

# **RISK MANAGEMENT**

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*“The best laid plans of mice and men often go astray.” -- Robert Burns*

*“Risk comes from not knowing what you're doing.” -- Warren Buffett*

Even simple economic endeavors, such as saving to buy a home, often go astray. Large corporations face a much more complex array of threats to success. Yet there is wisdom in Warren Buffett’s above quote. Informed risk management can reduce risk to tolerable levels, allowing companies to thrive. The consequences are economic success, new jobs, new products, and long-lasting benefits to society. In more extreme terms, the only risk-free path is not to operate at all, a path that ensures no gains. Sound risk management thus aims to allow managers to focus on creating value while reducing the risk of distraction.

That said, the academic evidence on the importance of risk management is frequently described as ‘mixed’ (MacKay and Moeller, 2007; Bodnar et al., 2019). This article will explore accomplishments in the literature, discuss where there has been a disconnect between theory and empirics, and highlight the many fertile areas for future work. Key to a constructive discussion of risk management is first establishing a baseline understanding of risk. As such, we begin by building a broad taxonomy for categorizing the key risks faced by a non-financial corporation (although the principles often apply equally to financial companies). We then delve into the motivations for managing risk as seen through the lens of various stakeholders, as well as broader interactions with the supply chain and product market. The chapter also surveys the many financial and operational hedging tools documented in the literature. We conclude with a discussion of possibilities for additional novel research.

## **I. TAXONOMY FOR UNDERSTANDING RISK**

Overall, the process of risk management requires understanding the fundamentals of risks, how to measure exposures, and understanding what specific actions can minimize the impact of risk at the lowest possible cost. To avoid falling victim to Warren Buffet’s quote above, we begin this chapter with an overview of the research on understanding and categorizing material risks. Unlike like cash or leverage, this fundamental element of a corporation does not have a uniform definition. Our taxonomy provides a foundation for understanding how risk manifests and can be grouped into categories. In turn, this will guide why and how risk can be managed.

## *Scope*

Scope is perhaps the most important dimension of risk-categorization. Risks typically fall into one of three buckets ranging from narrow to broad in scope: idiosyncratic, systematic, and systemic risk. Idiosyncratic risks are the most diverse and firm-specific, and this category includes risks that typically affect just one firm (or at most a handful of firms) at any one time. For example, consider a biotech company led by a single renowned scientist who is researching a cure for a new disease. One idiosyncratic risk is the possibility that the star scientist will leave the company before the research is completed. This retention risk is unique to this company, as the scientist's departure will not affect most other companies in the economy. It follows that managing this risk will likely require a custom internal risk management tool that is unique to this employee. Examples include employment contracts granting large rewards to the scientist if they stay with the company, contracts that preclude them from working with a competitor, or a "key man" insurance policy that pays off if the scientist is unable to work.

The second category is systematic risks, which are risks jointly faced by a large fraction of firms in the economy at the same time. Examples include major shifts in inflation, interest rates, exchange rates, or recession. Systematic risks tend to be macro-economic, whereas idiosyncratic risks have roots in micro-economics. There is little any one company can do to prevent systematic risks from materializing. Instead, companies must hedge their exposure. The concept of systematic risk dates at least as far back as the Black (1972) capital asset pricing model and the Arbitrage Pricing Theory of Ross (1976). These risks can be severe. For example, the onset of a moderate recession in the early 1990s is often credited with triggering the failure of numerous leveraged buyout deals initiated in the late 1980s (Eckbo and Thorburn, 2013). This risk could have been managed by taking on less debt or by using derivatives. Importantly, these tools can reduce exposure for the hedging party, but they do little to mitigate the severity of the shock itself.

The final category is systemic risk, which includes risks due to flaws in the political or economic system itself. Standard forms of systemic risk include loopholes or imperfections in the regulatory framework. The financial crisis of 2008 is an extreme example, where scholars argue that regulatory failures (Acharya and Richardson, 2009) led Bear Stearns and Lehman Brothers to fail, exacerbating an economy-wide recession that was taking hold. Changes in the financial markets also matter. Index investing in commodities markets has made prices less informative to producers (Brogaard, et al., 2019). Because systemic risk has roots in the political economy, risk management practices are different. For example, hiring lobbyists to promote regulatory changes (Bradley, et al., 2016), and contributing to the political campaigns of supportive candidates, are examples of risk management. Systemic risk also can be difficult to measure. For example,

few foresaw the coming of the financial crisis in 2008. Studies that attempt to measure systemic risk include Hanley and Hoberg (2019) and Bartram, Brown, and Hund (2007).

### ***Risk Horizons***

Another key element of defining risk is considering the duration of the exposure. Some risks only matter for a short period of time. For example, a hurricane might pose a risk of landfall tomorrow. This event could result in significant damages, but the threat will pass quickly. Likewise, some loans might create a short-term interest rate risk exposure. Often, short-term risks can be straightforward to manage, as financial products with clear time horizons simplify hedging.

However, many risks are longer-term and require a more elaborate and dynamic risk management plan, as simple derivative hedging strategies can lose efficacy for longer-term exposures (Kim, Mathur, and Nam, 2006). This is especially true when the level of demand is uncertain (Chowdhry and Howe, 1998). One example is the airline industry's exposure to fuel costs. Southwest Airlines used oil price hedges to create a competitive advantage for many years (Bailey, 2007). However, the company's true exposure to oil prices did not match the length of the contracts they acquired, and their advantage was not sustainable. Another example is Gruma, a tortilla maker in Mexico with a material exposure to the neighboring U.S. market. Gruma took a large derivative position aimed at hedging the dollar to peso exchange rate. Yet, when the peso crashed quickly in 2009, the contracts created a large short-term liability that led to significant distress, and Gruma's stock price experienced an 80% decline.

A unique challenge with longer-term risks is that it is difficult to predict how much exposure to a given risk a company will have deep into the future. Hence, uncertainty regarding the appropriate quantity of derivatives to transact - paradoxically - can amplify risk. The near bankruptcy of Metallgesellschaft is a classic example (Mello and Parsons, 1995). In these situations, operational hedges can be attractive, as this strategic form of risk management scales with the size of the business even over longer periods of time.

### ***Diversifiable Risks***

In addition to scope and duration, the portfolio of exposures requires consideration. Some risks are easily diversified whereas others are not. In our setting of non-financial firms, diversifiable risks dissipate toward zero impact as a business scales up. The most salient example is geographic or international risk. A company operating in a single city is exposed to the unique economic shocks of that city. Yet, when the

company expands geographically, the risk of any one city becomes immaterial. Similar logic applies to multinational corporations. When a company operates in just 1-2 nations, political shocks can significantly impact cash flows. In contrast, a company operating in 10 nations faces less exposure due to diversification, and this is amplified by increased flexibility to adjust operations across the nations to absorb the shock. This view is noted by Lucas (1977), although it has been challenged by Acemoglu, et al. (2012), as countries are connected by strong international network links, which can limit diversification.

In contrast, exposure to macro risks such as inflation are less diversifiable. For example, a large domestic firm faces rising prices in the same way that a smaller firm does. Note that whether a risk is diversifiable or not is different from identifying whether the risk can be hedged. Many undiversifiable risks are macro in nature and these still can be hedged by trading derivatives. They also can be mitigated by holding larger cash balances when risk exposures are elevated.

### ***Internal vs External Risks***

Another dimension for categorizing risk is the source. Some risks materialize due to actions or issues that transpire within a firm. One example is fraud, as was the case for Enron in the early 2000s, or Theranos more recently. Another example is the risk of losing key personnel. These risks can be managed by making changes within the firm, such as improving accounting controls, hiring a more reputable auditor, or buying key man insurance. However, many risks are external in nature. These include both financial risks (such as a change in the interest rates) and business risks (such as increased product market competition, supply chain disruptions, or cybersecurity risk).

Climate change is one of the most pressing and complex external risks, with a myriad of ramifications for corporations. Depending on location, firms may be exposed to a higher likelihood of property damage due to hurricanes, floods, or wildfires. Damages also can vary widely in severity. More extreme temperatures may affect both labor productivity and availability. Moreover, climate concerns also can impact firms through increased regulatory risk or institutional investor activism. Increased insurance premiums, lower productivity, magnified energy bills, and/or greater investments to relocate or retrofit buildings to confront climate change all can translate into a higher cost of capital (Chava, 2014; Seltzer, Starks, and Zhu, 2022). Here, investments in CSR may provide hedging benefits (Sharfman and Fernando, 2008; Albuquerque, Koskinen, and Zhang, 2019). Yet research on this topic is both nascent and challenging. For example, changes in climate are thought to be “slow moving”, making it difficult to separate the impact of long-term

changes in climate from the impact of “one-off” events such as hurricanes. Understanding how to measure and hedge climate risk remains a fertile area of research going forward.

### ***Ambiguity vs Risk***

Part of the challenge of climate risk is the horizon uncertainty (Barnett, Brock, and Hansen, 2020), and understanding the foundations of uncertainty is also important to understanding risk management more broadly. Risk aversion impacts a decision maker when they face an uncertain outcome. Classical theories assume that the decision maker understands the probability distribution associated with the possible outcomes. This knowledge of probabilities allows the decision maker to thoroughly assess the degree of risk exposure and to formulate a sound risk management strategy. However, some real-world scenarios are such that the decision maker might lack full information on the probabilities themselves. This issue is formally known as ambiguity. Decision makers also might face the more specific issue of ambiguity aversion (see Ellsberg, 1961, for early theory). Research suggests that ambiguity can confound risk management strategies. For example, Izhakian and Yermack (2017) find that elevated levels of ambiguity can lead managers to exercise their stock options earlier, which can unravel incentives aimed at ensuring managers maximize firm value. Although research on ambiguity is more nascent, these results suggest that jointly understanding both ambiguity and risk can fine-tune risk management strategies.

### ***Discussion***

In all, categorizing risks provides unique insights on how risks manifest. This holds for both classic risks such as input costs or financing uncertainty as well as increasingly salient risks like climate change or technology issues related to artificial intelligence or cybersecurity (Kamiya, et al., 2021; Florackis, et al., 2023). Relatedly, there has been an explosion of research generating many new and potentially useful measures of corporate risk. Some capture broad changes in the economy such as the dispersion of profitability (Bloom 2009) or common macroeconomic uncertainty (Jurado, et al., 2015) while others focus on firm-specific exposures. Many use accounting or price data (e.g., option data in Dew-Becker and Giglio, 2023) while others employ textual analysis (e.g., Hoberg, Phillips, and Prabhala (2014)’s product market fluidity or Manela and Moreira (2017)’s news implied volatility). We believe our risk taxonomy not only provides a lens for understanding risk but also a perspective on how these novel measures of risk fit into the larger, holistic picture. In turn, this implies a natural framework for formulating an appropriate risk management strategy.

## II. WHY MANAGE RISK?

*“The key to risk management is never putting yourself in a position where you cannot live to fight another day.” -- Richard S. Fuld, Jr.*

*“I always tell other people to protect against the downside... but I never stuck to that rule myself.” – Richard Branson*

Whether it is the risk of loss of a key employee, a change in commodity costs, or a decline in sales, the unifying element of corporate risk is that it has the potential to disrupt normal operations. But, as the above quotes suggest, how managers respond to this fundamental issue varies widely. This section will tackle the first part of this puzzle, which is why firms should care about managing risk. Perhaps surprisingly, the reasons for hedging are far broader than simply minimizing underinvestment and distress costs. Risk management plays an important role in firm operations across numerous dimensions, including contracting with suppliers and customers as well as designing effective compensation contracts.

Of course, not all hedging decisions are value maximizing. Managers may hedge due to risk aversion or for signaling goals. The benefits of hedging vary widely across firms - requiring not only identifying key exposures, but considering how various risks are correlated, align with investment opportunities, or can be transferred to other parties. Moreover, risk management has a cost such as purchasing insurance, increasing cash reserves, or hiring a Chief Risk Officer. Importantly, this section also will discuss when not to hedge.

### *The Classics*

We start with the number one reason to hedge: firms need cash. Numerous risks outlined in the prior section can disrupt the availability of cash for the firm to engage in its basic operations. Of course, this logic presupposes the existence of financial market frictions. In their absence, the firm would simply access external financing to cover any temporary shortfalls. In a perfect world, therefore, hedging adds no value. However, in the real world, the confluence of market frictions and cash flow volatility means risk management matters.

A significant amount of research in risk management builds on two seminal papers: Smith and Stulz (1985) and Froot, Scharfstein, and Stein (1993) provide a framework for risk management in a world with financial frictions, re-negotiable debt, and costly external financing. To the extent that financial or operational hedging decisions can reduce cash flow volatility, the firm will have a more stable stream of funds to service

debt obligations (minimizing the expected costs of financial distress) and invest in positive NPV projects (limiting underinvestment). The evidence supporting these two risk management motivations is both substantial and nuanced.

While minimizing expected distress costs seems like an obvious motivation for risk management, early research found that many firms do not practice this wisdom. Paradoxically, firms using derivatives are larger and have better access to the capital markets (Nance, Smith, and Smith, 1993; Mian, 1996). That is, firms with lower expected distress costs appear to hedge more. More recent work provides insight into this paradox. Rampini, Sufi, and Viswanathan (2014) argue that collateral constraints predict less hedging as firms approach distress as constrained firms may opt to spend scarce resources on new investment instead of hedging and document decreased financial hedging near distress. These findings are further reconciled with the seminal theories when we take a more holistic view of hedging. Almeida, Hankins, and Williams (2022) recognize that not all hedging tools have the same costs and document that non-financial firms do in fact continue to hedge as their financial condition deteriorates. These firms switch from financial derivatives (high fixed and collateral costs) to less costly purchase obligations. This evidence builds on the focused study of Aunon-Nerin and Ehling (2008), which shows that corporate property insurance use, an alternative risk management option, also correlates with expected distress costs. Thus, incorporating broader measures of hedging activity beyond derivatives is crucial to understanding the strong support for the classic theory of Smith and Stulz (1985).

The empirical evidence has been more consistent on the second major topic of hedging to limit underinvestment (Gam and Nam, 1998; Minton and Schrand, 1999; Haushalter, Heron, and Lie, 2002). Yet strong causal evidence didn't arrive until more recently. Cornaggia (2013) uses the introduction of various crop insurance products to clearly connect risk management to changes in agricultural productivity. In highlighting the importance of local access to finance for hedging and investment, these results directly illustrate that hedging products relax external financial constraints. Gilje and Taillard (2017) explore variation in basis risk within the oil and gas industry to present compelling evidence in support of firms hedging to both limit underinvestment and to reduce expected distress costs. Further, Alexandridis et al. (2021) find that hedging supports M&A investments specifically by enabling better access to capital. Moving forward, some questions remain for future research, which might explore the precise channels through which hedging affects investment and external financing. Some candidates include signaling managerial quality, monitoring, or reducing the distress risk.



The costs and probability of underinvestment will vary by firm, influencing the decision to hedge. Firms with more valuable investment opportunities need to prioritize having sufficient internal funds (Gamba and Triantis, 2008). Géczy, Minton, and Schrand (1997) and Graham and Rogers (2002) find that firms with higher growth options hedge more while Haushalter, Klasa, and Maxwell (2007) show that hedging to avoid underinvestment is particularly compelling when rivals with related growth options have predatory incentives. Yet we note that the literature would benefit from additional research improving causal identification. A less explored facet of hedging heterogeneity is the correlation of cash flows and investment opportunities described as ‘variability of investment opportunities’ in Petersen and Thiagarajan (2000) or ‘hedging needs’ in Acharya, Almeida, and Campello (2007). While it may be difficult to find direct evidence on the role of growth options, researchers might explore how firms adjust their business lines or make acquisitions to manage the correlation of cash flows and investment opportunities. Although evidence is limited to financial firms, there is evidence that firms recognize the risk management benefits of acquisitions which reduce overall cash flow volatility (Hankins, 2011).

Hedging not only can reduce cash flow volatility, but the increased stability of cash flows can expand a firm’s debt capacity (Leland, 1998; Graham and Rogers, 2002). Higher levels of debt then can increase the value of tax shields, a central feature of debt financing. Smith and Stulz (1985) illustrate this potential value creation of smoothing cash flows in the face of convex corporate taxation. While several empirical papers document that hedging indeed expands debt capacity (Haushalter, 2000; Graham and Rogers, 2002; Campello et al., 2011), there is little evidence of the tax convexity channel (Mian, 1996; Graham and Rogers, 2002; Perez-Gonzalez and Yun, 2013). Although more research is needed, this lack of evidence might be due to alternative tax shields. In addition to expanding debt capacity, hedging also is associated with a lower cost of the debt (Kumar and Rabinovitch, 2013; Chen and King, 2014; and Campello et al., 2011). While the cross-sectional evidence is broadly consistent, the value of alternative tax shields and the ability to move cash flow generating assets into low-tax jurisdictions could be relevant for future researchers, who could examine the 2017 Tax Cuts and Jobs Act to provide further insight on this topic.

### *Agency Issues*

Firms are complex organizations, rife with potential agency issues stemming from imperfect information or incentives. As such, hedging decisions have ramifications both for conflicts of interest amongst investors as well as risk aversion for internal agents including executives and labor.

### *Asset Substitution*

To start, recall that hedging can expand debt capacity and the level of debt is pivotal in understanding asset substitution and underinvestment. The presence of risky debt can distort the incentives to invest in projects where cash flows will disproportionately benefit debtholders. Active risk management - modeled as insurance - mitigates this underinvestment concern in Mayers and Smith (1987). Revisiting this topic, Bessembinder (1991) shows how financial derivatives increase the likelihood that equity holders are the residual claimant, thus reducing underinvestment stemming from equity versus debtholder conflicts. More recent work by Morellec and Smith (2007) extends this literature to consider manager-stockholder agency conflicts. That paper finds that hedging can limit overinvestment, explaining the otherwise puzzling hedging policies of large, unconstrained firms. Likewise, Chod and Zhou (2014) argue that hedging (taking the form of resource flexibility) by lowering the likelihood of bankruptcy, decreases both asset substitution and underinvestment.

Although the above studies show that hedging can reduce agency issues in theory, the empirical evidence is not as clear. By smoothing cash flows and reducing the need for external financing, Tufano (1998) notes that hedging actually can increase agency issues. There is evidence that hedging is indeed higher for entrenched CEOs (Kumar and Rabinovitch, 2013). Extending the notion of agency concerns to include a temporal component, Purnanandam (2008) presents a dynamic model of leverage and hedging. While hedging generally increases with debt, the incentive to hedge disappears with extreme leverage. Once a firm approaches insolvency, the equity value is increasing with volatility and thus the manager should cease hedging. Examining derivatives use, that paper finds less hedging in highly leveraged firms.

### *Information Asymmetry*

Hedging alters not only the stability of cash flows but also the information environment. Understanding information asymmetry thus is essential for why firms hedge. In DeMarzo and Duffie (1995), true managerial ability is unknown, and thus shareholders look to firm performance for information. The key take-away of their model is that risk management affects the balance of information between insiders and outsiders. Empirically, Brown (2001) presents case study evidence documenting hedging to smooth earnings while Pincus and Rajgopal (2002) document the substitution between hedging and the use of accruals to smooth earnings within the oil and gas industry. Like the evidence in Balakrishnan, Billings, Kelly, and Ljungqvist (2014) on voluntary disclosure, hedging is an alternative tool for managing the flow

of information. The implications of managers exploiting this potential are underexplored and include influences on peer investment (Foucault and Fresard, 2014).

A first implication is that hedging might increase firm opacity. In discussing corporate tax minimization, Donohue (2015) illustrates how derivatives create a wedge between reported and actual economic activity. Interestingly, Chang, Donohue, and Sougiannis (2015) document that analyst estimates are less accurate and more dispersed when firms initiate derivatives use. While this research abstracts from the motivation to start hedging, the evidence complements other research in this area. For example, Manconi, Massa, and Zhang (2018) find that hedging affects both information asymmetry as well as the profitability of informed trades.

Going further, changing the transparency of hedging can affect risk management choices. Analyzing the introduction of SFAS 133, Zhang (2009) finds that increased reporting requirements for derivative instruments lead many firms to reduce risk-taking. Although Lennox, Francis, and Wang (2012) raise concerns with the use of selection models such as Zhang (2009), identification concerns are common with among the older papers in this survey. Although these earlier contributions are important building blocks for the literature, we believe many topics can benefit from an increased focus on causal identification.

### *Risk Aversion and Compensation*

Within our discussion of agency issues, attention must be paid to the role of the managerial incentives and risk preferences. To reduce their personal exposure to own firm-risk, risk averse managers can pursue corporate decisions such as diversifying mergers (Gormley and Matsa, 2011) and underinvestment (Panousi & Papanikolaou, 2012). Characteristics such as manager age (Crocì, et al., 2017), culture (Li et al., 2013; Lievenbruck and Schmid, 2014), and risk salience (Dessaint and Matray, 2017) all associate with precautionary behavior. Even early studies (Stulz, 1984; Smith and Stulz, 1985) highlight that managerial risk aversion would encourage hedging but recognize that compensation potentially could counterbalance. In that spirit, Tufano (1996) finds hedging in the gold mining industry to be positively related to manager equity positions but negatively related to option compensation. Likewise, Knopf, Nam, and Thornton (2002), Rogers (2002), and Rajgopal and Shevlin (2002) link compensation incentives to risk management.

More recent evidence confirms the importance of managerial preferences. Using the passage of Financial Accounting Standard 123R on option compensation expensing, Bakke, Mahmudi, Fernando, and Salas (2016) provide causal evidence linking option compensation to hedging intensity and thus contribute causal

evidence on the risk aversion motive to hedging. Complementary survey evidence by Bodnar et al. (2019) document an association between personal risk aversion and risk management which is consistent with both agency theory as well as risk averse executives matching to more conservative firms.

Of course, agency issues and risk aversion aren't limited to managers. A primary benefit of hedging is to reduce cash flow volatility and the firm often is better suited to manage this risk than are other related parties such as employees, customers, or suppliers (Smith and Stulz, 1984). Idiosyncratic firm risk is particularly costly to employees. Berk, Stanton, and Zechner (2010) provide a theoretical framework for connecting employees' labor risk concerns to precautionary corporate behavior. Empirically, changes in labor risk (as proxied by unemployment insurance laws) indeed affect corporate decisions such as leverage and cash (Agrawal and Matsa, 2013; Devos and Rahman, 2018), and firms with more skilled labor - and thus higher risk of employee retention - adopt more precautionary financial policies (Qui and Wang, 2021; Baghai et al., 2021). However, the current evidence focuses on capital structure decisions - not specific financial or operational hedging decisions. Risk management could reduce the burden of idiosyncratic risk on employees, but a direct connection between labor risk and hedging has yet to be documented.

### *Speculation*

While the focus of this chapter is risk management, managers also can use financial derivatives to speculate. As such, derivatives use does not necessarily measure risk management and many papers attempt to disentangle these motivations. For example, Adams, Dasgupta, and Titman (2007) illustrate the product market's influence on hedging decisions while discussing the incentives to speculate. Thus far, the empirical evidence on the degree to which firms use derivatives to speculate is mixed. Allayannis and Ofek (2000), Adam and Fernando (2006), and Bartram (2019) find that derivatives generally support risk management while Faulkender (2005) and Adam (2009) document evidence of speculation.

The mixed evidence on speculation might stem from important heterogeneity in the incentive to speculate across firms. Using survey evidence, Géczy, Minton, and Schrand (2007) find that compensation incentives as well as weaker corporate governance figure prominently in the speculative use of derivatives. However, the authors also argue that risk management is the first-order determinant of establishing a derivative investment program. Complementary evidence is provided by Chernenko and Faulkender (2011). That paper both documents that firms hedge to address external financing frictions while showing that compensation contracts affect the decision to speculate and manage earnings using derivatives. Allayannis, Lel, and Miller (2012) also find that corporate governance moderates the temptation to speculate with

derivatives. The role of governance is buttressed by Hege, Hutson, and Laing (2021), who use Sarbanes-Oxley to document a causal link between governance and risk management. Lastly, both Beber and Fabbri (2012) and Adam, Fernando, and Golubeva (2015) provide evidence that speculative derivative use increases with managerial overconfidence.

### *The Big Wide World*

Thus far, we focused on firm-specific determinants of hedging, but firms are hardly isolated actors. Understanding corporate hedging decisions requires a more expansive perspective. Competitors, investors, and suppliers can influence this decision. On some level, their roles are simply extensions of earlier topics. For example, having sufficient internal funds to make strategic investments in response to product market threats is a variation on hedging mitigating underinvestment. Yet, these external relationships are pervasive and hence are an important and interesting dimension of risk management decisions.

### *Product Market*

The importance of the product market for hedging decisions is well-recognized going back to Froot, Scharfstein, and Stein (1993). Intuitively, hedging should vary with the degree of competition and whether competitors also hedge, as the availability of internal funds enables a firm to make strategic investments and thus impact competitive outcomes (Adam, Dasgupta, and Titman, 2007; Fresard, 2010). While anecdotes like the competitive advantage Southwest Airlines attributes to its fuel hedging program in the 2000s lend credence to the channel, empirical evidence also supports the relevance of competition. Purnanandam (2008) notes financially distressed firms operating in highly concentrated industries hedge more with derivatives while Haushalter, Klasa, and Maxwell (2007) document that predation risk correlates with both increased financial hedging and cash. Moreover, this evidence extends beyond derivatives hedging. Hoberg, Phillips, and Prabhala (2014) find product market fluidity leads to more conservative liquidity management across multiple dimensions. Future work could explore whether certain hedging tools or precautionary behaviors are more or less effective in the face of product market competition as well as strengthening the links between the corporate hedging and industrial organization literatures.

### *Supply Chain Linkages*

Supply chain issues are also important and can be framed as an extension of classical expected distress costs. A firm's likelihood of distress, and the associated counterparty risk it entails, is relevant for customers

and/or suppliers. The notion of indirect costs of financial distress originated in the capital structure literature (Titman, 1984; Titman and Wessels, 1988), but it also clearly applies to risk and liquidity management.

Supply chains are linked by the exchange of payments and goods, and we first focus on the financial side of these relationships. The distress of one firm can impact the operations of its trading partners (Hertzel et al., 2008). More than 30% of executives surveyed by Giambona et al. (2018) express credit risk concerns with long-term contracts with both consumers and suppliers and this risk affects the availability of trade credit (Aral et al., 2022). Trade credit not only exposes a firm to a customer's potential financial distress (Altinoglu, 2021), it also opens the door to the delayed payments. The 2021 collapse of Greensill Capital underscored the importance timely inter-firm payments as well as efforts devoted to general liquidity management. Further, the Greensill insolvency also illustrated that supply chain financing is a risk in and of itself – something that regulators and rating agencies are starting to notice.

Beyond payments, firms are linked by the transfer of goods. Hold-up problems are a classic corporate finance and industrial organization topic as relationship-specific investments are costly and require faith in the ability and intent of the counterparty. However, supply chain risk is more than a bargaining game. Upstream problems in procurement and/or quality can trickle down quickly – particularly with more specialized goods. While supply chain disruptions stemming from Covid-19 lockdowns and labor shortages made the front-page news, managing supplier risk has been increasingly important for firms over time. In 2016, the Wall Street Journal ran a full article on professional service firms like KPMG offering enhanced services for supply chain monitoring, ranging from operations to geopolitical exposure (Chao, 2016). Third party risk management (TPRM) is an understudied academic field, but there is support for the conclusion that firms consider supplier and customer risk beyond payment default. For example, risk of supply chain disruption (Kulchania and Thomas, 2017) and more central exposure to production network shocks (Gao, 2021) lead firms to precautionary behavior. Future research might focus on how firms balance these more idiosyncratic risks in the context of other hedging decisions.

### *Financial Markets and Institutions*

Just as hedging can reduce contracting frictions with labor or suppliers, it also mitigates frictions in the credit markets. There is broad evidence that industry and product market risks influence credit market terms (Benmelech and Bergman, 2011; Valta, 2012; Campello and Gao, 2017). As noted in the discussion of debt capacity, if risk management lessens the likelihood of financial distress, it also facilitates access to credit –

potentially lowering required collateral, allowing more lenient payment terms, or enabling contracts with more selective counterparties (Campello et al., 2011).

Indeed, access to the capital markets is a key determinant of risk management decisions. Most directly, Adam (2002) examines whether firms use derivatives to reduce their reliance on external funding. On the intensive margin, imperfect or uncertain access leads to more precautionary behavior as modeled in Arellano, Bai, and Kehoe (2019) and as shown empirically by Harford, Klasa, and Maxwell (2014), who documented evidence relating to debt rollover risk. On the equity side, Friberg, Hankins, and Goldstein (2023) show that the risk of future equity misvaluation leads to precautionary behavior. As investor composition can contribute to current or future misvaluation (Stambaugh, Yu, and Yuan, 2015; Ben-David, Franzoni, and Moussawi, 2018), this is another attribute of the financial markets which can influence risk management incentives both to maintain financial flexibility and to reduce information asymmetry.

The final component of financial market influence on risk management is simply the hedging product itself – both in terms of availability, suitability, and cost. Minton and Schrand (1999) note, “hedging costs are likely to be higher for firms in which significant cash flow volatility results from factors that are relatively uncorrelated with interest rates, foreign exchange prices, or commodity prices.” As such, the introduction of new insurance or derivative products (Cornaggia, 2013; Perez-Gonzalez and Yun, 2013; Almeida, Hankins, and Williams, 2017) can impact firm hedging decisions. Clearly, cost also is relevant. For example, the Wall Street Journal reported recent declines in foreign currency valuations have made derivative hedging more attractive.<sup>2</sup> Bartram, Brown, and Fehle (2009) present international evidence that the size of the local derivatives market is an important predictor of derivatives use. Providing causal support of the importance of hedging costs, Giambona and Wang (2020) use the Safe Harbor Reform of 2005 to document that decreasing the cost of financial derivatives increases hedging for treated firms while Giambona, Kumar, and Phillips (2022) find lower hedging costs enable insurance firms to lower prices and increase market share.

### ***When Not to Hedge***

This issue of hedging cost brings us to the final question: When should a firm not manage risk? The cost of risk management is more than simply the cost of a contract. First, one can consider the fixed cost of

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<sup>2</sup> Maurer, WSJ May 28, 2020: “Alamos Gold Inc. last month decided to take advantage of low currency-exchange rates for the Canadian dollar and Mexican peso against the U.S. dollar. The Canadian gold miner protected more of its currency exposure and extended that cover for a longer period.”

establishing a risk management department and this proves to be a significant hurdle for smaller firms (Mian, 1996; Haushalter, 2000). For example, Purnanandam (2007) finds that small banks use fewer derivatives than larger banks, but they substitute hedging toward more aggressively managing the duration gap between their assets and liabilities (a form of operational hedging). Collateral is another key aspect of hedging cost. Insightful work by Rampini et al. (2014) illustrate how collateral constraints may limit derivative use for constrained firms as collateral pledged to a hedge position cannot be pledged to support investment. In addition, regulatory costs matter (Sen, 2022) and survey evidence suggests that increased derivatives regulation would reduce financial hedging for many firms (Giambona et al., 2018). Further, Breeden and Viswanathan (2015) posit hedging costs may vary with managerial ability, although empirical support for this hypothesis remains to be seen.

Further, there is considerable heterogeneity in the expected benefits of risk management. Since the primary goal of hedging is to address risks which might disrupt normal operations (such as funding new projects or servicing debt), the focus should be on ‘material’ exposures as there is little expected benefit of managing trivial exposures. While exposure size is the first component of that evaluation, firms need to consider both the level of individual exposures as well as their correlation. Likewise, the correlation of the aggregate cash flows with the firm’s investment opportunities also matters (Duchin, 2010; Palazzo, 2012). A higher level of correlation implies that cashflows will offset and firms will gain less from risk management. In fact, an extremely low probability of distress or disrupted operations may make hedging irrelevant (Stulz, 1996).

Evaluating materiality also depends on the degree to which a shock can be transferred or absorbed. Most readers will remember that the supply chain and labor issues of 2022 were transferred, at least in part, to consumers via higher prices. This is, in part, a function of the product market as noted by Kofi Bruce, the CFO of cereal maker General Mills Inc. “It’s not just us feeling the effects of rising inflation.... We are all likely looking at the same headwinds.” Depending on broader market trends, firms may be able to extract concessions from labor or suppliers that mitigate the impact of negative events. Further, the practice of pass-through may be formalized with pass-through agreements such as those in the airline industry (Carter, Rogers, Simkins, 2006) or a “game-day” decision to transfer costs to consumers by raising prices when negative shocks arise or when the firm needs liquidity. Bodnar, Dumas, and Marston (2002) illustrate this practice and explain how the degree of pass-through depends on market structure while Hankins, Momeni, and Sovich (2023) document that captive finance units enable firms to transfer costs shocks to consumer credit, not just the price of goods. Intuitively, optimal pass-through declines when competitive pressure or product substitution increase. Hence, this practice is likely to be more effective when firms have unique



products or when competition is low, as rivals are less likely to steal market share during times of high firm-specific pass-through.

A final – and frequently overlooked – element of the decision to hedge or not is the risk inherent in the hedge. Mello and Parsons (2000) warn, “a poorly conceived hedge may increase the expected costs of financing, tightening the financial constraints on the firm.” The effectiveness of risk management using derivatives, much like contracting with suppliers, depends both on the counterparty risk as well as the having a contract that fits the exposure. Gilje and Taillard (2017) document that a change in basis risk – or hedge effectiveness – has a material impact on firm hedging and investment. Almost counter-intuitively, uncertainty itself may reduce the benefit of some hedging as derivatives create obligations when prices move in the opposite direction (Bretscher, et al., 2018).

Quantity risk is a serious concern as many contracts lock in future prices but only for a predetermined amount. Rolfo (1980), for example, discusses how production variation leads to less than full hedge efficacy. Chowdhry and Howe (1999) and Brown and Toft (2002) point to a key tension that arises given the fact that firms ultimately need to hedge revenues, and the impact of revenues on overall profits. Revenues are a function of both price (P) and quantity (Q). Overall, derivatives can be effective hedges against price risk, but can lose efficacy in the face of quantity risk. Standard foreign exchange derivatives directly hedge price risk across nations, as currency prices can change quickly with local inflation, allowing firms to mitigate currency exposure when they repatriate revenue from goods sold abroad. Unfortunately, however, these same derivatives can quickly lose efficacy when quantities sold are also stochastic. In a recent example, many airlines found themselves ‘overhedged’ on fuel prices when Covid hit, demand for flights plummeted, and jet fuel prices dropped. The risk manager needs to know quantity in order to determine how large a derivative position to take, and this is highly uncertain when future quantities sold are uncertain. This simple intuition also likely explains why firms tend to hedge short-horizon risk more perfectly than long-horizon risk. Firms have a harder time determining quantities in the long term, and hence taking smaller derivative positions becomes a safer, albeit imperfect, strategy. However, there is scant evidence on how firms evaluate the potential cost of being locked into hedging contracts that exacerbate rather than reduce volatility.

### **III. HOW DO FIRMS HEDGE?**

Clearly, corporate hedging is a function of the cost as well as the availability of risk management options. This section will discuss the vast array of risk management tools, starting with the most obvious -

derivatives. Beyond derivatives, the toolkit is even more broad and includes financial strategies such as holding precautionary cash, contracts such as property insurance, operational hedges such as operating in many foreign locations, and product pricing strategies that shift risks to other parties. Moreover, Bartram, Brown, and Fehle (2009) note that firms can use a basket of these strategies together in a portfolio approach. This fits into the broader notion of enterprise risk management. While this section will review numerous risk management tools, that does not imply that each is used in a vacuum. Rather the preponderance of evidence suggests that firms evaluate risks – and their hedging responses – in aggregate rather than on an individual basis (Nocco and Stulz, 2006; Hankins, 2011).

### *Derivatives*

*“Corporate derivatives use appears to be a small piece of non-financial firms’ overall risk profile.”*  
Guay and Kothari, 2003

*“The widespread use of derivative instruments... clearly indicates ...  
proactive ... management of financial exposures”*  
Bodnar, Consolandi, Gabbi and Jaiswal-Dale, 2003

Any discussion of how firms hedge must begin with derivatives. Yet, as the two quotes above suggest, their use can be appropriate in some cases, but alternative risk management strategies dominate in others. Part of our exploration of “how firms hedge” (the extensive margin) also ventures into the issue of how much firms hedge given that there is wide variation in hedge ratios (the intensive margin). Early theory by Stulz (1984) derives optimal hedging policies for risk averse managers, and further notes that issues like managerial incentives and hedging costs can lead hedge ratios to vary significantly from unity, the case of fully hedging risk. Froot, Scharfstein, and Stein (1993) argue that hedging intensity also will depend on investment strategies, as these issues drive financing needs. These studies suggest that “how much firms hedge” can vary, but also that there are scenarios where the need to hedge is mission critical.

Yet aggressive hedging might not always be warranted, and we note a salient example from the gold mining industry, where some shareholders prefer that managers do not hedge at all. Getting exposure to gold prices is a primary motive for their investing in these stocks. CEO Greg Robinson of Newcrest Mining stated, “Our investors are looking for spot price exposure,” insisting that shareholders could hedge on their own if desired. The key point is that readers should be open-minded regarding the question of “how the firms hedge” and expect that the answer to this question might range widely.

Rather than focusing on extremes, we now ask “what does the average firm do”? The literature suggests that Newcrest is not representative, as most publicly traded firms do hedge. For example, Hoberg and Moon (2017) find using textual analysis of the 10-Ks of both large and small U.S. public firms that 55% indicate that they use foreign exchange derivatives, a figure that establishes a lower bound as some companies might not disclose these practices or might do so using non-standard language. Studies in Europe find slightly higher numbers. Bodnar, Consolandi, Gabbi, and Jaiswal-Dale (2013) provide survey evidence from Italy indicating that roughly two-thirds of non-financial firms hedge currency and interest rate risk, and the overwhelming majority use derivatives. Similarly, Brunzell, Hansson, and Liljeblom (2011) report that 62% of listed companies in four Nordic European nations use derivatives. Among Chilean non-financial firms, Alfaro, Calani, and Varela (2021) show that derivative use is growing quickly over time and is more prevalent among firms engaged in international trade. Overall, these studies suggest that derivative use is widespread among publicly traded firms and is a global phenomenon.

Although the above studies suggest that the extensive margin of derivative use is roughly two-thirds among public companies, the results are less clear regarding the intensive margin of how intensely firms hedge, as noted by Guay and Kothari (2003). Examining 224 large non-financial firms, they find that derivative positions are economically small and provide only limited protection against shocks. More recently, Gamba and Triantis (2014) develop a calibrated structural model and draw a similar conclusion: derivatives likely contribute no more than 2% economic value to the firm on average. Yet the authors note that this understates the value of risk management overall due to the use of alternative risk management strategies that we discuss later such as precautionary cash. Measuring the true intensity of derivative use among users, and the resulting efficacy of this use, ultimately remains an active research area. Further, connecting this work to compensation incentives and division performance would be highly beneficial.

Some studies focus on specific scenarios and document that derivative hedging can be valuable (see Haushalter (2000) for oil and gas firms, Allayannis and Weston (2001) for exporters, and Carter, Rogers, and Simkins (2006) for airlines). However, not until the influential and relatively recent paper Perez-Gonzalez and Yun (2013) was there a clear link between hedging and firm value. Exploiting firm level variation in weather exposure and the introduction of weather derivatives, this paper documents a positive impact of financial hedging and firm value. This natural experiment supports hedging both reducing the external financing constraint as well as mitigating underinvestment.

In addition to documenting the widespread use of derivatives, the literature also has found that firms use multiple types of derivatives. MacKay and Moeller (2007) examine a sample of 34 oil refiners and show

that the type of derivative used across firms varies but most use a combination of operating (energy derivatives) and financial (interest rate derivatives and foreign exchange derivatives) derivatives. Each type of derivative can assist in mitigating a specific type of risk. That said, derivative use is not a panacea, as these instruments can lack full efficacy in many cases, and some risks do not have corresponding traded derivatives. In theory, a simple solution to solve these efficacy issues would simply be to use more sophisticated derivatives. Brown and Toft (2002) indeed suggest that the use of exotic derivatives can overcome even the challenge of hedging quantity risk. Unfortunately, however, exotic derivatives can be impractical due to high transaction costs and illiquidity. The authors note that a partial substitute is dynamic derivative hedging (see Duffie and Richardson, 1991, for a technical treatment), where the level of exposure is managed frequently over time as new information about quantity uncertainty is received. Yet this strategy might be difficult to employ if information about quantities arrives via jumps, and especially if derivative markets become illiquid when jumps arrive. This unfortunate liquidity profile of derivative markets is supported by evidence from the Asian financial crisis by Allayannis, Brown, and Klapper (2003).

Next, we turn to the many alternative risk management practices to assist risk managers in the cases where derivatives are less effective. These include financial management strategies, using contracts to manage risk, and operational hedging strategies. These channels are the focus of the remainder of this section.

### ***Financial Hedging Strategies***

The second major category of risk management tools entails tailoring the firm's financing policies to mitigate various risks facing the firm. This form of risk management is called financial hedging. As motivation, Boyle and Guthrie (2003) provide a theory of liquidity and financial constraints. The theory suggests that, by holding cash (precautionary savings), firms can reduce financial constraints and can smooth and time investment better. As we will explain in this section, financial risk management includes financial strategies based on cash, payout policy, the level and mix of debt, letters of credit, and leasing.

#### *Cash*

Bates, Kahle, and Stulz (2009) find strong empirical support for the use of precautionary cash holdings as a risk management tool. Underscoring its large economic importance and its growth in use over time, the authors find that average cash holdings in 2006 (the end of their sample) was sufficiently large such that it could retire the totality of firm debt obligations. As cash holdings are also largest for firms facing higher risk, and firms doing the risky investments in R&D, the results are consistent with managers holding cash

as a risk management tool. However, scholars do not fully agree that this intuition can explain all cash holdings, as Faulkender, Hankins, and Petersen (2019) find that a large fraction of these growing cash balances are held offshore, particularly in nations where tax rates are low. These findings suggest that some of the cash balances are driven by tax considerations and not precautionary needs.

Yet evidence of precautionary savings as a risk management tool remains vast, suggesting that it is likely a significant and important tool for many firms. Cash balances increase in response to product market competition (Hoberg, Phillips, and Prabhala, 2014), debt refinancing risk (Harford, Klasa, and Maxwell, 2014), and the stock price fragility (Friberg, Goldstein, and Hankins, 2023). Stand-alone firms hold more cash than diversified multi-segment firms (Duchin, 2010), and the value of cash is lower for more diversified firms (Bates, Chang, and Chi, 2018). Taken together, the literature suggests that cash – while not exclusively held for precautionary reasons - is a major risk management tool widely used by firms facing many different types of risk.

### *Payout*

Intuitively, corporate payouts also offer financial hedging benefits. Bonaimé, Hankins, and Harford (2014) show that firms can hedge by using more flexible payout schemes. Repurchases are more flexible than dividends, affording the firm more leeway to adjust the size of payouts whenever cashflow risks materialize, a form of smoothing. The authors find that this type of financial hedging is a substitute, as increased use of flexible payouts is negatively related to the use of other financial hedging strategies. Hoberg, Phillips, and Prabhala (2014) show that firms pay fewer dividends, and make fewer payouts overall, when firms face higher competitive threat risk. The authors show that this approach is complementary to holding cash, as lower payouts facilitate precautionary cash accumulation without needing to pay issuance costs to raise capital. Overall, these studies indicate that financial hedging instruments are flexible and can be bundled as substitutes or complements, and managers might consider payout and precautionary cash policies together as part of a unified strategy.

### *Leverage*

Another major category of financial hedging entails the use of debt with various characteristics to reduce risk exposures. Allayannis, Brown, and Klapper (2003) focus on three categories of debt: issued in foreign currency, issued in local currency, or in synthetic local currency. (Synthetic local debt is debt issued in foreign currency but hedged using derivatives, thus creating debt payments that effectively are in local

currency.) The authors illustrate risk management costs and benefits to each approach. For example, a company receiving revenue from a foreign source might issue debt in foreign currency to align its inflows and outflows, reducing the net dependence on foreign exchange conversion and thus exposure to exchange rates. The choice of synthetic-local versus pure-local debt might be driven by the relative cost and liquidity of the needed derivatives. Yet the authors examine risk management performance during the Asian financial crisis and note that synthetic local debt performed poorly, likely due to illiquidity of derivatives market during crisis periods. Similarly, the choice of fixed versus floating rate debt offers yet another way to use different types of debt to manage risk, although this particular dichotomy is most relevant to financial firms facing duration mismatch in their assets and liabilities. Vickery (2008) illustrates these issues and emphasizes that smaller and medium-sized financial firms are more likely to use alternative ways to hedge rather than derivatives, likely because smaller firms are less willing to pay the fixed costs necessary to develop a complete derivatives-based risk management program.

Preserving debt capacity is yet another way that debt issuance strategies can complement risk management strategies. Debt capacity offers future liquidity to smooth unexpected cash flows (Rampini and Viswanathan, 2010) or fund investment spikes (DeAngelo, DeAngelo, and Whited, 2011). Thus, it serves to manage risk much in the same way that precautionary savings does. Yet many firms do not use this risk management tool, exhausting their debt capacity in bad times and ultimately becoming financially constrained. An alternative debt strategy is described in Gamba and Triantis (2008). Firms can borrow and lend simultaneously, and this practice can mitigate risk exposures. For example, the firm might borrow using long-maturity debt, and, at the same time, improve liquidity by lending some of its cash balances using shorter-maturity lending. The latter can be pulled back to fund unexpected needs also in the same way that precautionary cash preserves liquidity. A key benefit to this more elaborate strategy is that cash does not need to be idle and can earn yield, provided it remains relatively liquid and available when needed. Finally, Cornaggia (2013) provides additional evidence regarding the relevance of availability of liquid financing as part of a sound risk management program by documenting how access to finance boosts the impact of hedging on productivity. If financing is unlikely to be available when needed, precautionary cash is the more appropriate risk management device as highlighted in Acharya, et al., (2013).

A final note on debt is that its use, at least in its most basic form, can increase risk. Indeed, debt contracts (unlike equity) require the firm to make fixed payments, and this can be problematic in times of economic distress or limited liquidity. Although managing the type of debt can reduce this risk (as noted above), Strebulaev and Yang (2013) examine the more extreme, and diametrically opposite, scenario of having no debt at all. Zero leverage firms tend to be younger and have higher market-to-book ratios, consistent with firms using zero leverage when they expect high levels of future investment and potential financial

constraints. Hence, opting for equity rather than debt financing reduces the risk of financial constraints for higher growth companies. Although this interpretation is intuitive and likely has merits, Strebulaev and Yang (2013) note that the underlying causes of zero leverage firms are unclear and may reflect managerial preferences. For example, some zero leverage firms pay large dividends, indicating the leverage choice was unlikely due to worries about financial constraints. Further exploration of these issues remains relevant for future research.

### *Additional Financial Hedging Tools*

Beyond cash, payout, and debt, other financial risk management tools include letters of credit (LOCs), leasing, and pensions. Sufi (2009) illustrates that LOCs can be seen as an (imperfect) substitute for precautionary cash. Firms prefer cash instead of LOCs when they are more likely to face financial covenant violations as cash can facilitate compliance with covenants more easily. Acharya, Almeida, and Campello (2013) go further and suggest that LOCs are more costly for firms that face higher systematic risk exposures (higher betas and higher exposure to recession risk). When macroeconomic risk is high, the banks providing the LOCs might also face distress. This can place the LOC itself, and its negotiated terms, at risk of deterioration. Firms facing higher macroeconomic risk should therefore favor cash. On the other hand, Disatnik, Duchin, and Schmidt (2014) show that LOCs are likely preferred when the firm also participates in derivative hedging. In particular, LOCs can be less costly than cash, as holding excess cash in itself exposes the firm to agency costs. In sum, these articles suggest that LOCs are likely more appropriate for larger and less cyclical firms, and firms in less competitive markets as such firms might face a higher risk of agency costs.

Leasing also offers risk management benefits because it increases debt capacity and repossessing a leased asset entails less friction than repossessing an owned asset (Eisfeldt and Rampini, 2009). Reducing this friction can be particularly valuable to firms that are financially constrained, and these firms do tend to lease more (likely to increase debt capacity). Devos and Li (2020) further show that leasing transfers the risk inherent to the value of the asset from the lessee to the lessor. Hence, this arrangement can be pareto improving when the lessee faces higher risks than the lessor. The lessee would have usage rights but would also hedge away the ownership risk to the lessor. This transfer would entail some rents for the owner, but the overall outcome should be pareto improving to both parties. Petersen (1994) also shows that pension design offers similar risk management benefits. A defined contribution plan creates more financial flexibility relative to a defined benefit plan. As is the case with leasing, a change in pension plans can transfer risk away from the firm toward other parties. Here, the transfer is to employees who might face a

higher risk of inadequate funding at the time of retirement. This, in turn, might increase costs for the firm during labor negotiations.

### *Contracts*

The third major category of risk management tools entails using contracts to mitigate specific risks facing the firm. As contracts can be customized, this entails a very wide array of practices, some of which are still poorly understood in the literature. Yet the literature documents many choices that make it clear that contracts are an important hedging option.

Perhaps the most intuitive risk management contract is insurance. An insurance policy can be customized, and terms can be negotiated. The result is ultimately a contract between insurer and insured. This flexibility creates a great deal of variety. Firms can purchase insurance for liability, property, political risk, credit risk, cyber risk, and more. For instance, Israelsen and Yonker (2017) document the use of key-man insurance to hedge human capital risk. This insurance is typically obtained for companies that are smaller and riskier, and that have less diversification in their human capital. The insured individuals tend to be highly educated, and the most exposed firms lose about 8% of their value when a key person departs, indicating that this insurance can be economically important.

Supply chain contracts, while the source of potential risk, also offer opportunities to reduce risk. Firms needing to purchase inputs to production have a choice: purchasing input at spot prices or locking in future prices for a period using purchase obligations. Almeida, Hankins, and Williams (2017) illustrate the risk management role of purchase obligations. Further affirming the risk management role, the authors further show using a quasi-natural experiment that purchase obligations are a substitute for financial derivatives. Purchase obligation contracts are generally 1-3 years in duration, are non-cancellable, and use fixed prices. These contracts are thus like forward contracts (derivatives) but are firm-specific and not traded.

Firms also use contracts to incentivize management. Gormley, Matsa, and Milbourn (2013) examine an unexpected change in firm risk profiles and find that firms cut managerial exposure to stock prices and reduce pay convexity when these risks are suddenly higher. In turn, this induces managers to take actions that are more consistent with risk management: they cut leverage and R&D, stockpile cash, and engage in more diversifying acquisitions. However, these findings do not indicate a risk management panacea, as these managerial policies are also consistent with agency problems and they might not increase value.



Indeed, Gormley and Matsa (2016) suggest that such incentives to do diversifying acquisitions are met with negative announcement returns.

There are other contracts that provide risk management. Kini, Williams, and Yin (2021) show that non-compete agreements have risk management as a primary motive, and their use is more prevalent when the potential damage of having an important employee relocate to a competitor is large. This risk management tool ultimately manages the risk of competitive threats and competitive entry. A final note on contracts is that Campello, Lin, Ma, and Zou (2011) show using an instrumental variable based on the convexity of statutory tax rates that hedging strategies are effective, and that hedging actually facilitates more advantageous contracts. For example, firms with better hedging are more likely to win debt contracts that do not limit investment intensities. Hence the causality between risk management and contracts can go both ways, indicating a strong economic link and potential complementarities.

### ***Operational Hedging***

A key limitation of many hedging strategies, especially derivative, is that they are less effective when companies face significant levels of quantity risk or when risks are longer-term in nature (Chowdhry and Howe, 1999). With less predictable future quantities, price risk is more difficult to hedge. Although dynamic management of the size of a derivative portfolio can partially overcome the challenges of quantity risk, the literature suggests that a different risk management tool, operational hedging, can be particularly effective. The literature also documents that the operational hedging tool kit is quite diverse, offering firms many opportunities to reduce risk in a way that naturally scales with the size of the business and that may be more effective for longer-term risks.

Allayannis, Ihrig, and Weston (2001) illustrate that geographic diversification is one such approach, as a multinational firm operating in many nations has relatively little residual undiversified exposure to risks that might emerge in any single nation. However, the authors note that this strategy is best when used in conjunction with financial hedging programs. Another strategy in this multinational setting is pointed out by Hoberg and Moon (2017), who document the operational hedge of purchasing inputs in the same nations where output is sold. This strategy matches inflows and outflows denominated in the same currencies, thus reducing net exposure to the risks of the given nation. This approach is particularly useful in nations where foreign exchange derivatives are not available or are illiquid. Moreover, it is effective in the presence of quantity risk, as the scale of the hedge naturally scales with the degree of exposure (the amount of input needed to be purchased is typically proportional to quantities sold).

It is natural to propose that outsourcing, which is different from offshoring (which keeps operations within the firm's boundaries), can also be used as a risk management tool even for purely domestic companies facing other sources of risk. Outsourcing might improve flexibility to the extent that outsourcing contracts can be adjusted when demand fluctuates. However, Moon and Phillips (2021) find that the data does not support this strategy. Outsourcing creates new risks just as it can mitigate others. If either outsourcing partner enters distress, relationship-specific investments can be lost, and disruptions could occur.

Corporate restructuring in the form of acquisitions and asset sales can also be used as an operational hedging strategy. For example, Garfinkel and Hankins (2011) show that vertical acquisitions can be driven by supply chain risk management considerations. Increases in uncertainty lead firms to vertically integrate, and ultimately, merger waves follow. These findings support the view that supply chain risk is a first order risk management focus. Hann, Ozbas, and Ogneva (2013) provide further evidence as they report that diversifying acquisitions reduce systematic risk while Hankins (2011) documents that operational hedging through acquisitions is a substitute for other hedging strategies. Risk management through restructuring is also not limited to acquisitions, as Bates (2005) finds that asset sales can also serve a risk management purpose. In particular, the divesting firm is more likely to retain the sale proceeds, and receive higher returns to doing so, when the firm is more innovative. These findings are consistent with risk management to preserve investment flexibility for more dynamic companies. Yet the author notes that this strategy does not apply to all firms, as firms with poor investment opportunities might also retain cash and increase investments, consistent with value-destroying agency motives.

We note two additional operational hedging strategies. First, Tomlin (2006) shows that diversifying the number and quality of suppliers can serve as a risk management strategy. Exposure to just one or only a small number of suppliers can expose a firm to significant risks should the sole supplier become unreliable. Diversifying suppliers intuitively reduces this risk, and the author shows that the reliability of suppliers also intuitively matters to the efficacy of this strategy. Second, Bianco and Gamba (2019) show that managing inventory is also an operational hedge. Inventory can hedge the cost of inputs to production, as its presence allows the firm to forego purchasing inputs for a period of time in distress scenarios. The authors find that this strategy is particularly effective when bundled with precautionary savings, as this liquidity can facilitate the firm's maintaining its investments even in the presence of financial constraints.

## *Pricing Strategies and Risk Management*

The prior section noted that the decision to hedge depends on the ability of a firm to pass through cost shocks to customers. Bartram, Brown, and Minton (2010) explain low nominal amounts of derivative use by noting that part of the risk exposure (10-15%) is indeed passed on to consumers while Hankins, Momeni, and Sovich (2023) highlight how firms with captive finance units can pass through cost shocks to both the price of products and financing terms. Intuitively, the more exposure that is passed onto consumers, the less exposed is the firm even if it avoids derivatives, and hence less hedging is necessary. This relates to a broader discussion of pricing strategies in risk management. Deneckere, Marvel, and Peck (1996) show that resale price maintenance (RPM) is an additional hedging option. With RPM, firms can set prices low to mitigate the risk of entry by discount retailers or other aggressive competitors. This strategy also helps firms to avoid excess inventory issues when demand is lower. The combination of resale price maintenance and pass-through options suggest that pricing – either high or low – offers risk management potential. However, each is different and should be employed to solve different types of uncertainty exposures.

## *IV. CONCLUSION*

This chapter provides an overview for risk management research and documents the importance of this area for corporate finance. The first section provided a framework for categorizing corporate risk. The second reviewed the many motivations for corporate hedging, as well as the times when firms should not hedge. Lastly, the third provided an extensive overview of the rich array of financial and operational risk management options. Throughout the chapter, we have highlighted areas where topics could be revisited with more modern identification strategies or where additional evidence is needed.

We hope this work will encourage further research. There is growing evidence that risk management can enhance productivity (Cornaggia, 2011), reduce the cost of capital (Hann, Ogneva, and Ozbas, 2013), and mitigate underinvestment (Gilje and Taillard, 2017). That is, corporate risk management is a potential source of value. But there is much to learn about which hedging tools best address specific exposures, how various risk management strategies complement each other, how firms use risk management to influence the information environment, which hedging options best support growth and innovation, and which executive teams use hedging to maximize firm value. Additionally, the growth in ESG concerns among citizens, business leaders, and regulators gives rise to a new area of research that remains important for scholars going forward.

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