the project. Kay and King (2020), following Knight (1921), emphasize the role of what they call radical uncertainty. The issue they focus on is that many situations are such that making decisions based on probability estimates is not possible. However, financial risk management is based on knowing the risks and their distributions.

This limitation of financial risk management does not mean that financial risk management is not useful. From Section 3, we know that risk has costs. If financial distress is costly, the firm benefits from reducing the probability of financial distress. Consequently, financial risk management enables firms to take on more risky projects by reducing the risks that can be easily reduced to open space for the risks that cannot be easily reduced (Stulz, 1996).

**Section 5.2. Economics and accounting misalignment.**

Because of the accounting rules with respect to the use of derivatives, it is possible for a firm to reduce economic risk but at the same time increase the volatility of accounting performance. For many firms, this issue makes many types of hedges non-starters. Suppose that a firm hedges foreign exchange exposure that arises in three years using derivatives. The exposure here is not one that corresponds to existing transactions it has made, for instance sales that it has entered contracts for. It corresponds to what the firm expects to do in three years. Hence, changes in the value of that exposure will not show up in quarterly accounting income. In contrast, most likely, changes in the value of derivatives used to hedge that exposure would show up in quarterly accounting income. This means that the firm will have an increase in volatility of accounting income because it decreases its exposure to a foreign currency. Firms generally want lower rather than higher volatility of earnings. For a firm to be willing to take an action that it knows increases substantially the volatility of accounting income, it would have to see a large enough payoff. Firms almost never see that type of payoff in hedging. They will be much more willing to hedge if the hedge qualifies for hedge accounting, so that the gains and losses of derivatives hit earnings at the same time as the gains and losses on the underlying position that is hedged. However, qualifying for hedge accounting for longer-term uncertain exposures is not typically feasible.

**Section 5.3. Frictions in the use of derivatives.**

There are many such frictions. Recent literature has focused on the importance of collateral in the use of derivatives (Rampini and Viswanathan, 2013). When a firm takes a position in derivatives, it may face

a cash outlay or may have to post collateral. Either of these actions is more difficult if a firm is financially constrained. As a result, a firm that is in financial distress may find it too costly or even impossible to enter derivatives positions. As discussed earlier, it is not clear that firms that are already in financial distress will benefit from hedging, but empirical evidence shows that if a firm lacks available collateral it may find hedging more difficult and hedge less (Rampini, Sufi, and Viswanathan, 2014).

Derivatives positions require collateral or cash to open the position. For instance, purchasing options involves an expense. Opening a swap position will often require putting up some collateral. As a result, opening a derivatives position is not a neutral transaction for the firm's liquidity. It will use up liquidity and create the risk that liquidity will be used up in the future. For instance, the present value of a firm's obligations under a swap may increase, so that the mark-to-market value of the swap for the firm may fall. In this case, the firm will generally have to post variation margin, which will use its liquidity. As a result, having derivatives positions can introduce volatility not only in a firm's accounting earnings as discussed above, but also in its unencumbered liquidity.

It is noteworthy that firms find ways to hedge without using standard derivatives to obviate the collateral problem. Specifically, firms often enter purchase agreements which are a form of forward contract. These agreements are between a firm and its supplier in contrast to a derivative which is an agreement between a firm and a financial intermediary. Almeida, Hankins, and Williams (2017) document the wide use of these agreements. Further, Almeida, Hankins, and Williams (2020) show that as firms become financially distressed, they use these instruments more and derivatives less.

Another friction that is widely discussed in the literature is basis risk. For some risks, a firm can find a derivative that hedges the risk it is exposed to perfectly. However, often, it has to choose among several imperfect solutions. For instance, it can find a contract to hedge foreign exchange risk, but the maturity or the amount does not match exactly its exposures. In such a situation, the firm is exposed to basis risk. In the oil and gas industry, derivatives benchmarks are oil and gas prices at specific locations. Producers located close to these locations have naturally less basis risk. Haushalter (2000) shows that firms located closer to the location of the benchmark prices hedge more, presumably because the hedge is more effective.

Part of the basis risk problem arises because standardized derivatives are much cheaper. A firm might enter a customized derivatives contract with a financial intermediary that reduces basis risk, but the cost of derivatives is typically much higher when the derivatives are customized. With customized derivatives, the cost itself can be a barrier to usage.

**Section 6. Risk management and resilience.**

With financial risk management, firms reduce risk ex ante. They take actions that reduce their exposure to risks before these risks have a chance to materialize. This approach does not work if the firm does not know which risks it is exposed to or the magnitude of that exposure. However, building resilience is one way that firms can create shareholder wealth in the presence of complexity and uncertainty.

To understand this approach, it is helpful to think about the motivation to manage risk to reduce the risk of financial distress when a firm has high costs of financial distress. If derivatives can be used to reduce the risk that a firm will suffer from financial distress, it makes sense for the firm to use these derivatives. However, if the firm cannot reduce the risk of falling in financial distress sufficiently using the tools of financial risk management, the firm can try to reduce the costs it will incur if it falls in financial distress directly. If it had no costs of financial distress, it would not have to hedge to reduce the likelihood of financial distress. An analogy is to think about plane safety. Many approaches can be used to reduce the risk that a plane will become disabled in some way in the air, but these approaches will not always work. Sometimes the plane is disabled. At that point, it makes sense to put foam on the runway so that when it attempts a landing there is minimum damage. With risk management for corporations, it often makes sense to put the foam on the runway ahead of time. For instance, firms can make distress less costly by keeping financial flexibility so that they can keep funding themselves in the event that they lose outside financing. Fahlenbrach, Rageth, and Stulz (2021) show the value of flexibility during the COVID-19 crisis of 2020. COVID-19 was precisely the type of risk that was not reasonably quantifiable before 2020. However, firms that had more financial flexibility, namely firms with greater cash holdings and lower leverage, performed better through the crisis.

Building financial flexibility is a way to build resilience. Resilience is the ability of the firm to cope with adverse risk outcomes. It is the foam on the runway. We can think of resilience in two ways. One way is general resilience. It is not designed for specific risks, but instead to help the firm recover from adverse shocks. We can also think of specific resilience. Specific resilience helps the firm cope with a well-defined risk. For instance, specific resilience would be a way to mitigate the loss to the firm of having an interruption in the supply chain because of the materialization of a specific geopolitical risk. The firm could cope with that interruption by having more inventory, but more inventory would not help with other risks.

Firms can build on resilience through operations as well as through finance. Barry, Campello, Graham, and Ma (2022) show that operational flexibility was valuable to firms during the COVID-19 crisis. An important issue is that building resilience through operations has costs. As a result, firms are less likely to invest in operational resilience when they are financially constrained. Acharya, Almeida, Amihud, and Liu (2024) examine the tradeoff between reducing the risk of financial distress and the risk of operational failure. They find that firms invest more in operational risk management when they are sounder financially. Gamba and Triantis (2014) address the choice of risk management tools when a firm can affect financial flexibility, operating policies, and derivatives positions. They conclude that in many situations cash holdings will be the most effective risk management tool. Cash holdings build general resilience in that they help the firm cope with the materialization of a wide range of risks, including some that are not known to exist ex ante. However, Sanz (2023) shows that inventory building can be a more effective way to mitigate supply chain risks than cash holdings when the inputs provided by a supplier do not trade in a spot market and may be hard to secure from other suppliers. Geczy, Minton, and Schrand (2006) study how the gas pipeline industry reacted to deregulation, which increased both price and quantity risk. They find that firms reacted by using several different tools – cash holdings, gas storage, line-of-business and geographic diversification, and commodity derivatives.

Future research in risk management should focus more on better understanding the role of resilience as a risk management tool that increases shareholder wealth. Resilience is generally viewed as the firm's ability to cope with adversity. I have used the concept this way in this article. However, such a definition

appears too limiting. Firms must position themselves so that they can take advantage of opportunities and their risk management helps put them in such a position. Financial flexibility reduces a firm's probability of falling in distress if affected by adverse shocks, but it also enables the firm to find funding more easily if it has new valuable investment opportunities. Though there is a general concern that building resilience is expensive, we do not understand well how to quantify the ex-ante (i.e., before the realization of a risk where flexibility is valuable) costs and benefits of maintaining financial flexibility. Many firms have substantial financial flexibility without seeming to pay a cost in performance. It seems quite clear that firms tend to seek conservative capital structures that give them much flexibility (DeAngelo, Gonçalves, and Stulz, 2018). Future research should help us understand the costs of financial flexibility as well as the costs of other forms of resilience as ways to manage the risk of corporations. Firms use these approaches to manage risk, but they often deal with them quite separately from financial risk management. Firms would benefit from incorporating these approaches in their risk management policies and strategies systematically, so that they can better trade off the costs and benefits of these approaches.

References


Agrawal, Ashwini K., and David A. Matsa. "Labor unemployment risk and corporate financing decisions." *Journal of Financial Economics* 108, no. 2 (2013): 449-470.

Allayannis, George, and Eli Ofek. "Exchange rate exposure, hedging, and the use of foreign currency derivatives." *Journal of International, Money and Finance* 20, no. 2 (2001): 273-296.

Acharya, Viral V., Heitor Almeida, Yakov Amihud, and Ping Liu. "Corporate resiliency and the choice between financial and operational hedging." Working paper (2024).

Almeida, Heitor, Kristine Watson Hankins, and Ryan Williams. "Risk management with supply contracts." *The Review of Financial Studies* 30, no. 12 (2017): 4179-4215.

Almeida, Heitor, Kristine Watson Hankins, and Ryan Williams. "Do firms hedge during distress?" Working paper (2020).

Bakke, Tor-Erik, Hamed Mahmudi, Chitru S. Fernando, and Jesus M. Salas. "The causal effect of option pay on corporate risk management." *Journal of Financial Economics* 120, no. 3 (2016): 623-643.

Barry, John W., Murillo Campello, John R. Graham, and Yueran Ma. "Corporate flexibility in a time of crisis." *Journal of Financial Economics* 144, no. 3 (2022): 780-806.

Bartram, Söhnke M. "Corporate hedging and speculation with derivatives." *Journal of Corporate Finance* 57 (2019): 9-34.

Bartram, Söhnke M., Gregory W. Brown, and Jennifer Conrad. "The effects of derivatives on firm risk and value." *Journal of Financial and Quantitative Analysis* 46, no. 4 (2011): 967-999

Bartram, Söhnke M., Gregory W. Brown, and Frank R. Fehle. "International evidence on financial derivatives usage." *Financial Management* 38, no. 1 (2009): 185-206.

Bartram, Söhnke M., Gregory W. Brown, and Bernadette A. Minton. "Resolving the exposure puzzle: The many facets of exchange rate exposure." *Journal of Financial Economics* 95, no. 2 (2010): 148-173.

Beatty, Anne, Reining Petacchi, and Haiwen Zhang. "Hedge commitments and agency costs of debt: evidence from interest rate protection covenants and accounting conservatism." *Review of Accounting Studies* 17 (2012): 700-738.

Bodnar, Gordon M., Erasmo Giambona, John R. Graham, and Campbell R. Harvey. "A view inside corporate risk management." *Management Science* 65, no. 11 (2019): 5001-5026.

Bolton, Patrick, Hui Chen, and Neng Wang. "A unified theory of Tobin's q, corporate investment, financing, and risk management." *The Journal of Finance* 66, no. 5 (2011): 1545-1578.

Breeden, Douglas T., and S. Viswanathan. "Why do firms hedge? An asymmetric information approach." *Journal of Fixed Income* 25, no. 3 (2016)*:1-25.*

Brown, Gregory W., Peter R. Crabb, and David Haushalter. "Are firms successful at selective hedging?." *The Journal of Business* 79, no. 6 (2006): 2925-2949.

Brown, Jennifer, and David A. Matsa. "Boarding a sinking ship? An investigation of job applications to distressed firms." *The Journal of Finance* 71, no. 2 (2016): 507-550.

Campbell, Tim S., and William A. Kracaw. "Corporate risk management and the incentive effects of debt." *The Journal of Finance* 45, no. 5 (1990): 1673-1686.

Campello, Murillo, Chen Lin, Yue Ma, and Hong Zou. "The Real and Financial Implications of Corporate Hedging." *The Journal of Finance* 66, no. 5 (2011): 1615–47.

Chernenko, Sergey, and Michael Faulkender. "The two sides of derivatives usage: Hedging and speculating with interest rate swaps." *Journal of Financial and Quantitative Analysis* 46, no. 6 (2011): 1727-1754.

Coles, Jeffrey L., Naveen D. Daniel, and Lalitha Naveen. "Managerial incentives and risk-taking." *Journal of Financial Economics* 79, no. 2 (2006): 431-468.

Coles, Jeffrey L., Jason Sandvik, and Nathan Seegert. "CEO risk exposure distorts investment decisions." Working paper (2023).

DeAngelo, Harry, and Linda DeAngelo. "The irrelevance of the MM dividend irrelevance theorem." *Journal of Financial Economics* 79, no. 2 (2006): 293-315.

DeAngelo, Harry, Andrei S. Gonçalves, and René M. Stulz. "Corporate deleveraging and financial flexibility." *The Review of Financial Studies* 31, no. 8 (2018): 3122-3174.

DeMarzo, Peter M., and Darrell Duffie. "Corporate incentives for hedging and hedge accounting." *The Review of Financial Studies* 8, no. 3 (1995): 743-771.

ISO, 2018. International Standard ISO 31000: Risk management – Guidelines. Second edition. ISO.

Fahlenbrach, Rüdiger, Kevin Rageth, and René M. Stulz. "How valuable is financial flexibility when revenue stops? Evidence from the COVID-19 crisis." *The Review of Financial Studies* 34, no. 11 (2021): 5474-5521.

Faulkender, Michael. "Hedging or market timing? Selecting the interest rate exposure of corporate debt." *The Journal of Finance* 60, no. 2 (2005): 931-962.

Froot, Kenneth A., David S. Scharfstein, and Jeremy C. Stein. "Risk management: Coordinating corporate investment and financing policies." *The Journal of Finance* 48, no. 5 (1993): 1629-1658.

Gamba, Andrea, and Alexander J. Triantis. "Corporate risk management: Integrating liquidity, hedging, and operating policies." *Management Science* 60, no. 1 (2014): 246-264.

Géczy, Christopher, Bernadette A. Minton, and Catherine Schrand. "Why firms use currency derivatives." *Journal of Finance* 52, no. 4 (1997): 1323-1354.

Géczy, Christopher C., Bernadette A. Minton, and Catherine Schrand. "The use of multiple risk management strategies: Evidence from the natural gas industry." *The Journal of Risk* 8, no. 3 (2006): 19-54.

Géczy, Christopher C., Bernadette A. Minton, and Catherine M. Schrand. "Taking a view: Corporate speculation, governance, and compensation." *The Journal of Finance* 62, no. 5 (2007): 2405-2443.

Geyer-Klingeberg, Jerome, Markus Hang, Andreas W. Rathgeber, Stefan Stöckl, and Matthias Walter. "What do we really know about corporate hedging? A meta-analytical study." *Business Research* 11 (2018): 1-31.

Geyer-Klingeberg, Jerome, Markus Hang, and Andreas Rathgeber. "Corporate financial hedging and firm value: A meta-analysis." *The European Journal of Finance* 27, no. 6 (2021): 461-485.

Giambona, Erasmo, Anil Kumar, and Gordon M. Phillips. "Hedging, contract enforceability and competition." Working paper, 2023.

Giambona, Erasmo, and Ye Wang. "Derivatives supply and corporate hedging: Evidence from the Safe Harbor Reform of 2005." *The Review of Financial Studies* 33, no. 11 (2020): 5015-5050.

Gilje, Erik P., and Jérôme P. Taillard. "Does hedging affect firm value? Evidence from a natural experiment." *The Review of Financial Studies* 30, no. 12 (2017): 4083-4132.

Ghoddusi, Hamed, Sheridan Titman, and Stathis Tompaidis. "Hedging commodity price risk." *Journal of Financial and Quantitative Analysis* 58, no. 3 (2023): 1202-1229.

Gormley, Todd A., David A. Matsa, and Todd Milbourn. "CEO compensation and corporate risk: Evidence from a natural experiment." *Journal of Accounting and Economics* 56, no. 2-3 (2013): 79-101.

Graham, John R. "Presidential address: Corporate finance and reality." *The Journal of Finance* 77, no. 4 (2022): 1975-2049.

Graham, John R., and Daniel A. Rogers. "Do firms hedge in response to tax incentives?" *The Journal of Finance* 57, no. 2 (2002): 815-839.

Graham, John R., and Clifford W. Smith. "Tax incentives to hedge." *The Journal of Finance* 54, no. 6 (1999): 2241-2262.

Guay, Wayne, and Sri Prakash Kothari. "How much do firms hedge with derivatives?" *Journal of Financial Economics* 70, no. 3 (2003): 423-461.

Haushalter, G. David. "Financing policy, basis risk, and corporate hedging: Evidence from oil and gas producers." *The Journal of Finance* 55, no. 1 (2000): 107-152.

Jin, Yanbo, and Philippe Jorion. "Firm value and hedging: Evidence from US oil and gas producers." *The Journal of Finance* 61, no. 2 (2006): 893-919.

Jensen, Michael C. "Agency costs of free cash flow, corporate finance, and takeovers." *The American Economic Review* 76, no. 2 (1986): 323-329.

Jensen, Michael C. and William H. Meckling. Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of Financial Economics* 3, no. 4 (1976): 305-360.

Kay, John, and Mervyn King. *Radical uncertainty: Decision-making beyond the numbers*. WW Norton & Company, 2020.

Knight, Frank Hyneman. *Risk, uncertainty and profit*. Vol. 31. Houghton Mifflin, 1921.

Knopf, John D., Jouahn Nam, and John H. Thornton Jr. "The volatility and price sensitivities of managerial stock option portfolios and corporate hedging." *The Journal of Finance* 57, no. 2 (2002): 801-813.

Leland, Hayne E. "Agency costs, risk management, and capital structure." *The Journal of Finance* 53, no. 4 (1998): 1213-1243.

Lewellen, Katharina. "Financing decisions when managers are risk averse." *Journal of Financial Economics* 82, no. 3 (2006): 551-589.

Mayers, David, and Clifford W. Smith Jr. "On the Corporate Demand for Insurance." *The Journal of Business* 55, no. 2 (1982): 281-296.

Merton, Robert C. *Continuous-time finance*. Wiley-Blackwell, 1992.

Mian, Shehzad L. "Evidence on corporate hedging policy." *Journal of Financial and Quantitative Analysis* 31, no. 3 (1996): 419-439.

Minton, Bernadette A., and Catherine Schrand. "The impact of cash flow volatility on discretionary investment and the costs of debt and equity financing." *Journal of Financial Economics* 54, no. 3 (1999): 423-460.

Opler, Tim C. "Controlling financial distress costs in leveraged buyouts with financial innovations." *Financial Management* (1993): 79-90.

Pérez-González, Francisco, and Hayong Yun. "Risk management and firm value: Evidence from weather derivatives." *The Journal of Finance* 68, no. 5 (2013): 2143-2176.

Purnanandam, Amiyatosh. "Financial distress and corporate risk management: Theory and evidence." *Journal of Financial Economics* 87, no. 3 (2008): 706-739.

Rampini, Adriano A., and Sridhar Viswanathan. "Collateral and capital structure." *Journal of Financial Economics* 109, no. 2 (2013): 466-492.

Rampini, Adriano A., Amir Sufi, and S. Viswanathan. "Dynamic risk management." *Journal of Financial Economics* 111, no. 2 (2014): 271-296.

Robichek, Alexander A., and Stewart C. Myers. "Problems in the theory of optimal capital structure." *Journal of Financial and Quantitative Analysis* 1, no. 2 (1966): 1-35.

Ross, Stephen A. "Compensation, incentives, and the duality of risk aversion and riskiness." *The Journal of Finance* 59, no. 1 (2004): 207-225.

Sanz, Leandro. “Supply network fragility, inventory investment, and corporate liquidity.” Working paper (2023).

Senbet, Lemma W., and Tracy Yue Wang. "Corporate financial distress and bankruptcy: A survey." *Foundations and Trends® in Finance* 5, no. 4 (2012): 243-335.

Sharpe, William F. "Capital asset prices: A theory of market equilibrium under conditions of risk." *The Journal of Finance* 19, no. 3 (1964): 425-442.

Stulz, René M. "Optimal hedging policies." *Journal of Financial and Quantitative analysis* 19, no. 2 (1984): 127-140.

Stulz, René M. "Managerial discretion and optimal financing policies." *Journal of Financial Economics* 26, no. 1 (1990): 3-27.

Stulz, René M. “Risk management and derivatives.” Southwestern College Publishing (2003).

Stulz, René M. "Rethinking risk management." *Journal of Applied Corporate Finance* 9, no. 3 (1996): 8-25.

Smith, Clifford W., and René M. Stulz. "The determinants of firms' hedging policies." *Journal of Financial and Quantitative Analysis* 20, no. 4 (1985): 391-405.

Titman, Sheridan. "The effect of capital structure on a firm's liquidation decision." *Journal of Financial Economics* 13, no. 1 (1984): 137-151.

Tufano, Peter. "Who manages risk? An empirical examination of risk management practices in the gold mining industry." *Journal of Finance* 51, no. 4 (1996): 1097-1137.