

Financial Hedging and Operational Flexibility in a Multinational Network

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Abstract—This paper examines the relationship between financial hedging and operational flexibility within a Multinational Corporation (MNC). We develop a formal model of two corporate structures: an expansion MNC that operates in a single product market across multiple countries, and a diversified MNC that operates across different product markets. The model shows that financial hedging and operational flexibility may function either as substitutes or as complements. The nature of this relationship depends on three key factors: return volatility, redeployment costs, and managerial risk aversion. By integrating these factors into a single framework, the paper helps reconcile the mixed findings in the literature on the interplay between these two important risk-management strategies in MNCs.

Keywords—financial hedging, real options, operational flexibility, complements, substitutes, risk aversion

I. INTRODUCTION

A distinctive advantage of a Multinational Corporation (MNC) is its operational flexibility. This flexibility can be viewed as a set of real options—such as compound or cross-border options—that allow the firm to respond to contingencies related to demand, taxes, tariffs, costs, and exchange rates within a global supply chain (Ding *et al.*, 2007). Real options theory explains the unique value derived from this multinational network; specifically, the ability to shift value chain activities like sourcing, manufacturing, and distribution across countries provides a strategic advantage not available to purely domestic firms. This flexibility allows an MNC to mitigate downside risk while capturing upside benefits as global contingencies change (Tong & Reuer, 2007).

Moreover, this type of real option is not always fairly priced in the market. Because of market incompleteness, firms may be able to use operational flexibility to create value, depending on factors such as volatility, correlation, and current return advantage (Sakharov & Folta, 2015). Operational flexibility can therefore serve as a form of operational hedging that enables firms to adapt more effectively to volatile market conditions and, in some cases, enhance firm value (Chod *et al.*, 2010; Huchzermeier & Cohen, 1996)¹. In addition to operational hedging, firms frequently use financial hedging. In practice, financial hedging can be implemented through instruments such as forwards, futures, swaps, options, and insurance products. Although corporate risk management would be irrelevant in a Modigliani-Miller world of perfect capital markets, a large

literature shows that hedging matters when market imperfections are present. Hedging may create value because managers are risk-averse (Stulz, 1984), taxes are convex in earnings (Smith & Stulz, 1985), financial distress is costly (Smith & Stulz, 1985), and financing frictions may interfere with investment opportunities (Froot *et al.*, 1993; Campello *et al.*, 2011).

Despite the extensive literature on real options and the widespread use of financial hedging, relatively few studies examine the relationship between operational and financial hedging within a multinational network. At first glance, the two strategies appear to be substitutes because both mitigate downside risk. However, the relationship is not always that simple. Financial contracts are most effective when risk exposure is closely tied to tradable asset prices, whereas operational hedging can address exposures that are difficult or impossible to hedge through financial markets alone (Guay & Kothari, 2003; Meulbroek, 2002). In addition, when financial instruments are illiquid, ineffective, or costly, firms may rely more heavily on operational hedging to manage exchange-rate or input-cost risk (Hoberg & Moon, 2017).

Some firms use both strategies simultaneously:

BMW took a two-pronged approach to managing its foreign exchange exposure. One strategy was to use a "natural hedge," meaning it would develop ways to spend money in the same currency as where sales were taking place, thereby matching revenues to the local currency. However, not all exposure could be offset in this way, so BMW decided it would also use formal financial hedges.... The natural hedge strategy was implemented in two ways: the first involved establishing factories in the markets in which it sold its products; the second involved making more purchases denominated in the currencies of its main markets².

In BMW's case, operational and financial hedging addressed different components of overall risk exposure. This paper addresses a more fundamental question: what is the relationship between financial and operational hedging when financial instruments are effective, liquid, and fairly priced, and when firms are not primarily exposed to non-hedgeable shocks? Under those conditions, do the two strategies operate as substitutes or as complements? More specifically, we ask two questions. First, can financial hedging and operational hedging increase firm value? Second, what factors determine the relationship between these two risk-management strategies?

To answer these questions, and following Feldman and

¹ For example, a firm may relocate production facilities to better match costs and revenues. In the airline industry, carriers often use diversified aircraft types to reduce exposure to fuel costs. Operational hedging can also take the form of product flexibility (Chod *et al.*, 2010), risk pooling (such as

allocation flexibility and transshipment), or geographic diversification (Tang and Tikoo, 1999; Kim *et al.*, 2006).

² Financial Times (October 29, 2012), "The case study: How BMW dealt with exchange rate risk," by Xu Bin and Liu Ying.

Sakhartov (2018), we build a theoretical model of two types of multinational firms. The first is an expansion MNC, which operates in a single product market across multiple countries and faces systematic risks such as exchange-rate fluctuations, input-cost shocks, and tariffs. The second is a diversified MNC, which operates across different product markets and countries and therefore faces both systematic and idiosyncratic risk. In each setting, the firm has some degree of operational flexibility and may also enter a financial hedging contract to reduce cash-flow uncertainty.

Our analysis shows that the relationship between financial hedging and operational flexibility can be complementary or substitutive, depending on risk aversion, return volatility, and redeployment costs. The value added by each strategy is also asymmetric. In particular, the incremental value of adding one form of hedging depends on whether the firm already possesses the other. This asymmetry helps explain why prior studies have reached mixed conclusions. This paper contributes to the literature in three ways. First, it shows that financial hedging can add value even when a firm already possesses operational flexibility, especially when return volatility is high and redeployment costs are low. Second, it provides a new explanation for the relationship between financial and operational hedging by emphasizing the joint role of managerial preferences and asset characteristics, rather than attributing the relationship solely to hedging costs or return correlation. Third, it offers managerial implications by identifying the conditions under which it is more valuable to add operational hedging to financial hedging, or vice versa.

II. LITERATURE REVIEW

This paper relates to three streams of research. First, it builds on the literature on real options and flexibility in international business. Second, it connects to the literature on financial hedging and corporate risk management. Third, it contributes to work on whether operational and financial hedging function as complements or substitutes.

A. Real Options and Flexibility in International Business

Real-options theory helps explain the value of a multinational network. Because an MNC can reallocate activities across countries, it possesses switching options that are not available to purely domestic firms. These options can reduce downside risk while preserving upside potential (Tong & Reuer, 2007). In this sense, flexibility can serve as an operational hedging mechanism that enables the firm to adapt to uncertainty and, potentially, enhance value.

Prior research shows that the value of such flexibility depends on several factors. Kogut and Kulatilaka (1994) demonstrate that a multinational network becomes more valuable when exchange-rate risk affects sourcing locations. Lee and Song (2012) and Pantzalis *et al.* (2001) similarly show that firms adjust production across borders in response to currency movements. Lee and Makhija (2009) further document that international investments can provide valuable flexibility during periods of crisis.

The value of operational flexibility is not determined by volatility alone. It also depends on current return advantages,

return correlation, and redeployment or switching costs (Sakhartov & Folta, 2015; Feldman and Sakhartov, 2018; Chi *et al.*, 2019). In general, higher volatility can increase option value, while high switching or redeployment costs reduce the value of flexibility. The effect of return correlation is more nuanced and may depend on other features of the assets and the decision environment.

B. Financial Hedging and Risk Management

Managing uncertainty is a central challenge for internationally active firms (Ghoshal, 1987). Financial hedging offers a direct method for mitigating some forms of risk. Although hedging would not matter in a world of perfect capital markets, several well-established theories explain why it may add value when capital-market imperfections are present. In particular, hedging can reduce cash-flow volatility, lower expected distress costs, reduce expected taxes, and support investment by easing financing frictions.

Recent empirical studies support the relevance of these mechanisms. For example, Allayannis *et al.* (2001) show that the use of foreign-exchange derivatives can create value. Financial hedging may also be especially attractive when managers are risk-averse and prefer smoother outcomes to more volatile cash flows.

C. Operational and Financial Hedging: Complements or Substitutes?

Financial contracts hedge specific exposures, whereas operational hedges arise from the real options embedded in a firm's asset base and organizational structure. The relative use of the two approaches may depend on contract availability, market liquidity, operating flexibility, financing needs, managerial incentives, and agency costs (Tang & Tikoo, 1999; Petersen & Thiagarajan, 2000; Hoberg & Moon, 2017; Mello *et al.*, 1995).

The existing literature offers mixed predictions. Mello *et al.* (1995) argue that agency costs link financial policy to production decisions and imply some degree of substitutability between financial hedging and operational flexibility. Chowdhry and Howe (1999) show that operational hedging becomes more attractive when firms face both exchange-rate and demand uncertainty. Chod *et al.* (2010) demonstrate that product flexibility and financial hedging may be complements when product demands are positively correlated and substitutes when they are negatively correlated. Hommel (2003) emphasize the distinction between hedgeable currency risk and non-hedgeable demand risk and show that operational hedging can complement financial hedging under some conditions.

In addition to value enhancement, a risk-averse firm or manager may have a different utility function. Following Mello *et al.* (1995) and Chowdhry and Howe (1999), Ding *et al.* (2007) study the integrated hedging decisions of a global firm. In their two-stage framework, the firm exercises its production allocation option after observing demand and exchange-rate realizations. This paper extends that line of research by considering how the relationship between financial and operational hedging changes with risk aversion³.

³ Other literature discusses the relationship between different real options, noting that they can be substitutes or complements (Trigeorgis, 1993; Trigeorgis, 1995). However, operational flexibility is a hybrid switching

option that consists of interrelated put and call components (Chi *et al.*, 2019). As a result, standard theories of interaction among simple real options do not directly apply to the relationship between a financial option and this type of

Empirical evidence is similarly mixed. Kim *et al.* (2006) find that firms with less operational hedging use more financial hedging, which is consistent with substitution. Hankins (2011) report that financial hedging declines following acquisitions that increase operational hedging. By contrast, Allayannis *et al.* (2001) find evidence consistent with complementarity, and Geczy *et al.* (2006) document mixed results in the natural gas industry. Treanor *et al.* (2013) find that some operational hedges in the airline industry complement financial hedging, while others do not.

D. Summary of the Literature and Research Gap

Most prior studies examine financial hedging and operational flexibility separately. The smaller literature that considers both often does not model the core factors that determine when the relationship is complementary and when it is substitutive. This paper addresses that gap by focusing on three drivers: risk aversion, return volatility, and redeployment cost.

Our contribution is to provide an integrated real-options framework that links these three factors to the interaction between financial hedging and operational flexibility. From a risk-management perspective, risk-averse decision makers value mechanisms that reduce downside risk. From a value-creation perspective, the joint use of operational flexibility and financial hedging may create additional value under specific conditions. This framework helps explain why prior research has produced mixed findings.

This paper differs from prior literature in three respects. First, whereas previous work often suggests complementarity arises only from non-hedgeable risks or market frictions, we identify conditions under which a fair-priced financial contract can add value even when operational flexibility is already present. Second, we adopt a real-options perspective to study the interaction between the financial option and the real option, emphasizing the joint role of risk aversion, return volatility, and redeployment cost. Third, we provide an integrated framework and managerial guidance that help reconcile the mixed evidence in the literature by specifying the conditions under which it is beneficial to add one strategy to the other.

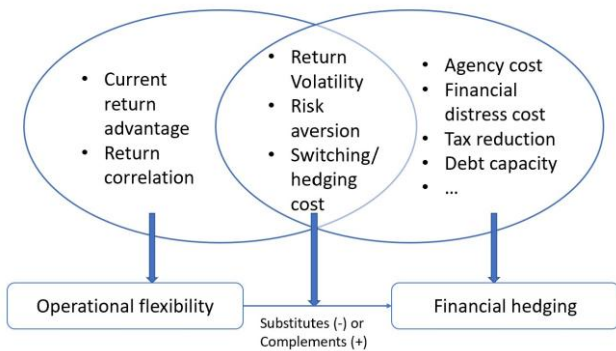


Fig. 1. Antecedents for the relationship between operational flexibility and financial hedging.

hybrid operational option.

⁴ We assume $\sigma_A < \sigma_B$ without loss of generality. Thus, when the firm has operational flexibility, the optimal strategy is to purchase two contracts for A. However, if the firm does not have operational flexibility, it must purchase

III. MODEL

A. Expansion MNC

To analyze the value of hedging in a multinational network, we first consider a multinational firm with a single product operating in two countries, A and B. This expansion structure can alleviate systematic risk across countries. Following Kogut and Kulatilaka (1994), the decision facing the firm is to minimize production costs by switching flexibly between the two countries. To simplify the problem, we assume that switching between the two countries is costless.

To mitigate exchange-rate risk, the firm may choose to operate in different countries and/or enter a financial hedging contract at a cost of p_f (the fair price) at the beginning of each period. At the end of the period, the firm can decide whether to exercise the financial option and/or use operational flexibility. If the return on one asset is lower than the strike price, the firm can either redeploy resources to another project or exercise the financial option to obtain the strike price. The firm, or the firm's manager, is risk-averse and has a CARA utility function (Arrow, 1971):

$$u(\gamma, V) = 1 - e^{-\gamma V}, \quad (1)$$

In the first period, we assume that returns are the same in countries A and B. Following Feldman and Sakhartov (2018), we use backward induction to calculate the return matrix in each state k ($k = uu, ud, du, dd$) in the last period. If the firm does not use financial hedging, it can switch between the two sites to maximize return.

$$r_o(i) = v_k^A * (2 - i) + v_k^B * (i - 1), \quad (2)$$

where i denotes the asset position in the current period. The redeployment decision can be expressed as follows: if $i = 1$, the firm produces in country A; if $i = 2$, the firm produces in country B. k denotes the state of return in countries A and B. For example, $k = ud$ means the return in A increases and the return in B decreases. If the firm uses financial hedging and operational hedging at the same time, then

$$r_{of}(i, j) = \begin{cases} v_k^A * (2 - i) + v_k^B * (i - 1), & v_k^A \geq v_0^A \\ v_0^A * (2 - i) + v_k^B * (i - 1), & v_k^A < v_0^A \end{cases} \quad (3)$$

In the first period, because the firm is risk-averse and can switch the production site, the optimal hedging strategy is to purchase the cheaper hedging contract (the real-option value-added effect)⁴. The price of a financial hedging contract is fairly priced as $p_f^A = (q_{du} + q_{dd}) * [u(v_0^A) - u(v_{dd}^A)]$ and $p_f^B = (q_{du} + q_{dd}) * [u(v_0^B) - u(v_{dd}^B)]$ ⁵. A firm with a financial hedging contract generates utility

$$u_f = q_{uu} * u(\gamma, v_{uu}^A - p_f^A + v_{uu}^B - p_f^B) + q_{ud} * u(\gamma, v_{ud}^A - p_f^A + v_{ud}^B - p_f^B)$$

one contract for A and one for B.

⁵ We adjust the value for risk attitudes because the contract is worth more when firms are risk-averse.

$$+q_{du} * u(\gamma, v_{du}^A - p_f^A + v_{du}^B - p_f^B) \\ +q_{dd} * u(\gamma, v_{dd}^A - p_f^A + v_{dd}^B - p_f^B), (4)$$

The net value of the financial hedging contract to the firm is $V_F = 0$. We now calculate utility under three cases: (1) the firm has only operational flexibility; (2) the firm uses only financial hedging; and (3) the firm uses financial hedging and operational hedging at the same time. If the firm uses both financial hedging and operational hedging, the utility is

$$u_{of} = q_{uu} * u(\gamma, r_{of}(uu) - p_f^A * 2) \\ +q_{ud} * u(\gamma, r_{of}(ud) - p_f^A * 2) \\ +q_{du} * u(\gamma, r_{of}(du) - p_f^A * 2) \\ +q_{dd} * u(\gamma, r_{of}(dd) - p_f^A * 2), (5)$$

If the firm relies only on operational hedging, the utility is

$$u_o = q_{uu} * u(\gamma, r_o(uu)) + q_{ud} * u(\gamma, r_o(ud)) + q_{du} * u(\gamma, r_o(du)) + q_{dd} * u(\gamma, r_o(dd)), (6)$$

Following Chod *et al.* (2010), we assess whether operational and financial hedging are complements or substitutes by examining whether one strategy increases or decreases the value of the other. Here, $V_{FR} = u_{of} - u_o$ denotes the value added by financial hedging when operational hedging is already available, and $V_{RF} = u_{of} - u_f$ denotes the value added by operational hedging when financial hedging is already available.

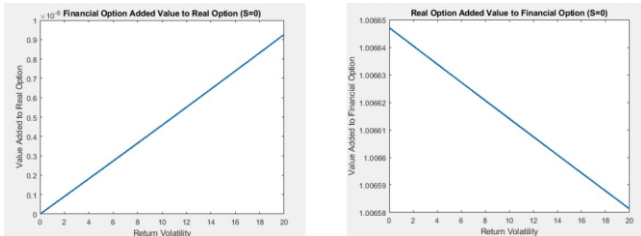


Fig. 2. How the Added Value V_{FR} or V_{RF} Changes with Return Volatility σ_A ?

Fig. 2 illustrates the benchmark relationship between volatility and the incremental value of the two hedging strategies⁶. When risk aversion is low, the value added to operational hedging increases with the return volatility of A, whereas the value added to financial hedging decreases with the return volatility of A. Although a fairly priced financial option has zero standalone value, it can add value when combined with operational flexibility. The intuition is that the firm can exploit operational flexibility while purchasing the cheaper financial contract, here the contract on project A. If both A and B face downside risk, the firm can switch from B to A and exercise the two financial hedging contracts, generating a contract-cost-saving effect.

At first glance, one might expect the value of hedging to rise with return volatility. However, when a firm with financial hedging also adopts operational hedging and risk aversion is not too low, the incremental value of financial hedging can decline. As return volatility increases, the value of both the financial option and the real option rises, but so does the price of the financial option. Because the contract on A is cheaper than the contract on B, the firm benefits from both contract-cost savings and upside value enhancement. As volatility rises further, however, these gains shrink relative to the higher contract price, so the incremental value of financial hedging declines.

B. Diversified MNC

In this section, we consider an MNC with diversified products A and B. The return on each project may increase or decrease in the next period. Specifically, we assume that asset returns follow Geometric Brownian Motions (GBMs), and we use the binomial lattice method to derive NPV. This diversified structure allows a firm to redeploy resources between the two projects at a redeployment cost S , which does not depend on direction, and may therefore alleviate idiosyncratic risk. However, because of the operational complexity of multinational activity, we allow the firm to redeploy only at discrete intervals. In addition to operational flexibility, the firm may enter a financial hedging contract to reduce future risk. Unlike the redeployment of resources, financial contracts are standardized products with low transaction costs. To simplify the problem, we assume that the firm can enter a hedging contract at a cost of p_f^i (the fair price), where $i \in \{A, B\}$, at the beginning of each period if it chooses financial hedging. In the next period, the firm can decide whether to exercise the financial option and/or use operational flexibility. If the return on one asset falls below the strike price, the firm can either redeploy resources to the other project or exercise the financial option to receive the strike price. Without loss of generality, we assume that asset B has lower variance ($\sigma_A > \sigma_B$).

Following Feldman and Sakhartov (2018), we build a dynamic model and use backward induction to calculate the return matrix in each return state k ($k = uu, ud, du, dd$) in the last period. If the firm does not use financial hedging, it can redeploy resources between the two projects to avoid losses. Specifically, if the firm holds diversified assets, it can maintain the status quo or redeploy half of its resources to either project, depending on the redeployment cost and the return on the asset:

$$r_o(ij) = v_k^A * (3 - i) + v_k^B * (i - 1) - S * |i - j|, \quad (7)$$

where i denotes the asset position in the current period and j denotes the asset position in the previous period. The redeployment decision can be expressed as follows: if i or $j = 1$, all of the assets are in A; if i or $j = 2$, half of the assets is in A and half of the assets is in B; if i or $j = 3$, all of the assets are in B. k denotes the state of return for asset A and B. For example, $k = ud$ means the return in A increases and the return in B decreases. If the firm decides to use financial hedging

⁶ The following values of the ancillary parameters are used in Figure 2. The probabilities of asset A and B going up or down are $q_{uu} = q_{dd} = 0.4$ and $q_{ud} = q_{du} = 0.1$. In the initial period, $v_0^A = 50$ and $v_0^B = 50$. For asset B,

$v_{uu}^B = v_{ud}^B = 70$ and $v_{du}^B = v_{dd}^B = 30$. The redeployment cost is 0 and $\gamma = 0.1$.

and operational hedging at the same time, then

$$r_{of}(i, j) = \begin{cases} v_k^A * (3 - i) + v_k^B * (i - 1) \\ -S * |i - j|, v_k^A \geq v_0^A \\ v_0^A * (3 - i) + v_k^B * (i - 1) \\ -S * |i - j|, v_k^A < v_0^A \end{cases} \quad (8)$$

In the first period, because the firm is risk-averse and can redeploy resources, the optimal hedging strategy is to purchase the cheaper hedging contract (the real-option value-added effect). The price of a financial hedging contract is fairly priced as $p_f^A = q_{du} * [u(v_0^A) - u(v_{ud}^A)] + q_{dd} * [u(v_0^A) - u(v_{dd}^A)]$ and $p_f^B = (q_{du} + q_{dd}) * [u(v_0^B) - u(v_{dd}^B)]$ ⁷. A firm with a financial hedging contract generates utility

$$\begin{aligned} u_f = & q_{uu} * u(\gamma, v_{uu}^A - p_f^A + v_{uu}^B - p_f^B) \\ & + q_{ud} * u(\gamma, v_{ud}^A - p_f^A + v_{ud}^B - p_f^B) \\ & + q_{du} * u(\gamma, v_{du}^A - p_f^A + v_{du}^B - p_f^B) \end{aligned}$$

$$+ q_{dd} * u(\gamma, v_{dd}^A - p_f^A + v_{dd}^B - p_f^B), \quad (90)$$

The value of the financial hedging contract to the firm is $V_F = 0$. Initially, the firm holds diversified assets in both A and B. We now calculate utility under three cases: (1) the firm has only operational flexibility; (2) the firm uses only financial hedging; and (3) the firm uses financial hedging and operational hedging at the same time. If the firm uses both financial hedging and operational hedging, the utility is

$$\begin{aligned} u_{of}(i) = & u(\gamma, (3 - i) * v_0^A + (i - 1) * v_0^B - |i - 2| * S - \\ & p_f * 2) + q_{uu} * u(\gamma, \max[r_{of}(uu, i)]) + q_{ud} * \\ & u(\gamma, \max[r_{of}(ud, i)]) + q_{du} * u(\gamma, \max[r_{of}(du, i)]) + \\ & q_{dd} * u(\gamma, \max[r_{of}(dd, i)]), \quad (10) \end{aligned}$$

If the firm relies only on operational hedging, the utility is

$$\begin{aligned} u_o(i) = & u(\gamma, (3 - i) * v_0^A + (i - 1) * v_0^B - |i - 2| * S) + \\ & q_{uu} * u(\gamma, \max[r_{o(uu, i)}]) + q_{ud} * u(\gamma, \max[r_{o(ud, i)}]) + \\ & q_{du} * u(\gamma, \max[r_{o(du, i)}]) + q_{dd} * \\ & u(\gamma, \max[r_{o(dd, i)}]), \quad (11) \end{aligned}$$

The value added by financial hedging when operational hedging is already available is $V_{FR} = \max(u_{of}(i)) - \max(u_o(i))$, and the value added by operational hedging when financial hedging is already available is $V_{RF} = \max(u_{of}(i)) - u_f$, where $i = 1, 2, 3$.

IV. RESULTS

In this section, we present the results. The findings are asymmetric: *ceteris paribus*, adding financial hedging to

operational hedging does not generate the same result as adding operational hedging to financial hedging.

A. The Value Added to Financial Hedging

Fig. 3 shows how the value added to financial hedging changes with risk aversion, redeployment cost, and return volatility⁸. In Fig. 3(a)-(c), the value added to financial hedging increases with risk aversion. This result is robust across different levels of return volatility and redeployment cost. In Fig. 3(d)-(f), the value added to financial hedging decreases with redeployment cost. In addition, the incremental value is less sensitive to redeployment cost when the risk-aversion parameter is higher.

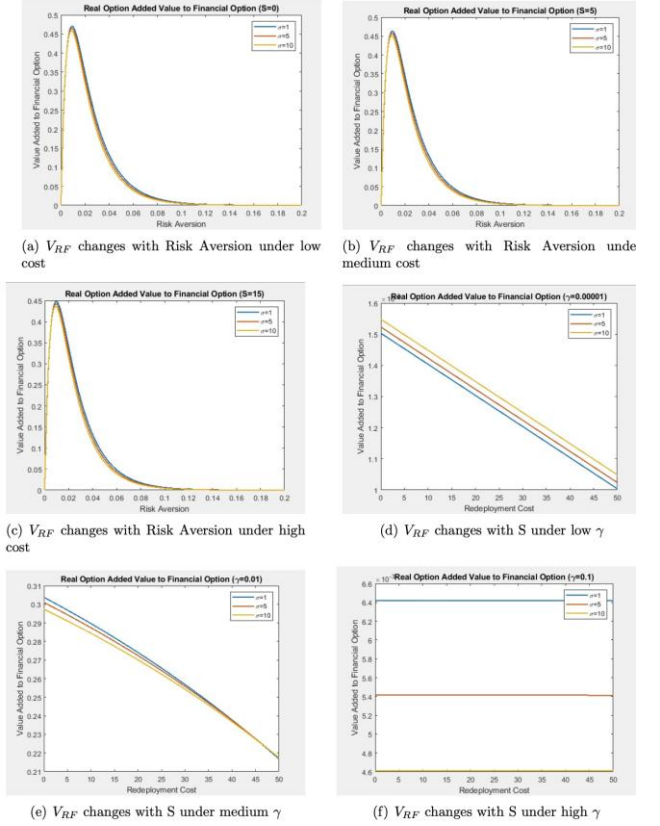


Fig.3. How the value added to financial hedging V_{RF} changes with risk aversion γ , redeployment cost S and return volatility σ ?

Across all panels of Fig. 3, the value added to financial hedging decreases with return volatility. Although one might expect the value of financial hedging to increase with volatility because the two options can jointly hedge risk, this is not the net effect in the model. As the volatility of the underlying asset increases, the price of the financial contract increases as well, which reduces the net benefit from redeployment.

B. The Value Added to Operational Hedging

Fig. 4 shows how the value added to operational hedging changes with risk aversion, redeployment cost, and return volatility. In Fig. 4(a)-(c), the value added to operational hedging is non-monotonic in risk aversion. When redeployment cost is low and volatility is high, the value

⁷ We adjust the value for risk attitudes because the contract is worth more when firms are risk-averse.

⁸ The following values of the ancillary parameters are used in Figures Figure 3 and Figure 4. The probabilities of asset A and B going up or down are $q_{uu} = q_{dd} = 0.4$ and $q_{ud} = q_{du} = 0.1$. In the initial period, $v_0^A =$

50 and $v_0^B = 25$. For asset B, $v_{uu}^B = v_{ud}^B = 40$ and $v_{du}^B = v_{dd}^B = 10$. For asset A, in a high-volatility condition, $v_{uu}^A = v_{ud}^A = 60$ and $v_{du}^A = v_{dd}^A = 40$. In a medium-volatility condition, $v_{uu}^A = v_{ud}^A = 55$ and $v_{du}^A = v_{dd}^A = 45$. In a low-volatility condition, $v_{uu}^A = v_{ud}^A = 51$ and $v_{du}^A = v_{dd}^A = 49$.

added to operational hedging is positive and first increases and then decreases with risk aversion. When redeployment cost is high and volatility is low, the value added to operational hedging is negative and first decreases and then increases with risk aversion.

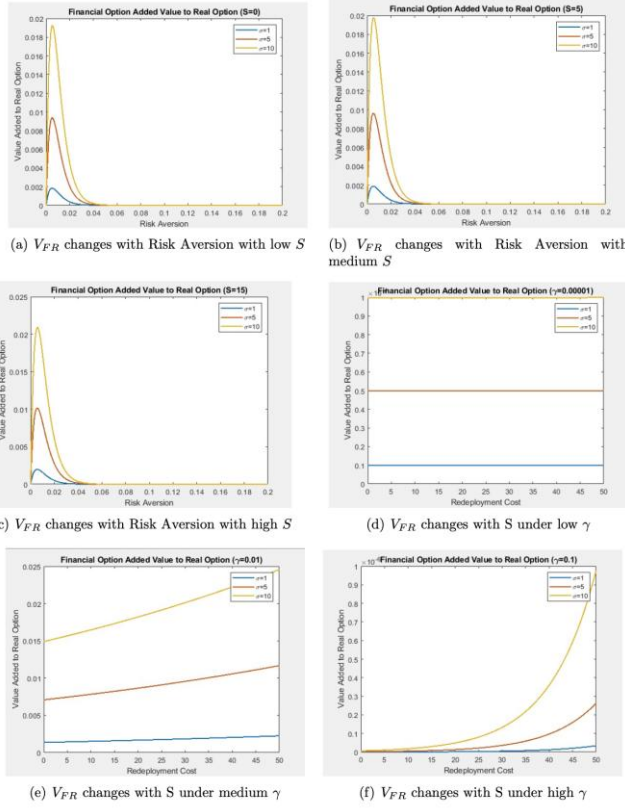


Fig. 4. How the value added to operational hedging V_{FR} changes with risk aversion gamma, redeployment cost S and return Volatility σ ?

These results also clarify the relationship between the two types of hedging. When redeployment cost is high and volatility is low, financial hedging and operational hedging behave as substitutes. When redeployment cost is low and volatility is high, they behave as complements.

In Fig. 4(d)-(f), the value added to operational hedging generally decreases with redeployment cost when risk aversion is not too high. This pattern reflects the synergy between the two options: when redeployment becomes more expensive, the benefit of switching resources declines, and the combined value of using both strategies falls. When both risk aversion and redeployment cost are high, however, this result may reverse because operational hedging becomes less practical and the risk-averse decision maker places greater value on the remaining protection.

Overall, Fig. 4 shows that the value added to operational hedging is more sensitive to risk aversion and redeployment cost under high volatility.

V. CONCLUSION AND FUTURE RESEARCH

A. Summary of Results

The relationship between financial hedging and operational hedging can be either substitutive or complementary, depending on return volatility, redeployment cost, and risk aversion. Moreover, the relationship is asymmetric: *ceteris paribus*, adding financial hedging to operational hedging does not produce the same result as

adding operational hedging to financial hedging. Specifically, we show that (1) the value added to financial hedging decreases with return volatility, despite the intuition that higher volatility should increase the value of protection; (2) the value added to operational hedging is non-monotonic in risk aversion; (3) the value added to operational hedging generally decreases with redeployment cost when risk aversion is not too high; and (4) the value added to operational hedging is more sensitive to risk aversion and redeployment cost under high volatility.

B. Contributions and Future Research

This paper contributes to the literature on both risk management and the relationship between financial hedging and operational hedging. First, whereas earlier work often suggests that complementarity arises only when one considers short- versus long-term effects, non-hedgeable risk exposure, or the availability of financial hedging, we identify conditions under which a fair-priced financial contract can add value even when operational flexibility is already present. Second, we adopt a real-options perspective to study the interaction between the financial option and the real option, showing how risk aversion, return volatility, and redeployment cost jointly shape the relationship between the two strategies. Third, we provide an integrated framework and managerial guidance regarding the conditions under which it is beneficial to add operational hedging to financial hedging or financial hedging to operational hedging.

Future research could extend the analysis in several directions. In this study, we use a two-period model to illustrate how the relationship between financial hedging and operational flexibility changes with risk aversion, return volatility, and redeployment cost. A richer dynamic model could examine how this relationship evolves over time and how it is affected by return correlation and intertemporal economies of scope.

APPENDIX

Table A1. Model notation

Notation	Explanation
σ_A	Return variance of asset A
σ_B	Return variance of asset B
γ	Risk aversion parameter
$u(\gamma, V)$	Utility function of the risk-averse firm
S	Redeployment cost
k	State variable of the asset
p_f	The fair price of the financial contract
i	Asset position in the current period
j	Asset position in the previous period
$r_o(ij)$	Return of the firm with operational flexibility, with position i in the current period and position j in the previous period
$r_{of}(ij)$	Return of the firm with both financial hedging and operational flexibility, with position i in the current period and position j in the previous period
v_k^A	Value of asset A in state k in the second period
v_k^B	Value of asset B in state k in the second period
v_0^A	Value of asset A in the first period
v_0^B	Value of asset B in the first period
q_k	The probability of state k
V_F	The value of the financial hedging contract
V_{FR}	The value added by financial hedging when operational hedging is already available
V_{RF}	The value added by operational hedging when financial hedging is already available

CONFLICT OF INTEREST

The author declares no conflict of interest.

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REFERENCES

- Allayannis, G., Ihrig, J., & Weston, J. P. 2001 Exchange-rate hedging: Financial versus operational strategies. *American Economic Review*, 91(2): 391–395.
- Arrow, K. J. 1971 The theory of risk aversion. *Essays in the Theory of Risk-Bearing*: 90–120.
- Belderbos, R., & Zou, J. 2009 Real options and foreign affiliate divestments: A portfolio perspective. *Journal of International Business Studies*, 40(4): 600–620.
- Campello, M., Lin, C., Ma, Y., & Zou, H. 2011 The real and financial implications of corporate hedging. *The Journal of Finance*, 66(5): 1615–1647.
- Chi, T., Li, J., Trigeorgis, L. G., & Tsekrekos, A. E. 2019 Real options theory in international business. *Journal of International Business Studies*, 50(4): 525–553.
- Chod, J., Rudi, N., & Van Mieghem, J. A. 2010 Operational flexibility and financial hedging: Complements or substitutes? *Management Science*, 56(6): 1030–1045.
- Choi, J. J., Ju, M., Kotabe, M., Trigeorgis, L., & Zhang, X. T. 2018 Flexibility as firm value driver: Evidence from offshore outsourcing. *Global Strategy Journal*, 8(2): 351–376.
- Chowdhry, B., & Howe, J. T. 1999 Corporate risk management for multinational corporations: Financial and operational hedging policies. *Review of Finance*, 2(2): 229–246.
- Ding, Q., Dong, L., & Kouvelis, P. 2007 On the integration of production and financial hedging decisions in global markets. *Operations Research*, 55(3): 470–489.
- Feldman & Sakhartov 2018 *The Strategic Choice between Resource Redeployment and Divestiture*. Working paper.
- Froot, K. A., Scharfstein, D. S., & Stein, J. C. 1993 Risk management: Coordinating corporate investment and financing policies. *the Journal of Finance*, 48(5): 1629–1658.
- Geczy, C. C., Minton, B. A., & Schrand, C. 2006 The use of multiple risk management strategies: Evidence from the natural gas industry. *The Journal of Risk*, 8(3): 1.
- Ghoshal, S. 1987 Global strategy: An organizing framework. *Strategic Management Journal*, 8(5): 425–440.
- Guay, W., & Kothari, S. P. 2003 How much do firms hedge with derivatives? *Journal of Financial Economics*, 70(3): 423–461.
- Hankins, K. W. 2011 How do financial firms manage risk? unraveling the interaction of financial and operational hedging. *Management Science*, 57(12): 2197–2212.
- Hoberg, G., & Moon, S. K. 2017. Offshore activities and financial vs operational hedging. *Journal of Financial Economics*, 125(2): 217–244.
- Hommel, U. 2003 Financial versus operative hedging of currency risk. *Global Finance Journal*, 14(1): 1–18.
- Huchzermeier, A. & Cohen, M. A. 1996. Valuing operational flexibility under exchange rate risk. *Operations research*, 44(1): 100–113.
- Kim, Y. S., Mathur, I., & Nam, J. 2006. Is operational hedging a substitute for or a complement to financial hedging? *Journal of corporate finance*, 12(4): 834–853.
- Kogut, B., & Kulatilaka, N. 1994. Operating flexibility, global manufacturing, and the option value of a multinational network. *Management science*, 40(1): 123–139.
- Lee, S.-H., & Makhija, M. 2009. The effect of domestic uncertainty on the real options value of international investments. *Journal of International Business Studies*, 40(3): 405–420.
- Lee, S.-H., & Song, S. 2012. Host country uncertainty, intra-mnc production shifts, and subsidiary performance. *Strategic Management Journal*, 33(11): 1331–1340.
- Lim, S. S., & Wang, H. C. 2001. Stakeholder firm-specific investments: Financial hedging and corporate diversification. *Available at SSRN 292611*.
- Margrabe, W. 1978. The value of an option to exchange one asset for another. *The Journal of Finance*, 33(1): 177–186.
- Mello, A. S., Parsons, J. E., & Triantis, A. J. 1995. An integrated model of multi-national flexibility and financial hedging. *Journal of International Economics*, 39(1–2): 27–51.
- Meulbroek, L. K. 2002. A senior manager’s guide to integrated risk management. *Journal of Applied Corporate Finance*, 14(4): 56–70.
- Modigliani, F., & Miller, M. 1958. The cost of capital, corporation finance and the theory of finance. *American Economic Review*, 48(3): 291–297.
- Pantazis, C., Simkins, B. J., & Laux, P. A. 2001. Operational hedges and the foreign exchange exposure of us multinational corporations. *Journal of International Business Studies*, 32(4): 793–812.
- Petersen, M. A., & Thiagarajan, S. R. 2000. Risk measurement and hedging: With and without derivatives. *Financial Management*: 5–29.
- Sakhartov, A. V., & Folta, T. B. 2015. Getting beyond relatedness as a driver of corporate value. *Strategic Management Journal*, 36(13): 1939–1959.
- Smith, C. W., & Stulz, R. M. 1985. The determinants of firms’ hedging policies. *Journal of Financial and Quantitative Analysis*, 20(4): 391–405.
- Stulz, R. 1982. Options on the minimum or the maximum of two risky assets: analysis and applications. *Journal of Financial Economics*, 10(2): 161–185.
- Stulz, R. M. 1984. Optimal hedging policies. *Journal of Financial and Quantitative analysis*, 19(2): 127–140.
- Tang, C. Y., & Tikoo, S. 1999. Operational flexibility and market valuation of earnings. *Strategic Management Journal*, 20(8): 749–761.
- Tong, T. W., & Reuer, J. J. 2007. Real options in multinational corporations: Organizational challenges and risk implications. *Journal of International Business Studies*, 38(2): 215–230.
- Treanor, S. D., Carter, D. A., Rogers, D. A., & Simkins, B. J. 2013. Operational and financial hedging: friend or foe? Evidence from the us airline industry. *Journal of Accounting and Finance*, 13(6): 64–91.
- Trigeorgis, L. 1993. The nature of option interactions and the valuation of investments with multiple real options. *Journal of Financial and Quantitative Analysis*, 28(1): 1–20.
- Trigeorgis, L. 1995. *Real options in capital investment: Models, strategies, and applications*. Greenwood Publishing Group.

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