ECONOMIES OF SCOPE AND OPTIMAL DUE DILIGENCE IN CORPORATE ACQUISITIONS

INTRODUCTION

The gains that organizations expect in corporate acquisitions have long been under scrutiny by managers and researchers alike. 'Economies of scope' (Teece 1980) underlie the value creation logic of many acquisitions (Larsson and Finkelstein 1999; Seth 1990; Singh and Montgomery 1987) and reflect value that can be added only when an acquirer and a target combine into a single firm. According to a recent survey, more than 60% of Chief Financial Officers of acquiring organizations consider such economies a key aim of acquisitions (Sirower et al. 2017). Economies of scope can occur in an acquisition when resources are either redeployed (Anand 2004; Anand and Singh 1997) or shared (Brush 1996; Li and Greenwood 2004) between an acquirer and a target.

Even if such economies seem promising to an acquiring organization, the acquirer often has only incomplete information about them before the deal (Coff 1999; Ranft and Lord 2002; Zaheer, Hernandez, and Banerjee 2010), which in part explains why acquisitions so often fail to deliver gains to acquirers (Porter 1987; Sirower 1997). This study focuses on the effort that an acquiring organization should put in improving its information about the target and, more specifically, in assessing economies of scope before completing an acquisition deal. Many guides for practitioners of corporate acquisitions (Cullinan et al. 2004; Deloitte 2016; DePamphilis 2010; Howson 2003; KPMG 2018) recognize that the scrutiny of economies of scope is a critical part of *due diligence*—the organizational activity an acquiring firm undertakes to inspect the records, risks and potential liabilities, facilities, and other resources of the target (DePamphilis 2010).[1]

[1] Besides the review of economies of scope, due diligence may involve the examination of 'intrinsic' (Eccles et al. 1999) or 'stand-alone' (Cullinan et al. 2004) value of the target that reflects the value of the target if it continues to be independent rather than is combined with the acquirer. The present study does not focus on due diligence with respect to intrinsic value. In addition to corporate acquisitions, two alternative modes of corporate development–internal development and alliances–also include the analysis of information about the expected gains. Accordingly, the term 'due diligence' has been used in the context of these alternative modes of corporate development (*e.g.*, Puranam and Vanneste 2016). However, each of those modes has its specific informational context and requires a respective analytical approach. Notably, a corporate acquisition poses a particularly acute risk of adverse selection because this kind of deal is unique in demanding a sizeable upfront payment for the intended economies that is followed by the irreversible passing of the ownership from the target to the acquirer. Also, the target in a corporate acquisition is often traded on a (public) market, where the acquirer has to outbid multiple alternative suitors (to bid above the public target's market valuation). This study therefore focuses on acquisitions and avoids overgeneralizing this specific context to related contexts such as internal development and alliances.

ECONOMIES OF SCOPE AND OPTIMAL DUE DILIGENCE IN CORPORATE ACQUISITIONS

How much due diligence should an acquiring organization undertake with respect to economies of scope? Conventional wisdom expressed by consultants, the business press, and educators often implies that acquirers cannot be too diligent, given the risks that acquisitions entail. For instance, Moeller and Brady (2014, p. 142) argue that "the 'knowledge is power' mantra could not be more appropriate than in describing the value of genuine due diligence." Accordingly, consultants have cast the pre-deal evaluation of economies of scope as "the prime hard key to deal success, one which can enhance the chance of success to 28 percent above average" (KPMG 1999). Consultants have also warned that 88 percent of corporate acquirers consider insufficient due diligence the most common reason for deal failure (The Storytellers and Mergermarket 2013). Accordingly, the business press advises that organizations undertaking corporate acquisitions be very skeptical about the target's asking price (Eccles et al. 1999) and prepare to refrain from a deal if that price exceeds the value diagnosed in careful due diligence (Cullinan et al. 2004). Likewise, the virtue of extensive due diligence is emphasized in business cases that introduce MBA students to best practices in M&A deal-making. For example, Cisco Systems Inc. is often held out as an exemplar that conducts far-reaching due diligence involving large cross-functional teams from human resources, manufacturing, engineering, and marketing (Singh et al. 2009).

Academic research on corporate acquisitions has also advocated extensive due diligence of economies of scope: "Acquiring firm decision makers must have a clear vision of how synergy will be created in the combined firm… Such a vision is worked out through careful due diligence on the part of acquiring firm executives before a decision is made to proceed with the acquisition. Effective visions do not result from transactions that are completed quickly and without careful analyses" (Hitt et al. 2005, p. 386). The importance of careful due diligence is also reflected in the frequency with which management research appeals to the importance of due diligence. Due diligence has been mentioned in over 350 articles published in *Academy of Management Journal*, *Academy of Management Review*, *Administrative Science Quarterly*, *Management Science*, *Organization Science*, and *Strategic Management Journal* during the 1985-2019 timeframe. Although direct empirical evidence on the amounts that acquirers spend on 'in-house due diligence' (Servaes and Zenner 1996) and the efforts that organizations undertake before

the deal (v. Werder 1999) is yet to develop, multiple studies reported that acquirers pay high advisory fees when due diligence is conducted by external advisers such as investment banks (Chahine and Ismail 2009; Chuang 2017; Golubov et al. 2012; Thomas 1995).[2] Much of that research has concluded that the more corporate acquirers pay for such outsourced due diligence, the greater the acquirers' returns (Benou and Madura 2005; Chuang 2017; Golubov et al. 2012; Hunter and Jagtiani 2003). Despite this initial evidence, organization theory has also highlighted important bounds on the efficiency with which information is acquired and processed by firms (Cyert and March 1963; March and Simon 1958), and some empirical research found that even the use of the expensive investment bank advisory services does not improve acquirer returns (Servaes and Zenner 1996). Moreover, research in accounting, economics, and law on the contractual provisions that acquirers use to address adverse selection risks in acquisitions (*e.g.*, material adverse change provisions, earnouts, *etc*.) also suggests there are inherent limitations in the efficacy and efficiency of acquisition due diligence (*e.g.*, Datar et al. 2001; Gilson and Schwartz 2005; Cain et al. 2011). Most commonly in empirical M&A research, however, studies treat selection processes as exogenous and targets as givens (*cf.* Schildt and Lamaanen 2006), yet the deals that materialize and the characteristics of these transactions are likely to be the consequence of firms' heterogeneous due diligence efforts.

This study aims to develop a more nuanced view of due diligence and to offer a theory of this important aspect of acquisition deal-making. It is natural for an acquirer to want an accurate assessment of a target's value that would protect the acquirer from the adverse selection problem (Akerlof 1970); at

[2] One very rare clue for the cost of in-house due diligence is the post by Peter Lehrman, the Chief Executive Officer of Axial: "A lot of due diligence can be done yourself these days by leveraging expert networks who can connect you with experts very quickly on the topics that [are] related to the transaction. As a rule of thumb, all of your transaction-related expenses shouldn't be more that 5% of the purchase price" (Quora 2014). According to Kosnik and Shapiro (1997), the prevailing structure for external advisory fees was based on the Lehman Formula that applies a decreasing sliding scale against the deal value. The scale starts at 5% for the first $1 million of the deal value, 4% for the second $1 million, and declines to 1% for all values over $4 million. Chahine and Ismail (2009) reported that, in 2005, acquisition advisors generated over $31 billion in fees on the overall volume of deals of over $2.7 trillion, thus representing 1.15% of the deal value. Chuang (2017) analyzed 5,271 corporate acquirers from the Asia-Pacific region in 1995-2011 and found that 4,200 of those bidders conducted due diligence without assistance from investment banks. Golubov et al. (2012) reported that, in 2007, investment banks advised on over 85% of acquisition deals by transaction value and received advisory fees of $39.7 billion from the overall value of transactions of $4.2 trillion. Of course, these figures exclude the opportunity costs of executive's time, which can also be substantial. Thomas (1995) analyzed a sample of 627 corporate acquirers in 1988-1990, of whom 70% used in-house due diligence.

the same time, organizational theory would highlight that, like for any strategic choice (Cyert and March 1963; March and Simon 1958; Simon 1947), due diligence poses considerable demands on the time, attention, and cognitive abilities of an acquirer's management (DePamphilis 2010; Howson 2003). Hence, this study places due diligence in the specific context of the economies that are inherent in the value creation logic of an acquisition but that may be compromised by incomplete information about them. With that approach, this study investigates *the extent of due diligence that is optimal for economies of scope*, while holding other conditions (specific to the target, to the acquirer, and to the deal) constant. Such an inquiry can identify rules of thumb that executives may use in acquisition strategies. Such a perspective draws broad support from the focus of Makadok and Barney (2001) on strategic factor market intelligence that, while not considering economies of scope in corporate acquisitions, developed normative implications of strategizing over the acquisition of information more generally.

Following precedents in research on economies of scope (Sakhartov and Folta 2014), this study uses a formal model to build a theory of acquisition due diligence. The model derives both the optimal due diligence effort and the return to an acquirer, and separate focus is given to resource redeployment and resource sharing as conceptually-distinct sources of scope economies in acquisitions. The model delivers four sets of results involving the key determinant of economies of scope (*i.e.*, relatedness between the merged businesses) and the key factor of incomplete information in acquisitions (*i.e.*, ambiguity about the targeted economies of scope). First, when economies of scope derive from resource redeployment between the target and the acquirer, the optimal due diligence effort has inverse U-shaped relationships both with relatedness between the merged businesses and with ambiguity about such economies. Second, when acquisition economies stem from resource sharing between the merged businesses, the optimal due diligence effort rises with ambiguity about such economies but is unaffected by relatedness. Third, when acquisition economies are linked to resource redeployment, the return to the acquirer has inverse U-shaped relationships both with relatedness between the merged businesses and with ambiguity about such economies. Finally, when acquisition economies involve resource sharing, the

return to the acquirer has an inverse U-shaped relationship with ambiguity about such economies and increases in relatedness.

The inverse U-shaped relationship between due diligence and relatedness involved in resource redeployment stems from the following two opposing forces. On the one hand, relatedness affects the selectivity of redeployment. At the highest level of relatedness (*i.e*., with negligible redeployment costs), any current advantage of the business receiving resources over the business giving them justifies instantaneous redeployment; with weaker relatedness (*i.e*., with higher redeployment costs), such redeployment should be done at the best possible time. This more selective redeployment with weaker relatedness demands better information about the redeployment cost, thereby justifying more due diligence. On the other hand, when relatedness is too weak, the redeployment cost is so high that the acquirer does not count on redeployment and carries out no due diligence. Therefore, the peak in the due diligence effort happens at an intermediate level of relatedness, with which redeployment is sufficiently selective to justify due diligence but the redeployment cost is not prohibitively high.

The inverse U-shaped relationship between due diligence and ambiguity holds because, on the one hand, a lack of ambiguity makes economies of scope transparent to the acquirer and renders due diligence by that acquirer unneeded; on the other hand, very high ambiguity is too costly for the acquirer to resolve, thus discouraging due diligence and the acquisition deal overall. Accordingly, the peak in the due diligence effort occurs between these two extreme scenarios when some intermediate level of ambiguity can be resolved by the acquirer at a reasonable cost. A subsequent section devoted to findings from the model specifies eight hypotheses on the determinants of due diligence as well as of acquirer returns and elaborates upon the interpretations and intuition for each of them. The discussion section also presents implications for empirical studies carrying forward this analysis in future research. Parameters used to formally derive the results that underlie these three implications are first introduced qualitatively in the review of the relevant literature in the next section.

THEORETICAL BACKGROUND

Gains in corporate acquisitions

While this study focuses on due diligence concerning economies of scope, such economies are not the only motive for acquisitions. This section gives a brief overview of the extant explanations and positions economies of scope relative to other motives that have been featured in the literature. Since the creation of the corporate diversification typology by Rumelt (1974), many inquiries into acquisition motives have built off diversification research and appealed to gains from diversification. Two such exemplary studies, Seth (1990) and Singh and Montgomery (1987), summarized gains in corporate acquisitions that had been raised in research.[3] Notably, some research has assumed that acquisitions are not driven by the economic gains to the merged firm. Such explanations suggest that managers of acquiring firms do acquisitions to maximize their private benefits (*e.g.*, compensation and employment security) potentially to the detriment to the value of the merged firm. Conversely, other strategy studies have been based on the idea that acquisitions are undertaken to maximize the value of the merged firm. Within that broad value-maximizing hypothesis, Seth (1990) and Singh and Montgomery (1987) identified the following four specific explanations: (a) economies of financing, (b) market power, (c) economies of scale, and (d) economies of scope.

A pure financial motive (*i.e.*, 'a' above) for corporate acquisitions counts on a reduction of the cost of capital to the merged firm. The reduction is enabled by the decrease in the risk of bankruptcy for the firm that consists of multiple businesses whose returns are not perfectly correlated with each other. In such cases, typified by conglomerate mergers, the merged firms do not reallocate resources across their businesses, except for occasionally shifting capital and non-specialized labor. As summarized by Teece et al. (1994) and Porter (1987), this merger motive is no longer sustainable. The market power motive (*i.e.*,

[3] Each of the two cited acquisition studies explicitly positioned itself in corporate diversification research from the very first sentence. Thus, Seth (1990, p. 99) started with the following statement: "A key issue in the diversification research is the relationship between diversification strategy and economic performance." Similarly, Singh and Montgomery (1987, p.377) opened with the following sentence: "Research on corporate diversification is an important area in the strategic management literature." Moreover, Singh and Montgomery (1987, p. 377) emphasized the convergence between corporate diversification research and corporate acquisition research after the development of the typology of corporate diversification: "As the specificity of research on diversification has increased, corporate acquisitions have been researched as an exclusive focus."

'b' above) implies that the larger size of the merged firm gives the firm the ability to better control price and quantity of its product, thus generating extra profit. While such economies are conceptually intriguing, they come at the expense of consumers and their implementation is restricted by the antitrust laws. In turn, economies of scale (*i.e.*, 'c' above) exist when the merged firm can spread its fixed costs of manufacturing and distribution of a single product over greater output, thus reducing its average cost and raising its profit. The utility of an acquisition based on economies of scale is restricted to the context where none of the two merging firms operates at or above the minimum efficiency scale level. Like economies of scale, economies of scope (*i.e.*, 'd' above) reduce average costs by optimizing the use of the firm's resources. Unlike economies of scale, economies of scope exist when the merged firm allocates or reallocates its resources between the acquirer's and the target's businesses, which can be different from one another. This is a key contrast of economies of scope with market power and with economies of scale (Seth, 1990; Singh and Montgomery, 1987).

An additional motive for acquisitions, which is based on the recombination of resources of merging firms and which extends the range of value-maximizing explanations reviewed by Seth (1990) and Singh and Montgomery (1987), was developed by Capron et al. (1998) and Karim and Mitchell (2000). With this motive, merging firms recombine their resources and reconfigure their business units to create valuable and unique resource bundles. This rationale applies both to acquisitions that do not alter the product scope of two merging firms producing the same product (Capron et al. 1998) and to acquisitions that change the product scope of the two firms by eliminating some products (Karim 2006). The former case, just like motives based on market power or economies of scale, does not overlap with economies of scope because the product scope does not change. The latter case has recently been enriched with the idea that strategic complementarity, the extent to which products of merging firms differ from each other instead of resembling each other, creates additional value by allowing the merged firms to create unique combinations of resources (Kim and Finkelstein, 2009). While the recombination of complementary resources is definitely a conceptually unique motivation for acquisitions, it has been very difficult to

separate operationally from economies of scope—the motivation for corporate acquisitions that is the exclusive focus of this study and that is elaborated upon next.[4]

Economies of scope

'Economies of scope' were originally defined as the reduction in average costs for a firm that combines multiple businesses relative to the costs that those businesses would incur when operated as stand-alone firms (Panzar and Willig 1981; Teece 1980). This reduction often occurs when a firm shares knowledge developed in one of its businesses with another business in the firm, thus avoiding costly duplication in knowledge development (Bryce and Winter 2009; Teece et al. 1994). That original definition was later extended to include 'demand-side synergy' (Ye et al. 2012), for example when a firm that shares sales and distribution activities across its businesses not only cuts costs but also raises revenues by adding the convenience of one-stop shopping and thus increasing consumer willingness-to-pay.[5] Helfat and Eisenhardt (2004) have recently contrasted such 'intra-temporal economies of scope' on the cost or revenue side with 'inter-temporal economies of scope'—or the value that is added when a firm withdraws some resources from one of its businesses and redeploys them to another of its businesses. The use of inter-temporal economies of scope in multi-business firms was exemplified with E.I. du Pont de Nemours & Co.'s redeployment of resources from its declining explosives businesses to other units in the firm (Chandler 1962; Penrose 1960) and has been assessed empirically in multiple studies (Anand and Singh

[4] Karim and Mitchell (2000, p. 1066) explained that reconfiguration required changing resources of merging firms. Notably, with reconfiguration, merging firms seek the best available mechanisms to recombine routines that underlie different resources; thanks to this search, the merged firm creates valuable and unique resources (Karim and Mitchell 2000, p. 1063). Meanwhile, in explaining corporate acquisitions, researchers often did not distinguish such recombination of complementary resources from redeployment of resources between merging firms: "if a firm can successfully redeploy its assets to enter new markets, or recombine existing assets with the complementary assets of an acquired firm, it may be able to reinvigorate firm growth" (Kim, Haleblian, and Finkelstein 2011, p. 28). Indeed, empirically, both Karim and Mitchell (2000) and Karim (2006) operationalized reconfiguration with the extent to which one party of the deal discontinued a product following the acquisition. Furthermore, the measure of reconfiguration in Karim (2006) combined such a withdrawal from a product with the transfer of the respective resources to the business of another party in the deal. As described in the next section, a partial or a complete exit from a product market combined with the transfer of the associated resources to another product market is what Helfat and Eisenhardt (2004, p. 1217) termed 'inter-temporal economies of scope' from resource redeployment. Such economies do not necessarily involve the recombination of complementary resources of merging firms. Of course, the empirical overlap does not suggest a conceptual redundancy between redeployment and recombination of complementary resources.

[5] With this extended definition of economies of scope, the shared resources do not have to be 'scale free' (Levinthal and Wu 2010). For example, the sharing of sales and distribution activities to achieve the demand-side synergy can involve such 'non-scale free resources' (Levinthal and Wu 2010) as sales outlets, sales and customer-service personnel, and delivery trucks.

1997; Lieberman et al. 2017; O'Brien and Folta 2009; Wu 2013). Economies of scope in the form of resource sharing (Brush 1996; Chatterjee 1986; Li and Greenwood 2004) or resource redeployment (Anand and Singh 1997) have also been applied directly to the contexts of mergers and acquisitions where the value of a merged company is expected to exceed the sum of the values of an acquirer and a target.

'Relatedness,' or the similarity between businesses (Rumelt 1974), has been identified as the key determinant of scope economies (Hill et al. 1992). With intra-temporal economies, relatedness enables the contemporaneous sharing of resources. For instance, because knowledge is intangible and thus is not limited in physical capacity, a merged firm can apply technological or marketing knowledge from one party to another party in the deal, thus avoiding the costly duplication in knowledge creation (Porter 1987; Teece 1980). The more related the two combined firms, the more similar are their knowledge requirements and the easier is the knowledge sharing between them (Bryce and Winter 2009).[6] Relatedness between the combined businesses in terms of served consumers can also enable a firm to share the sales and distribution system across its businesses and to sell multiple products to the same consumers at a premium, thus also enhancing 'demand-side synergy' (Ye et al. 2012). With inter-temporal economies, relatedness also makes resource requirements between businesses more similar, thus reducing costs of redeployment of a firm's resources between its businesses (Montgomery and Wernerfelt 1988; Sakhartov and Folta 2014, 2015). With these effects, many empirical studies confirmed the positive relationship between relatedness and the performance of multi-business firms (Ahuja and Novelli 2017). Although economies of scope in corporate acquisitions are expected to be enhanced by relatedness, they may also be susceptible to serious information challenges in M&A. The next section therefore reviews the literature that characterizes possible incompleteness of information about economies of scope.

[6] Although relatedness enables the knowledge sharing, not any degree of relatedness creates intra-temporal economies. Because the transfer of knowledge between businesses is costly (Maritan and Brush 2003), such costs can exceed the small sharing benefits in unrelated diversification. Conversely, substantial benefits in related diversification are likely to exceed the sharing costs.

Incomplete information

Just as economies of scope are often central to the value creation logic in many acquisitions, they have also been associated with the challenges that incomplete information presents to acquirers. Like a buyer of a used car with an uncertain quality in the classic example of the adverse selection problem (Akerlof 1970), a corporate acquirer can bear the risk of buying a 'lemon'—a target that is worth less than the price the acquirer pays for it. Just like the market for used cars can break down with the high risk of adverse selection for buyers, so do potential corporate acquirers avoid uncertainty by switching from acquisitions to joint ventures (Balakrishnan and Koza 1993) or by selecting targets presenting lower uncertainty (Coff 2002). Indeed, economies of scope have often turned out to be illusive and worth less than the acquisition premium, leading acquirers into a 'synergy trap' (Sirower 1997). Scholars noted that external evaluators, including corporate acquirers, are unlikely to know the value of synergy between the merged businesses (Sirower 1997), particularly revenue- or innovation-based synergies rather than more straightforward cost-based synergies. Thus, intra-temporal economies of scope, or synergy, from shared knowledge, sales and distribution activities, or other functions are notoriously hard to estimate (Cullinan et al. 2004; Eccles et al. 1999). Likewise, inter-temporal economies of scope from resource redeployment are difficult to evaluate (Maritan and Florence 2008; Sakhartov 2018).

Information challenges associated with economies of scope are often even more severe than in the standard adverse selection problem (Akerlof 1970), in which evaluators of a good with an uncertain quality can quantify the uncertainty using a known probability distribution. In contrast to such a quantifiable uncertainty assumed in the market for used cars, scope economies in corporate acquisitions often represent an 'unactualized possible' that is real before execution but is hard to quantify because it has not been actualized yet (Denrell et al. 2003, p. 981). In line with this idea, Litov et al. (2012) raised the 'uniqueness paradox' wherein unique economies from sharing resources within a multi-business firm are also hard to evaluate adequately. Likewise, Sakhartov (2018) proposed a 'redeployability paradox' that is specific to inter-temporal economies of scope: resource redeployment between two businesses is a valuable option that may be hard to assess due to its uniqueness. Both Litov et al. (2012) and Sakhartov

(2018) cast such uniqueness as a matter of degree that is specific to a particular corporate investment context. When a certain opportunity for resource sharing or for resource redeployment has not been previously pursued, then evaluators such as an acquirer have no data points to estimate the economies or their distribution. Conversely, when such economies are prevalent, evaluators are better equipped to quantify them.

The uncertainty about economies of scope that is hard to quantify but that is present in corporate acquisitions corresponds to the notion of 'ambiguity' defined in the literature as the "subjective experience of missing information relevant to a prediction" (Frisch and Baron 1988, p. 149). Evaluators face ambiguity where the sample for studying the event is small (Einhorn and Hogarth 1985). According to Bernstein (1996), when events are unique, ambiguity becomes significant. In that case, evaluators might reveal ambiguity aversion—they refuse to bet on outcomes with unknown probabilities. Ambiguity aversion was discovered by Ellsberg (1961) in an experiment in which he let subjects bet on picking a ball of a certain color from one of two urns, each with 100 balls. The first urn had an unknown ratio of red and black balls, while the second urn had 50 red and 50 black balls. With the option to win money for picking a ball of the color they had named before the trial, the subjects preferred to bet on the second urn. That result demonstrated the subjects' aversion to ambiguity about the ratio of balls in the first urn, even though both urns offered the same chances for a win. Ambiguity aversion has been robustly confirmed in experimental studies (Curley et al. 1986; Ellsberg 1963; Roberts 1963; Yates and Zukowski 1976) and empirical studies (Anderson et al. 2009; Antonioua et al. 2015; Drechsler 2013; Jeong et al. 2015; Williams 2015). In addition to the experimental and empirical evidence of ambiguity aversion, the implication of ambiguity was formalized with the 'maxmin' expected utility of Gilboa and Schmeidler (1989) that has become prevalent in formal studies of capital markets (Antonioua et al. 2015; Bossaerts et al. 2010; Chen and Epstein 2002; Easley and O'Hara 2009; Leippold et al. 2008; Riedel 2009). With maxmin utility, capital market participants have too little information to form a single prior for an ambiguous good and instead form multiple priors with unknown likelihoods. Ambiguity-averse

participants count on the minimal utility expected over all possible priors, and the market with incomplete information equilibrates at a price reflecting the worst-case scenario.

While uncertainty and its specific ramification of ambiguity pose challenges to a passive evaluator, they also create arbitrage opportunities for a buyer in strategic factor markets. Some studies (*e.g.*, Denrell et al. 2003) explained that such opportunities could be realized in contexts with economies of scope *via* 'serendipity' when a buyer arrived at the new profitable use of a target's resources by experimenting with various uses and learning about their outcomes. Other research (Sakhartov 2018) quantified such arbitrage opportunities while remaining agnostic about how exactly an acquirer learned the true value of economies of scope. Still other work (Makadok 2001; Makadok and Barney 2001) remained agnostic about economies of scope and focused instead on the 'strategic factor market intelligence' with which costly information about the to-be-bought resources with uncertain value is endogenously acquired by an interested buyer. Despite the general intuition that greater uncertainty makes evaluation of a resource more difficult to a buyer, how much an acquirer should invest in the reduction of ambiguity in the specific context of economies of scope in corporate acquisitions has not been investigated. Therefore, the next section builds a formal model that identifies the amount of due diligence as a function of relatedness and of ambiguity, and predicts the return to the acquirer from those parameters.

MODEL

The model of acquisition due diligence focuses on two firms, the acquirer and the target. At the initial time $t = 0$, the acquirer runs business j and considers buying the target engaged in business i. Each of the following three conditions is necessary for the deal. The first condition is that the deal should add value above the value the two firms can create separately. Accordingly, the model specifies two types of economies of scope that can justify the deal (Helfat and Eisenhardt 2004; Sakhartov and Folta 2014). First, the merged firm can attain intra-temporal economies of scope by keeping both the target's and the acquirer's businesses and by sharing resources between them (Bryce and Winter 2009). Second, the

merged firm can attain inter-temporal economies of scope by redeploying resources from the target to the acquirer or *vice versa*. Thus, if the target underperforms, then at any time before the end of the useful life of the resources $t = T$, the acquirer can withdraw the target's resources from i and redeploy them to j (Capron et al. 2001). Alternatively, if the acquirer underperforms, then before $t = T$ the acquirer can withdraw its resources from j and redeploy them to the target's business i (Anand and Singh 1997).

The second condition is that the price paid by the acquirer for the target must be at least as high as the next best bid. If the bid by the acquirer is below another bid, the acquirer cannot get the target. While the next best bid depends on the market equilibrium, this model does not derive that equilibrium explicitly. Rather, the model follows the approach established in research on asset pricing in the presence of ambiguity (*e.g.*, Chen and Epstein 2002; Epstein and Wang 1994; Sakhartov 2018) and implies the existence of the equilibrium in the market where players have incomplete information about the target.[7] The implied equilibrium reflects the state of the market before the focal acquirer commits due diligence.

The third condition is that, by committing due diligence, the acquirer arrives at the estimate of the target's value that is at least as high as the deal price; but the difference between the acquirer's improved estimate and the deal price should not be offset by cost of the due diligence effort. Otherwise, that difference would not compensate the acquirer for efforts that are needed in due diligence. The three conditions are built into the model as described in the three respective subsections below.

Economies of scope in the acquisition deal

In presenting the first condition necessary for the deal, this subsection summarizes assumptions about how the acquisition deal can add value through economies of scope. To isolate the mechanisms unique to economies of scope, this subsection closely follows Sakhartov and Folta (2014) and considers such

[7] As reviewed in the previous section and as operationalized below, this approach was validated in laboratory experiments and in empirical studies of real capital markets. It has been axiomatized with the maxmin utility that is prevalent in models of capital markets with incomplete information. In addition to being grounded in established research, this modeling approach avoids substantial complications of combining a game-theoretic model with the valuation of an American-type redeployment option. Meanwhile, an additional analysis that is reported in ONLINE APPENDIX B confirms the results of the main model in the context where the equilibrium in the market for the target is established formally instead of being implied.

economies in the context where information about economies of scope is complete. This approach starts with defining the evolution of uncertain returns in i and j when those businesses are run as stand-alone firms. In particular, the margin C_{it} in the target's business and the margin C_{jt} in the acquirer's business follow geometric Brownian motions:

$$C_{it} = C_{i0} e^{\left[\left(\mu_i - \frac{\sigma_i^2}{2}\right)t + \sigma_i W_{it}\right]} \qquad (1)$$

$$C_{jt} = C_{j0} e^{\left[\left(\mu_j - \frac{\sigma_j^2}{2}\right)t + \sigma_j W_{jt}\right]} \qquad (2)$$

$$dW_{it}\, dW_{jt} = \rho\, dt\,. \qquad (3)$$

In Equations 1–3, C_{i0} and C_{j0} are margins in i and j, respectively, at the initial time $t = 0$; μ_i and μ_j are drifts for the two margins; σ_i and σ_j are volatilities of the margins; and W_{it} and W_{jt} are Brownian motions with the correlation coefficient ρ.

After the acquisition, the firm can stay in both i and j and contemporaneously share resources between them, thus realizing intra-temporal economies of scope (Helfat and Eisenhardt 2004). The firm can also redeploy resources from i to j or *vice versa*, thus attaining inter-temporal economies of scope (Helfat and Eisenhardt, 2004).[8] Like in Sakhartov and Folta (2014), the two economies are reflected in the net cash flow generated by the merged firm at time t:

$$\begin{aligned} F_t^{xy} = {} & \omega_{it}^{xy} C_{it}^{x} + \left(1 - \omega_{it}^{xy}\right) C_{jt}^{y} - S\left\{\max\left[0, \left(\omega_{it}^{xy} - \omega_{it-1}\right)\right] C_{it}^{x} + \max\left[0, \left(\omega_{it-1} - \omega_{it}^{xy}\right)\right] C_{jt}^{y}\right\} \\ & + \mathbf{1}_{0<\omega_{it}^{xy}<1} \beta\left[\omega_{it}^{xy} C_{it}^{x} + \left(1 - \omega_{it}^{xy}\right) C_{jt}^{y}\right] \end{aligned}. \qquad (4)$$

In Equation 4, the use of economies of scope by the firm is parameterized in the following ways. Parameter ω_{i0} is the proportion of resources of the target in the overall stock of resources of the two

[8] In addition to redeploying resources of the underperforming target to the acquirer's business, the acquirer can try to turn around the target's business. This intriguing scenario is outside of the present focus on economies of scope and, thus, is not included in the model. Accordingly, the margin in the target's business C_{it} (just like the margin in the acquirer's business C_{jt}) is exogenous and is therefore not what the acquirer can strategically change.

parties at the initial time $t = 0$, whereas ω_{it}^{xy} is the part of resources of the merged firm that is used in the target's business i at time t. Because the merged firm can redeploy resources from i to j or *vice versa*, parameter ω_{it}^{xy} varies from zero (when all resources are redeployed from i to j) through ω_{i0} (when no resources are redeployed) to one (when all resources are redeployed from j to i). Accordingly, $\left(1-\omega_{i0}^{xy}\right)$ is the proportion of resources of the acquirer in the overall volume of resources of the two parties at the initial time $t = 0$, whereas $\left(1-\omega_{it}^{xy}\right)$ is the part of resources of the merged firm that is deployed in the acquirer's business j at time t; $\max\left[0,\left(\omega_{it-1}-\omega_{it}^{xy}\right)\right]$ is the part of resources that is switched from i to j at time t (*i.e.*, when $\left(\omega_{it-1}-\omega_{it}^{xy}\right)>0$); $\max\left[0,\left(\omega_{it}^{xy}-\omega_{it-1}\right)\right]$ is the part of resources that is switched from j to i at time t (*i.e.*, when $\left(\omega_{it}^{xy}-\omega_{it-1}\right)>0$). Expression $\mathbf{1}_{0<\omega_{it}^{xy}<1}$ equals one when $0<\omega_{it}^{xy}<1$ and is zero otherwise. That expression captures the use of resource sharing by the merged firm that would end if the firm discontinued the target's (*i.e.*, $\omega_{it}^{xy}=0$) or the acquirer's (*i.e.*, $\omega_{it}^{xy}=1$) business.

The following two parameters in Equation 4 capture relatedness between i and j. First, relatedness facilitates redeployment of resources between i and j by reducing the marginal redeployment cost S. Accordingly, S is an inverse proxy for relatedness involved in resource redeployment. When the firm redeploys resources to business j (or to business i), the net margin earned with the redeployed resources is lower than the regular margin C_{jt} (or C_{it}) by S. This parameter captures a loss in efficiency due to the needed adjustment of resources, which were previously tailored for use in i (or in j), for their new use in j (or in i); the stronger the relatedness, the less adjustment is needed (Montgomery and Wernerfelt 1988). Thus, the full redeployment cost is a product of the marginal redeployment cost S of a unit of resources, the amount $\left(\omega_{it-1}-\omega_{it}^{xy}\right)$ (or $\left(\omega_{it}^{xy}-\omega_{it-1}\right)$) of redeployed resources, and the current value of the margin C_{jt}^{y} (or C_{it}^{x}) in the recepient business. Second, relatedness

enables sharing of resources between i and j by raising the sharing factor β. When the firm keeps both businesses (*i.e.*, $0 < \omega_{it}^{xy} < 1$) and shares resources between them, the net margin in each business is increased by the multiplier $(1+\beta)$ over the margin that would be realized if the firm discontinued i or j. In this specification, β is the sharing factor—a direct proxy for relatedness involved in resource sharing. The stronger the relatedness, the more similar the resource requirements between the businesses and the easier the firm can share resources between those businesses.[9] Finally, x and y denote current realizations for margins C_{it} and C_{jt} within their probability distribution (Equations 1–3) and characterize the respective current resource use ω_{it}^{xy}.[10]

Deal price for the target

In presenting the second condition that is necessary for the acquisition deal, this subsection summarizes the assumptions about how the target firm is priced by the capital market. The price for the target is modeled in the capital market where economies of scope are incompletely understood by players. The incompleteness is enabled by making β and S ambiguous to market players. Such ambiguity represents the experience of missing information about rare events (Bernstein 1996; Frisch and Baron 1988) of resource sharing and redeployment. In this case, each market player has multiple priors for S and for β but does not know the relative odds of those priors. Because the rarity of redeployment and of sharing of resources between businesses i and j that leads to ambiguity is a matter of degree, ambiguity about the two ramifications of relatedness, S and β, is parametrized with σ_M, like in Sakhartov (2018):

$$S_t^M = S_0^M e^{\left[\left(\mu_S - \frac{\sigma_M^2}{2}\right)t + \sigma_M W_{Mt}\right]} \qquad (5)$$

[9] The sharing factor can, in principle, be negative thus reflecting the situation where the cost of the contemporaneous sharing exceed its benefits. Because this scenario leads to the result of the acquirer refraining from the deal, this model disregards this case.

[10] Like in Sakhartov and Folta (2014), this specification of relatedness is agnostic with regard to whether relatedness is concerned with inputs or with outputs of the merged businesses. In contrast to this simplification, related inputs may differ from related outputs in the marginal redeployment cost and in the sharing factor.

$$\beta_t^M = \beta_0^M e^{\left[\left(\mu_\beta - \frac{\sigma_M^2}{2}\right)t + \sigma_M W_{Mt}\right]}. \qquad (6)$$

In Equations 5 and 6, S_t^M and β_t^M reflect multiple priors maintained at time t for S and β.[11]

The model assumes that the acquirer can buy the target only at time $t = 0$ and competes for the target with all market players. The target market valuation V_0^M that the acquirer has to match to win the bid is the net present value of the target including economies of scope as seen by a representative buyer of the target. That value cannot be computed by market players as an expectation because they do not know the probability distributions for S_t^M and β_t^M. The target's market value V_0^M is assessed based on the 'maxmin' principle of Gilboa and Schmeidler (1989):

$$V_0^M = \max_{\boldsymbol{\Phi}} \int_{t=0}^{t=T} \left[e^{-rt} \int_y \int_x \min_{z \in Q_{xyz}^M} \left\{ F_t^{xyz} \right\} dxdy \right] dt - V_0^B = \max_{\boldsymbol{\Phi}} \int_{t=0}^{t=T} \left[e^{-rt} \int_y \int_x F_t^{xy \underline{Q}_{xyz}^M} dxdy \right] dt - V_0^B . \qquad (7)$$

Like F_t^{xy}, F_t^{xyz} is the net cash flow generated by the merged firm at time t when C_{it} and C_{jt} have realizations x and y. Parameter z shows ambiguity about S and β. The 'min' reflects ambiguity aversion with which market players count on the worst case $\underline{Q}_{xyz}^M$ from all scenarios Q_{xyz}^M (Equations 5 and 6): the highest value $\overline{S}_t^M$ and the lowest value $\underline{\beta}_t^M$. With this maxmin principle, economies of scope are undervalued in the incomplete market, thus enabling an arbitrage opportunity to the diligent acquirer. Matrix $\boldsymbol{\Phi}$ includes current resource deployment choices ϕ_{it}^{xy} a representative buyer would make in the presence of ambiguity (ϕ_{it}^{xy} may differ from choices ω_{it}^{xy} that would be made if there were no ambiguity about economies of scope). Finally, V_0^B is the stand-alone value of a representative buyer. Because

[11] The Brownian motion W_{Mt} is set uncorrelated with either W_{it} or W_{jt}. Initial values S_0^M and β_0^M for S_t^M and β_t^M are set equal to the respective true values S and β; and μ_S and μ_β are drifts for the evolution of priors for S and for β. Setting the initial values for S and β reflects the authors' preference to avoid the consideration of biases in the priors.

redeployment is an American-type option with non-trivial exercise cost, Equation 7 cannot be solved analytically. Therefore, V_0^M is estimated numerically, as described in ONLINE APPENDIX A.[12,13]

Value of the target to the acquirer with due diligence

In introducing the third condition necessary for the deal, this subsection presents assumptions about how the target firm is appraised by the acquirer. This model focuses on the utility of due diligence and, therefore, does not consider an arbitrage opportunity that the acquirer cannot anticipate and can realize only through serendipity (Denrell et al. 2003). Accordingly, without due diligence, the modeled acquirer has no information advantage over other buyers and cannot attain superior returns. If due diligence were effortless, the acquirer would always conduct the most thorough examination to fully eliminate ambiguity about economies of scope and to fully appropriate the undervaluation of such economies. Of course, due diligence is generally neither absent nor effortless. The utility of due diligence to the acquirer involves the balance between the extent of the undervaluation of the target that can be uncovered and the cost of the due diligence effort that is borne to uncover that undervaluation. Those two sides of the balance are modeled as follows.

In the general case the acquirer undertakes the extent of due diligence that eliminates some (from none to all) ambiguity, so the acquirer sees the target's value as follows:

$$V_0^D = \max_{\boldsymbol{\psi}} \int_{t=0}^{t=T} \left[e^{-rt} \int_y \int_x \min_{z \in Q_{xyz}^D} \left\{ F_t^{xyz} \right\} dxdy \right] dt - V_0^A = \max_{\boldsymbol{\psi}} \int_{t=0}^{t=T} \left[e^{-rt} \int_y \int_x F_t^{xy \underline{\in} Q_{xyz}^D} dxdy \right] dt - V_0^A . \quad (8)$$

[12] The need for the numerical solution derives from the inherent complexity of redeployment. Economies of scope linked to that option are inter-temporal (Helfat and Eisenhardt 2004) and path-dependent (Kogut and Kulatilaka 1994; Sakhartov and Folta 2014). Accordingly, such economies must be analyzed in a multi-period model that is based on dynamic optimality. Otherwise, as Sakhartov and Folta (2014) formally illustrated, the neglect of dynamic optimality leads to naïve and myopic redeployment and to inferior value outcomes. Therefore, dynamic optimality is operationalized with Equation 7 that makes the potential buyer of the target very selective in redeploying resources. Not only does this selectivity demand that redeployment occur when the current advantage of the recipient business over the business that gives the resources exceed the redeployment cost (*i.e.*, the requirement that would suffice without dynamic optimality), but it also requires that such redeployment occur at the best possible time from the completion of the deal to the end of the lifecycle of the resources. This contingent use of resource redeployment is a key mechanism that underlies the complex results in Figure 1. The main cost of representing resource redeployment consistently is that the target's value cannot be estimated analytically. Hence, Equation 7 is solved recursively in time with a very intense computational procedure where each of numerous data points in the reported figures takes several hours to estimate even on an advanced computer.

[13] This model excludes the possibility that the deal price can be affected by the winner's curse, a tendency for a corporate acquirer to bid over the true value of the target in the presence of competitive bidding.

Like Equation 7, Equation 8 cannot be solved analytically and is instead estimated numerically, as described in detail in ONLINE APPENDIX A.[14] Equation 8 differs from Equation 7 in the following three ways. The first distinction is that the representation Q_{xyz}^{M} of priors that a representative buyer maintains for S and β changes to Q_{xyz}^{D} that is held by the acquirer. That change occurs because the acquirer exerts due diligence effort $\theta \geq 0$ that makes S and β less ambiguous:

$$\sigma_D = \frac{\sigma_M}{(1+\theta)} \qquad (9)$$

$$S_t^D = S_0^D e^{\left[\left(\mu_S - \frac{\sigma_D^2}{2}\right)t + \sigma_D W_{Dt}\right]} \qquad (10)$$

$$\beta_t^D = \beta_0^D e^{\left[\left(\mu_\beta - \frac{\sigma_D^2}{2}\right)t + \sigma_D W_{Dt}\right]}. \qquad (11)$$

In Equations 9–11, σ_D represents the residual ambiguity that is faced by the acquirer regarding S and β after it exerted due diligence effort θ. An intuitive interpretation of that representation is that there is information asymmetry between a representative buyer and the acquirer: the bands for possible values of S and β as seen by the acquirer are narrower that the bands considered by the market. With this model, S_t^D and β_t^D summarize the multiplicity of priors for S and β that is still experienced by the acquirer.[15] The 'min' models ambiguity aversion, with which the acquirer counts on the worst case $\underline{Q}_{xyz}^{D}$ from all scenarios Q_{xyz}^{D} for S_t^D and β_t^D (*i.e.*, the highest value $\overline{S}_t^D$ and the lowest value $\underline{\beta}_t^D$). The second distinguishing feature of Equation 8 is that choices $\boldsymbol{\Psi}$ by the acquirer with regard to the target's resources can differ from choices $\boldsymbol{\Phi}$ by another buyer. The third unique feature of Equation 8 is that the acquirer's stand-alone value V_0^A is subtracted instead of the stand-alone value of a representative buyer

[14] Just as Equation 7 imposes the requirement of dynamic optimality on the use of economies of scope by a representative buyer, so does Equation 8 reflect the dynamically optimal use of economies of scope by the focal acquirer. Accordingly, the solution for V_0^D can also be completed only numerically, like for V_0^M.

[15] The Brownian motion W_{Dt} is set uncorrelated with W_{it}, W_{jt}, or W_{Mt}. Initial values S_0^D and β_0^D are equal to S and β.

V_0^B. Because the only way in that the model differentiates the acquirer from another buyer is by enabling the due diligence effort, $V_0^A = V_0^B$.

The disutility of the due diligence effort to the acquirer is modeled to capture diminishing returns to that effort. That feature of the specification is operationalized similar to Makadok and Barney (2001, p. 1626) by setting the problem of choosing the optimal due diligence level as follows:

$$\theta^* = \arg\max_{\theta} \left\{ \frac{\left(V_0^D(\theta) - V_0^M \right)}{(1+\theta)} \right\} \tag{12}$$

$$\Delta^* = \max_{\theta} \left\{ \frac{\left(V_0^D(\theta) - V_0^M \right)}{(1+\theta)} \right\}, \tag{13}$$

where Δ is the return to the acquisition deal that is maximized by the acquirer with respect to the endogenously selected due diligence effort θ.

RESULTS

The model is used to characterize how the optimal due diligence effort θ^* and the return to the acquirer Δ^* derive from the key determinant of economies of scope—relatedness between the acquirer's and the target's businesses, and from the key information challenge faced by market players—ambiguity about economies of scope.[16] The two types of economies of scope, inter-temporal economies from resource redeployment and intra-temporal economies from resource sharing, are considered in turn in the next two subsections. While focusing on one type of economies of scope, each of the two analyses disallows the other type. In particular, the first analysis that focuses on due diligence of inter-temporal economies from resource redeployment disallows intra-temporal economies from resource sharing by setting the sharing factor equal to zero. Specifically, in Figure 1 illustrating results for due diligence of inter-temporal economies, relatedness present in such economies is captured inversely with the marginal redeployment

[16] The optimal due diligence effort and the maximized return to the acquirer are derived simultaneously in a single model by applying the MATLAB script 'fminsearch' that iterates over non-negative values of the due diligence effort. The simultaneous identification of the optimal due diligence effort and of the maximized return to the acquirer is analogous to the simultaneous estimation of regression coefficients and of the maximized log-likelihood function in the maximum-likelihood estimation.

cost S, so that higher redeployment cost represents weaker relatedness between the acquirer's and the target's businesses. In turn, the second analysis that focuses on intra-temporal economies from resource sharing excludes resource redeployment possibilities. In Figure 2, which demonstrates results for due diligence of intra-temporal economies, relatedness involved in such economies is operationalized directly with the sharing factor β. In Figures 1 and 2, ambiguity about economies of scope is captured directly with the parameter σ_M representing the variation in priors for the two manifestations of relatedness. Other parameters from Equations 1–13 are not directly involved in the theoretical predictions in this study. The robustness tests undertaken to examine the sensitivity of findings to alternative specifications and to alternative values of these secondary parameters are offered in ONLINE APPENDIX B.

Due diligence of inter-temporal economies of scope from resource redeployment

Figure 1 shows the effects of the redeployment cost and of ambiguity on the optimal due diligence effort (Panel A), and on the return to the acquirer that results from that effort (Panel B).

Insert Figure 1 about here

Optimal due diligence with inter-temporal economies of scope from resource redeployment

The key observation in Panel A is that it contains a diagonal ridge for the optimal due diligence effort. Because the marginal redeployment cost is the only (inverse) manifestation of relatedness in Figure 1, this result suggests that neither the weakest nor the strongest relatedness involved in resource redeployment between the target and the acquirer demands the highest due diligence effort. Similarly, neither the lowest nor the highest ambiguity about economies of scope leads to the highest due diligence effort. That non-monotonicity of the two effects is a novel finding that is provided by the present formal model, and it can be explained by discerning the mechanisms unfolding in the following three areas that are separated with the dotted lines in Panel A.

Area I, where the optimal due diligence effort is zero, comprises combinations of the redeployment cost and of ambiguity such that at least one of the following two conditions holds: the redeployment cost is trivial (*i.e.*, relatedness between the two businesses is the strongest) and ambiguity is trivial. Accordingly, this area involves two thin stripes next to the left and to the bottom margins of Panel A. What makes due diligence useless in these stripes? The result holds because ambiguity about economies from resource redeployment is absent at both margins, but for reasons that differ between these zones. At the left margin, the acquirer's and the target's businesses are identical, thus having the same resource requirements, causing no efficiency loss in redeploying resources between them, and leaving no room for ambiguity about that perfectly efficient shift.[17] At the bottom margin, the lack of ambiguity is a feature of the informational context in which economies of scope are situated. That context may be exemplified with situations where resource redeployments between the businesses are commonplace. In this case, uniqueness—the key determinant of ambiguity—is absent. Regardless of the reason for the absence of ambiguity, this absence makes due diligence unnecessary. This lack of due diligence does not necessarily suggest that the acquirer refrains from the deal. As described in the next section, Area I entails zero acquirer return thus making the acquirer indifferent between buying the target and refraining from the deal.

In Area II, the optimal due diligence effort grows monotonically in the directions from the left to the right and from the bottom to the top. The increase of the optimal due diligence in the direction from the left to the right takes place because resource redeployment becomes more selective in this direction. In particular, with low levels of redeployment costs, states for the two margins that might make redeployment economically meaningful abound. Even if the ambiguity-averse acquirer rules out some of these states as potentially loss-making, there are still enough states in which even the worst-case scenario for the redeployment cost keeps redeployment profitable. In this context, where states for the margins that

[17] The mathematical explanation for the lack of ambiguity about the trivial redeployment cost is as follows. Feasible values of the redeployment cost are naturally bounded by zero from below: $S \in [0, \infty)$. Accordingly, that the expectation for that non-negative cost is equal zero, $\mathrm{E}[S] = 0$, leaves only one feasible value for that situation, $S = 0$, thus making the redeployment cost certain.

invite redeployment abound, the acquirer can economize on the costly due diligence effort and accepts higher residual ambiguity with little due diligence. With higher levels of redeployment costs, the number of states that keep redeployment profitable is lower. Therefore, the ambiguity-averse acquirer no longer enjoys the slack, with which it could costlessly cherrypick some states that guaranteed a positive outcome in the worse-case scenario. At some relatively high level of the redeployment cost, there remains no such 'sure' states and, to discover at least some of them, the acquirer has to apply due diligence. In turn, Area II reveals the growth in the optimal due diligence in the direction from the bottom to the top of Panel A because, with lower quality of available information about the redeployment cost farther from the bottom margin, the need to improve that quality becomes more pertinent to the acquirer. This stronger demand makes the acquirer commit more due diligence effort.

Area III involves a dark blue quarter circle to the north-east of the ridge in Panel A. In this area, the acquirer undertakes no due diligence, like in Area I but for a different reason. In contrast to Area I, neither ambiguity nor the redeployment cost is trivial in Area III. Accordingly, the two sources of disutility to the acquirer—the cost of due diligence to resolve ambiguity and the cost of resource redeployment to apply the target's resources in the new context—interact in determining the acquirer's due diligence effort. The understanding of this subtle interaction starts with the comprehension of the distinct effect of the redeployment cost on the use of redeployment. Thus, keeping ambiguity constant and going from the left margin to the right, the redeployment cost hits a threshold above which the estimate for that cost held by the acquirer is so high that the acquirer would never redeploy resources. In line with this intuition, Sakhartov and Folta (2015) showed that, above some level of the redeployment cost, the option to redeploy resources across businesses adds no value to a firm that combines them. Going from that threshold further to the right in Panel A, the acquirer anticipates no economies from buying the target and redeploying resources between the merged businesses, thus refraining from the deal. Letting ambiguity vary affects how far from the left margin the threshold for the redeployment cost is located. That happens because ambiguity raises the cost of due diligence that, in turn, substitutes for the cost of the would-be redeployment. With the redeployment cost and ambiguity competing to reduce the utility of the

deal to the acquirer, higher ambiguity reduces threshold values of the redeployment cost above which the acquirer refrains from the deal, thus explaining the downward slope of the threshold line that bounds Area III from below. In contrast to Area I, zero due diligence effort in Area III represents the decision by the acquirer to walk away from the deal.

Acquirer return with inter-temporal economies of scope from resource redeployment

The most interesting result in Panel B of Figure 1 is that it has an interior peak, which is outside the bottom left corner where the redeployment cost is zero and ambiguity is absent. This location of the peak indicates that the acquirer's return has inverse U-shaped relationships both with the redeployment cost and with ambiguity. Because the redeployment cost is the inverse proxy for relatedness, this result means that neither the weakest *nor even the strongest* relatedness present in resource redeployment leads to the highest acquirer return. Instead, low-to-medium relatedness maximizes the observed return to the acquirer. This result, explained intuitively below, contrasts with the long-believed monotonic positive relationship between the return to a corporate acquirer and relatedness between the merged businesses. Another ramification of the interior peak in Panel B is that neither the highest *nor even the lowest* ambiguity maximizes the return to the acquirer. This result contrasts with the prevalent view in the literature that was based on the avoidance of difficult-to-evaluate targets. The result demonstrates that some ambiguity (*i.e*., low-to-medium) is actually necessary to make the deal profitable to the acquirer. Without such ambiguity, even very strong economies of scope do not suffice to reward the acquirer (*cf*. the bottom left corner of Panel B).

So, why doesn't the peak for the observed return to the acquirer occur right in that corner where the two sources of disutility to the acquirer are minimal? That straightforward effect does not unfold because the absence of ambiguity in Area I disallows any information asymmetry between the acquirer and a representative buyer. Accordingly, in Area I, the two bidders share the same appraisal for the target and are prepared to pay the same price. If the acquirer offers an infinitesimal premium to win the bid, the

observed return to the acquirer is zero because the acquirer gets what it pays for. If the acquirer concedes the bid to another buyer, the observed return to the acquirer is also zero.[18]

A final observation in Panels A and B of Figure 1 is that the highest acquirer return does not necessarily derive from the highest due diligence effort. Thus, the diagonal ridge in Area II in Panel A with the maximal due diligence effort maps on the dark blue part of Area II in Panel B where the acquirer return is very low (but not zero). Alternatively, the peak in Area II in Panel B where the acquirer return is maximal corresponds to the dark blue part of Area II in Panel A where the optimal due diligence effort is very low (but not zero). That misalignment emerges because the disutility of the due diligence effort offsets the arbitrage opportunity that derives from the information advantage an acquirer would obtain over a representative buyer.

Due diligence of intra-temporal economies of scope from resource sharing

Figure 2 shows the effects of the sharing factor and of ambiguity on the optimal due diligence effort (Panel A), and on the return to the acquirer that results from that optimal effort (Panel B).

Insert Figure 2 about here

Optimal due diligence with intra-temporal economies of scope from resource sharing

The first noteworthy pattern in Panel A of Figure 2 is that the sharing factor has a discrete effect on the optimal due diligence effort. Thus, when the sharing factor is trivial at the left margin, the due diligence effort is zero; whereas, when the sharing factor is positive, the due diligence effort is positive but it is unaffected by that factor. This discrete effect, with which the trivial sharing factor merely turns the due diligence off, differs from the continuous relationship between the optimal due diligence effort and the redeployment cost as another manifestation of relatedness (see Figure 1). The second observation in Panel A of Figure 2 is that, with intra-temporal economies from resource sharing, ambiguity has a monotonic

[18] Although the return to the target in the acquisition deal is not the focus of this study, it is worth noting that the target appropriates economies of scope reflected in Area I at the expense of the suitors competing for it. Thus, the model accommodates the stylized fact that target firms often appropriate most of the value created in acquisitions (Bruner 2002).

positive effect on the optimal due diligence effort. This second observation contrasts with the inverse U-shaped relationship between the optimal due diligence effort and ambiguity diagnosed for inter-temporal economies from resource redeployment in Figure 1. To explain these findings, Panel A of Figure 2 is split into areas with distinct causal mechanisms. In contrast to the three areas identified in Figure 1 for inter-temporal economies of scope, Figure 2 does not isolate Area III where the acquirer refrains from the deal for a reason other than the lack of ambiguity as this scenario is absent from Figure 2.

In Area I that involves two thin stripes at the left and the bottom margins, the optimal due diligence effort is zero because ambiguity about economies from resource sharing is absent. Notably, on the left margin, the acquirer's and the target's businesses are totally unrelated, thus having no similarity in resource requirements. If the two businesses have no similarity in consumers served or knowledge used, intra-temporal economies from resource sharing are unlikely anyway. This case by itself is the worst case for economies of scope, regardless of whether such economies are considered by the focal acquirer or by a representative buyer[19] In turn, at the bottom margin, the lack of ambiguity characterizes the specific informational context for economies of scope. That context includes situations where sharing of resources between the businesses, in which the acquirer and the target operates, is prevalent. Therefore, the uniqueness of such sharing—the key determinant of ambiguity—is absent. Regardless of why ambiguity is absent, this lack of ambiguity makes due diligence unneeded in Area I in Panel A of Figure 2.

In Area II, ambiguity is present and so is the potential for information asymmetry between the diligent acquirer and a representative buyer. Why doesn't the sharing factor reduce the optimal due diligence effort in Figure 2 just as another inverse proxy for relatedness, the redeployment cost, raises that effort in Figure 1? This difference happens because intra-temporal economies are based on the contemporaneous sharing of resources and thus do not require the selective use of such sharing. Unlike the selective redeployment of resources that depends on states for the margins in the merged businesses

[19] The mathematical explanation for this situation is as follows. Feasible values of the sharing factor are naturally bounded by zero from below: $\beta \in [0, \infty)$. Accordingly, that the expectation for that non-negative factor is equal zero, $\mathrm{E}[\beta] = 0$, leaves only one feasible value for that situation, $\beta = 0$, thus making the sharing factor the worst possible for any evaluator.

and explains the dependence of the due diligence effort on the redeployment cost, resource sharing will occur whenever the sharing factor is positive. In other words, just knowing that the two businesses are not totally unrelated guarantees that the acquirer will always profitably share resources between the merged businesses, thus explaining the discrete effect of the sharing factor on optimal due diligence.[20] Why doesn't the optimal effort of due diligence with respect to resource sharing reveal an inverse U-shaped relationship with ambiguity? Because the distinct nature of resource sharing makes Area I in Figure 2 subsume the roles of Area I (*i.e.*, trivial ambiguity) and of Area III (non-trivial ambiguity and less-than-perfect relatedness) in Figure 1, the inverse U-shaped relationship between the optimal due diligence effort and ambiguity degenerates to the monotonic relationship.

Acquirer return with intra-temporal economies of scope from resource sharing

The key observation in Panel B of Figure 2 is that, when the acquirer carries out the due diligence optimally, the return to the acquirer has a peak that is located on the right margin and is very close to, but not exactly on, the bottom margin of the figure. The positioning of this peak outside the bottom margin suggests that the acquirer return has an inverse U-shaped relationship with ambiguity about intra-temporal economies from resource sharing, similar to inter-temporal economies from resource redeployment in Figure 1. In turn, the location of the peak on the right margin means that the sharing factor monotonically increases the return to the acquirer. This monotonic effect differs from the inverse U-shaped relationship between the acquirer return and another manifestation of relatedness, the redeployment cost (*cf.* Figure 1).

Why don't intra-temporal economies from resource sharing repeat the inverse U-shaped relationship between the acquirer return and relatedness that is observed with economies from resource redeployment? This difference takes place because, as described in the previous section, the use of resource sharing and of due diligence about it by the acquirer does not create Area III where the acquirer

[20] As described in Footnotes 6 and 9, this study does not assume that the resource sharing is costless. With weak relatedness, the costs of the resource sharing are equal to (or even exceed) the small benefits of such sharing, making the sharing factor zero (or even negative). In this case, the acquirer refrains from a deal. Conversely, when relatedness is not weak, the higher benefits of the resource sharing exceed its costs, making the sharing factor positive. As a result, the acquirer engages in the deal under these conditions.

walks away from the deal for a reason other than the lack of ambiguity. As long as ambiguity about intra-temporal economies from resource sharing is present (*i.e.*, both the sharing factor is not trivial and the resource sharing is not commonplace), the acquirer never refrains from the deal. Accordingly, in the absence of Area III, the inverse U-shaped relationship between the acquirer return and ambiguity degenerates to the monotonic positive relationship.

The derived results are summarized in Table 1 in the form of hypotheses. The results are grouped for the two focal outcomes of the model: the optimal due diligence effort and the acquirer's return.

Insert Table 1 about here

DISCUSSION

Contributions and implications

The idea that corporate acquirers should be very diligent with respect to economies of scope (casually termed 'synergy') inherent in acquisitions has been prevalent among consultants, market analysts, and scholars. Extensive due diligence has also been promoted in cases that teach students of business administration how exemplar corporate acquirers withdraw numerous key employees from their own functional activities, send those employees to acquired firms, engage their own top executives as well as external advisers in the evaluation process, and apply many valuation techniques. Business gurus regularly advise that corporate acquirers be very skeptical about the target's asking price and be ready to refrain from the deal if that price exceeds the value diagnosed in extensive due diligence. Acquirers are often reminded that many acquisitions do not deliver upon anticipated economies of scope, specifically due to insufficient due diligence. In accord with this advice, hundreds of research articles published in top management journals appear to support the popular idea that acquirers should always be very diligent. Surprisingly, despite sparse mentions of the costliness of due diligence and despite preexisting research on the strategic acquisition of information by buyers of resources, none of these numerous corporate

acquisition studies cast due diligence of economies of scope as an endogenous choice or a predicted variable.

Responding to the gap in research on corporate acquisitions, this study casts acquisition due diligence as its primary focus and develops a more nuanced theory of due diligence. Whereas the careful assessment of a target's value could protect an acquirer from adverse selection problems, due diligence is an expensive commitment of resources of the acquirer's management. To provide for a more balanced view in future considerations of due diligence, this study places due diligence in the specific context of economies of scope that are inherent in acquisitions but that may also be compromised by the incomplete information about them. Following precedents in the literature on economies of scope, this study uses a formal model to build a theory of acquisition due diligence. The model predicts both an acquirer's optimal due diligence effort and the net return to an acquirer based on the most popular determinant of economies of scope—relatedness between the merged businesses, and on the key determinant of incomplete information in acquisitions—ambiguity about economies of scope as the source of value in acquisitions.

By demonstrating that corporate acquirers should not indiscriminately apply a very extensive (or any other uniform) level of due diligence to all deals, the results derived from the model provide the foundations for a theory of due diligence in corporate acquisitions. The four hypotheses that are generated by the formal model express the optimal commitment to due diligence as a function of parameters that characterize the specific acquisition at hand, based on key considerations raised in previous research. The developed hypotheses can be tested in future empirical research on corporate acquisitions. The predictions may also guide corporate acquirers on the optimal allocation of their due diligence efforts. In particular, this work can begin to offer heuristics to corporate development staff as to when organizations should devote more or less resources to due diligence in acquisitions.

One of the central implications of the results in the study is that, in deciding how much effort corporate acquirers should commit to due diligence, it is critical to distinguish between resource sharing and resource redeployment as two separate types of economies of scope present in corporate acquisitions.

Although resource relatedness facilitates both resource sharing and resource redeployment, its effect on the optimal due diligence effort varies remarkably between these two benefits. The distinctive effect of relatedness that is present in redeployment (*i.e*., the inverse U-shaped relationship between due diligence and relatedness) stems from its complexity. In particular, resource redeployment is a real option that demands prudent timing. Because the merged firm is not obliged to instantly redeploy resources, the time for redeployment is selected based on when such redeployment is optimal for the firm. Such prudent timing of redeployment critically depends on the redeployment cost (*i.e*., an inverse manifestation of relatedness) and is rigorously characterized with the model based on the principle of dynamic optimality. As Kogut and Kulatilaka (1994) explained, the costliness of resource redeployment introduces "hysteresis," or rational inertia into the use of redeployment. Sakhartov and Folta (2014) formally demonstrated the loss in corporate value that occurs when such rational inertia is ignored. In the context of the present study, the dependence of the optimal timing of redeployment on redeployment costs affects the use of due diligence to resolve ambiguity about such costs. If, alternatively, resource redeployment were not treated as a real option available to the merged firm *at any time* (*i.e*., from the completion of the acquisition deal to the full depreciation of resources), the optimal due diligence effort would be invariant to redeployment costs (*i.e*., relatedness) – just like with resource sharing.[21] Speaking to the importance of implementation of corporate strategy, this study also more generally emphasizes the critical role that time plays as well as the importance of due diligence as a critical process that determines the value that organizations obtain in implementing acquisitions. Since the timing of potential resource redeployment is an important facet of acquisition implementation, this work emphasizes the need to think across the various stages of the M&A process, beginning with the earliest stages of acquisition search and deal-making.

The third implication of the theory offered in this paper is that it elaborates upon how resource relatedness, the chief determinant of economies of scope, affects value realized in corporate acquisitions

[21] This additional result is available from the authors upon request.

when information about such economies is incomplete. That elaboration is implemented by bringing information economics, with its focus on adverse selection concerns, to the context of economies of scope that were often treated by research as occurring when information is either complete or easy to access. In fact, the presence of ambiguity about economies of scope substantially revises the well-known relationship with which relatedness was argued conceptually (Penrose 1959; Sakhartov and Folta 2014, 2015) and shown empirically (Anand and Singh 1997; Montgomery and Wernerfelt 1988; Wu 2013) to enhance value realized in corporate acquisitions. When ambiguity is present and due diligence is a costly commitment, an intermediate rather than the highest level of relatedness involved in redeployment of resources between the merged businesses is shown to lead to the highest net return that the acquirer. The result that the acquirer return does not monotonically increase with relatedness is consistent with a few other studies (Chen, Kaul, and Wu 2019; Palich, Cardinal, and Miller 2000) which previously diagnosed a curvilinear relationship between the value of a diversified firm and relatedness. Complementing this earlier research, the relationship diagnosed in this study derives from the focus on inter-temporal economies of scope from resource redeployment and on the information challenges specific to corporate acquisitions.[22]

The final ramification of the theory developed in this paper involves the strategic use of incomplete information, where the quality of information about the target is actively managed by an acquirer rather than is taken as given. In contrast to the prevalent view that is based on avoidance of deals involving targets that are difficult to evaluate (Balakrishnan and Koza 1993; Drechsler 2013), this study demonstrates that some ambiguity about economies of scope between the merged businesses is a necessary condition to make the deal profitable to an acquirer. In the absence of such ambiguity, even very high economies of scope alone cannot justify the deal and would not lead to returns to an acquirer.

[22] Other research has also challenged the monotonic positive effect of relatedness between merging businesses on the acquirer returns, but for other reasons that complement those offered in this study. For example, Barney (1988) explained that relatedness takes on its positive effect on acquirer returns only when synergistic gains between the merged businesses are either unique to the specific pair of the acquirer and of the target or are unexpected before the deal. Also, Ahuja and Katila (2001), Cloodt, Hagedoorn, and Van Kranenburg (2006), Kim and Finkelstein (2009), and Yu, Umashankar, and Rao (2016) highlighted that relatedness can also be related to the complementarity as well as redundancies in resources between the acquirer and the target, thus having a non-trivial effect on the value eventually realized by the acquirer.

The developed formal model indicates that, with economies of scope either from resource sharing or from resource redeployment, an intermediate rather than the lowest level of ambiguity about such economies leads to the highest net return to the acquirer.

Moving from theory to empirical research on due diligence

The derived results can be subjected to empirical analysis, and this study encourages such research. Although there are many opportunities to design studies to pursue empirically the ideas emerging from the model, this section outlines some of key elements that such investigations might entail. To begin with, an important as well as challenging part of empirical research in this domain is obtaining proxies for the predicted and explanatory constructs that are involved in the theory. With regard to the predicted variables, although corporate strategy research has regularly used stock market and accounting returns to estimate the acquirer's return in corporate acquisitions, operationalizing the extent of due diligence clearly requires additional creativity and investment to build appropriate constructs. Because the due diligence effort involves the investment of the acquirer's time, capital, and other resources, the aggregate measure of the due diligence effort that the acquirer commits internally is unlikely to be available in secondary databases. As a consequence, a survey of acquirers seems to be a default means of measuring the internal due diligence effort, yet it is also likely that some firms do not have quantitative information assembled on these costs. An alternative approach to measuring this construct is to consider acquirers that rely upon external advisors to conduct due diligence. Examples of using the cost of such services as a proxy for the due diligence effort can be found in finance research (*e.g.*, Chahine and Ismail 2009; Hunter and Jagtiani 2003). It would also be valuable to appraise the opportunity cost of management's time devoted to due diligence activities. Given the importance and centrality of due diligence to the acquisition literature, advances in these directions would be valuable, even in studies proceeding in other theoretical directions and examining antecedents or consequences different from those identified here. Such research efforts would be important to close the gap between studies that theorize upon, or invoke, due diligence and the scant empirical research on this important facet of the M&A process.

With regard to the explanatory variables, the two dimensions of relatedness considered in this study are notoriously difficult to separate from each other. However, Sakhartov (2017) provides an illustration of one possibility for separate operationalizations of the sharing factor and of the redeployment cost. Because intra-temporal economies of scope from the contemporaneous sharing of resources are often linked to the sharing of scale free knowledge (Bryce and Winter 2009), the sharing factor capturing relatedness in such economies can be estimated using patent profiles of various industries. That measure assumes that sharing technological knowledge is easier between industries with more-similar knowledge requirements. Accordingly, Sakhartov (2017) measured knowledge dissimilarity between two industries as a Euclidean distance and used that distance as an inverse proxy for the sharing factor.[23] In turn, because inter-temporal economies of scope from resource redeployment involve the withdrawal of resources from a business (Helfat and Eisenhardt 2004), such economies are unique to non-scale free resources (Levinthal and Wu 2010). Those resources have physical substance, cannot be levered infinitely across businesses, and thus often coincide with resources classified as tangible on the balance sheets. Therefore, Sakhartov (2017) used Compustat to compile profiles of industries in terms of their tangible assets and measured the redeployment cost between two industries as a Euclidean distance in tangible assets. Consistent with Montgomery and Wernerfelt (1988), that measure assumed that redeployment of resources is less costly between industries with more similar (i.e., less distant) requirements for tangible assets. Here too it could be valuable to obtain primary data on the value creation logics of acquirers to separate intra- and inter-temporal scope economies, yet a challenge of survey-based research is to separate an acquirer's assessment of these economies independent from the success of acquisitions or the actual redeployment of resources that occurs upon implementation of the deal (*e.g.*, Capron et al. 1998).

[23] In addition to the sharing factor for scale free knowledge developed by Sakhartov (2017), the sharing factor might be operationalized for non-scale free resources, for example for sales and distribution systems. Such an additional measure of the sharing factor for non-scale free resources should be carefully isolated from the redeployment cost for those resources.

Finally, in line with its theoretical definition (Bernstein 1996; Einhorn and Hogarth 1985; Frisch and Baron 1988), ambiguity can be measured based on the degree of uniqueness of the evaluated matter. Such uniqueness has been assessed based on the frequency of the previous occurrence of the evaluated event (*e.g.*, Litov et al. 2012) and would require data on past sharing and past redeployment of resources in various pairs of industries.

Limitations and future research directions

In addition to the research opportunities identified in the foregoing discussion, several opportunities exist to extend this research and address some of its limitations. To begin with, the model used in this study to investigate due diligence was intended to be general to economies of scope in corporate acquisitions and, thus, is rather abstract with respect to other considerations. This focus on a particular part of reality while abstracting from other parts is recognized as an inevitable and practical approach for refining the understanding of the specific focal phenomenon (Bettis et al. 2014). As reviewed in the paper, economies of scope are recognized as a primary motive for acquisitions, but they are not the only motive. Many horizontal acquisitions involve targets that operate in the same product markets as acquirers. Acquirers in such deals aim to recombine resources of the merged firms and reconfigure their business units, to increase market power, to attain economies of scale, or to reduce the cost of capital. Each of these motives potentially entails its own information perils. Moreover, additional sources for the incompleteness of information are present in cross-border acquisitions where ambiguity involved in entering a new market is an important object of due diligence and information costs also find their roots in the institutional contexts of host countries. Also, in acquisitions where targets are from high-tech industries, due diligence of R&D, know-how, and other intangible assets is of special importance. Furthermore, the practitioners' view of due diligence encompasses the examination of legal issues involved in the deal and the thorough auditing of accounting reports (Howson 2003). As a final illustration of the many ways to extend the investigation of the nature and determinants of due diligence, the intended degree of integration of the target by the acquirer can affect the optimal extent of due

diligence by the acquirer. Given the present focus on economies of scope in particular and due diligence of such economies, there are many opportunities to investigate additional facets of due diligence and consider how firms might engage in due diligence in a strategic, selective manner.

Another limitation that is implied by the analysis is that the model is agnostic with respect to whether due diligence is done in-house or is outsourced to investment banks and consulting firms. How would the presence of that choice change the results derived in this study? That question can inspire a new iteration in the existing research on the outsourcing of due diligence, given that it has not addressed due diligence with respect to economies of scope in particular (Chahine and Ismail 2009; Chuang 2017; Golubov et al. 2012).

For the sake of tractability of the model and interpretability of the results, this study also does not explicitly capture the tradeoff between the risk of adverse selection (*i.e.*, picking a bad target) and the risk of competitive preemption (*i.e.*, losing a good target to an alternative bidder). On the one hand, when due diligence efforts proceed over a longer time period, this investigation is likely to be more productive and efficient, all else equal. On the other hand, shorter research on the target's resources can be levered by the acquirer to obtain a first-mover advantage *vis-à-vis* other suitors, so it would be interesting to juxtapose the information considerations that are out focus with such competitive considerations that can also shape optimal due diligence. Furthermore, the formal model of due diligence in this study does not consider possible cooperation or resistance by the target during the due diligence process. Targets in M&A deals might exhibit preferences for one buyer over another, and this preference may depend on the nature of economies of scope. In turn, the utility of due diligence may depend on the target's response, given the potential of moral hazard on the part of target firm management. While this study abstracts away from such considerations for purposes of tractability, it would be interesting and valuable in future research to explore the role of a target's responses.

One more ramification of the current study is that due diligence is only one of several ways of mitigating the adverse selection problem and is often not the ultimate remedy. Existing research has suggested that, in lieu of due diligence, corporate acquirers can use alternative ownership arrangements

(*e.g.*, equity joint ventures) or craft contractual agreements (*e.g.*, material adverse change provisions, earnouts, *etc.*) (Balakrishnan & Koza 1993; Datar et al. 2001). Furthermore, a careful selection of the target, based on its capabilities (Kaul and Wu 2016), may at least in part substitute for due diligence of economies of scope for a particular target. As long as those alternatives act as substitutes for due diligence in mitigating the adverse selection problem, the current study can overstate the effects that are derived in the artificial context where those alternatives are disallowed. It would therefore be valuable in future modeling of due diligence to incorporate other organizational forms and contractual arrangements that firms can employ, as well as other stages of the acquisition process in which firms contend with adverse selection concerns.

An additional direction for extending this study is to combine its focus on economies of scope with ideas about the development of acquisition capabilities. It would be interesting to study how optimal due diligence and the resulting returns to the acquirers relate to the development of capabilities at both evaluating economies of scope (*e.g.*, 'resource picking' in Makadok 2001) and implementing those economies after the deal (*e.g.*, 'capability-building' in Makadok 2001). Both capabilities are potentially subject to experience curves and, thus, are likely to vary across firms. Future research can explore how 'corporate advantage' (Collis and Montgomery 1998) stems from acquirers' capabilities to assess and implement economies of scope. Research on the development of such capabilities can therefore join this study to provide new insights into how firms make M&A decisions, contract for targets, and implement transactions. Given the importance of due diligence as a central, yet at the same time hidden or implicit, construct in M&A research, research along these lines holds the potential to reinvigorate and enrich scholarship on corporate strategy.

REFERENCES

Ahuja G, Katila R (2001) Technological acquisitions and the innovation performance of acquiring firms: A longitudinal study. *Strategic Management J.* 22(3):197–220.

Ahuja G, Novelli E (2017) Redirecting research efforts on the diversification–performance linkage: The search for synergy. *Acad. Management Ann*. 11(1):342–390.

Akerlof G (1970) The market for 'lemons': Quality uncertainty and the market mechanism. *Quart. J. Econom.* 84(3):488–500.

Anand J (2004) Redeployment of corporate resources: A study of acquisition strategies in the US defense industries, 1978–1996. *Managerial Decision Econom.* 25(6/7):383–400.

Anand J, Singh H (1997) Asset redeployment, acquisitions and corporate strategy in declining industries. *Strategic Management J.* 18(S1):99–118.

Anderson EW, Ghysels E, Juergens JL (2009) The impact of risk and uncertainty on expected returns. *J. Financial Econom.* 94(2):233–263.

Antoniou C, Harris RDF, Zhang R (2015) Ambiguity aversion and stock market participation: An empirical analysis. *J. Banking Finance* 58:57–70.

Balakrishnan S, Koza MP (1993) Information asymmetry, adverse selection and joint-ventures: Theory and evidence. *J. Econom. Behav. Organ.* 20(1):99–117.

Barney JB (1988) Returns to bidding firms in mergers and acquisitions: Reconsidering the relatedness hypothesis. *Strategic Management J*. 9(S1):71–78.

Benou G, Madura J (2005) High-tech acquisitions, firm specific characteristics and the role of investment bank advisors. *J. High Tech. Management Res.* 16(1):101–120.

Bernstein PL (1996) *Against the Gods: The Remarkable Story of Risk*. (Wiley, New York).

Bettis RA, Gambardella A, Helfat C, Mitchell W. (2014), Theory in strategic management. *Strategic Management J*. 35(10):1411-1413.

Bossaerts P, Ghirardato P, Guarnaschelli S, Zame WR (2010) Ambiguity in asset markets: Theory and experiment. *Rev. Financial Stud.* 23(4):1325–1359.

Bruner RF (2002) Does M&A pay? A survey of evidence for the decision-maker. *J. Appl. Finance* 12(1):48–68.

Brush TH (1996) Predicted change in operational synergy and post-acquisition performance of acquired businesses. *Strategic Management J.* 17(1):1–24.

Bryce DJ, Winter SG (2009) A general interindustry relatedness index. *Management Sci*. 55(9):1570–1585.

Cain MD, Denis DJ, Denis DK (2011). Earnouts: A study of financial contracting in acquisition agreements. *J. Account. Econom.* 51:151–170.

Capron L, Dussauge P, Mitchell W (1998) Resource redeployment following horizontal acquisitions in Europe and North America, 1988–1992. *Strategic Management J.* 19(7):631–661.

Capron L, Mitchell W, Swaminathan A (2001) Asset divestiture following horizontal acquisitions: A dynamic view. *Strategic Management J.* 22(9):817–844.

Chahine S, Ismail A (2009) Premium, merger fees and the choice of investment banks: A simultaneous analysis. *Quart. Rev. Econom. Finance* 49(2):159–177.

Chandler AD (1962) *Chapters in the History of the American Industrial Enterprise*. (MIT Press, Cambridge, MA).

Chatterjee S (1986) Types of synergy and economic value: The impact of acquisitions on merging and rival firms. *Strategic Management J.* 7(2):119–139.

Chatterjee S (2007) Why is synergy so difficult in mergers of related businesses? *Strategy and Leadership* 35(2):46–52.

Chen Z, Epstein L (2002) Ambiguity, risk, and asset returns in continuous time. *Econometrica* 70(4):1403–1443.

Chen M, Kaul A, Wu B. (2019) Adaptation across multiple landscapes: Relatedness, complexity, and the long run effects of coordination in diversified firms. *Strategic Management J*. 40(11):1791–1821.

Chuang KS (2017) The role of investment banks on the impact of firm performance in mergers and acquisitions: Evidence from the Asia-Pacific market. *Rev. Quant. Finance Account*. 48(3):677–699.

Cloodt M, Hagedoorn J, Van Kranenburg H (2006) Mergers and acquisitions: Their effect on the innovative performance of companies in high-tech industries. *Res. Policy* 35(5):642–654.

Coff RW (1999). How buyers cope with uncertainty when acquiring firms in knowledge-intensive industries: Caveat emptor. *Organ. Sci*. 10(2):144–161.

Coff RW (2002) Human capital, shared expertise, and the likelihood of impasse in corporate acquisitions. *J. Management* 28(1):107–128.

Collis DJ, Montgomery CA (1998) Creating corporate advantage. *Harvard Bus. Rev.* 76(3):70–83.

Cullinan G, Le Roux J–M, Weddigen RF (2004) When to walk away from a deal. *Harvard Bus. Rev.* 82(4):96–105.

Curley SP, Yates JF, Abrams RA (1986) Psychological sources of ambiguity avoidance. *Organ. Behav. Human Decision Proc.* 38(2):230–256.

Cyert RM, March JG (1963). *A Behavioral Theory of the Firm*. (Prentice Hall, Englewood Cliffs, NJ).

Datar S, Frankel R, Wolfson M (2001) Earnouts: The effects of adverse selection and agency costs on acquisition techniques. *J Law, Econom. Organ.* 17(1):201–238.

Deloitte (2016) M&A strategy series. Due diligence for cost synergy capture: Building deals on bedrock. Accessed August 21, 2019, https://www2.deloitte.com/content/dam/Deloitte/us/Documents/mergers-acqisitions/us-m-a-strategy-2.pdf.

Denrell J, Fang C, Winter SG (2003) The economics of strategic opportunity. *Strategic Management J*. 24(10):977–990.

DePamphilis D (2010) *Mergers and Acquisitions Basics: All You Need to Know* (Academic Press).

Drechsler I (2013) Uncertainty, time-varying fear, and asset prices. *J Finance* 68(5):1843–1889.

Easley D, O'Hara M (2009) Ambiguity and nonparticipation: The role of regulation. *Rev. Financial Stud.* 22(5):1817–1843.

Eccles R, Lanes KL, Wilson TC (1999) Are you paying too much for that acquisition? *Harvard Bus. Rev.* 77(4):136–147.

Einhorn HJ, Hogarth RM (1985) Ambiguity and uncertainty in probabilistic inference. *Psych. Rev.* 92(4):433–461.

Ellsberg D (1961) Risk, ambiguity, and the Savage axioms. *Quart. J. Econom.* 75(4):643–669.

Ellsberg D (1963) Risk, ambiguity, and the Savage axioms: Reply. *Quart. J. Econom.* 77(2):336–342.

Epstein LG, Wang T (1994) Intertemporal asset pricing under Knightian uncertainty. *Econometrica* 62(2):283–322.

Frisch D, Baron J (1988) Ambiguity and rationality. *J. Behav. Decision Making*, 1(3):149–157.

Gilboa I, Schmeidler D (1989) Maximum expected utility with non-unique priors. *J. Math. Econom.* 18(2):141–153.

Gilson RJ, Schwartz A (2005) Understanding MACs: Moral hazard in acquisitions. *J Law, Econom. Organ.* 21(2):330–358.

Golubov A, Petmezas D, Travlos NG (2012) When it pays to pay your investment banker: New evidence on the role of financial advisors in M&As. *J. Finance* 67(1):271–311.

Harrison JS, Hitt MA, Hoskisson RE, Ireland RD (1991) Synergies and post-acquisition performance: Differences versus similarities in resource allocations. *J. Management* 17(1):173–190.

Helfat CE, Eisenhardt KM (2004) Inter-temporal economies of scope, organizational modularity, and the dynamics of diversification. *Strategic Management J.* 25(13):1217–1232.

Hill CW, Hitt MA, Hoskisson RE (1992) Cooperative versus competitive structures in related and unrelated diversified firms. *Organ. Sci.* 3(4):501–521.

Hitt MA, Ireland RD, Harrison JS (2005) Mergers and acquisitions: a value creating or value destroying strategy? Hitt MA, Freeman RE, Harrison JS, eds. *The Blackwell Handbook of Strategic Management* (Blackwell Publishing), 377–402.

Howson P (2003) *Due Diligence: The Critical Stage in Mergers and Acquisitions* (Gower Publishing Company, Burlington, VT).

Hunter WC, Jagtiani J (2003). An analysis of advisor choice, fees, and effort in mergers and acquisitions. *Rev. Financial Econom*. 12(1):65–81.

Karim S (2006) Modularity in organizational structure: The reconfiguration of internally developed and acquired business units. *Strategic Management J.* 27(9):799–823.

Karim S, Mitchell W (2000) Path-dependent and path-breaking change: reconfiguring business resources following acquisitions in the US medical sector, 1978–1995. *Strategic Management J.* 21(10-11):1061–1081.

Kaul A, Wu B. (2016). A capabilities-based perspective on target selection in acquisitions. *Strategic Management J* 37(7):1220–1239.

KPMG (1999) Unlocking shareholder value: The keys to success. Accessed August 21, 2019, http://people.stern.nyu.edu/adamodar/pdfiles/eqnotes/KPMGM&A.pdf.

KPMG (2018) Updating your synergy playbook: Four tactics to deliver better deal results. Accessed August 21, 2019, https://advisory.kpmg.us/content/dam/advisory/en/pdfs/updating-your-synergy-playbook.pdf.

Jeong D, Kim H, Park JY (2015) Does ambiguity matter? Estimating asset pricing models with a multiple-priors recursive utility. *J. Financial Econom.* 115(2):361–382.

Kim JY, Finkelstein S (2009) The effects of strategic and market complementarity on acquisition performance: Evidence from the US commercial banking industry, 1989–2001. *Strategic Management J.* 30(6):617–646.

Kim JY, Haleblian J, Finkelstein S (2011). When firms are desperate to grow via acquisition: The effect of growth patterns and acquisition experience on acquisition premiums. *Admin. Sci. Quart.* 56(1):26–60.

Kosnik RD, Shapiro DL (1997) Agency conflicts between investment banks and corporate clients in merger and acquisition transactions: Causes and remedies. *Acad. Management Perspect.* 11(1):7–20.

Larsson R, Finkelstein S (1999). Integrating strategic, organizational, and human resource perspectives on mergers and acquisitions: A case survey of synergy realization. *Organ. Sci.* 10(1):1–26.

Lee GK, Lieberman MB (2010) Acquisition vs. internal development as modes of market entry. *Strategic Management J.* 31(2):140–158.

Leippold M, Trojani F, Vanini P (2008) Learning and asset prices under ambiguous information. *Rev. Financial Stud.* 21(6):2565–2597.

Levinthal DA, Wu B (2010) Opportunity costs and non-scale free capabilities: profit maximization, corporate scope, and profit margins. *Strategic Management J.* 31(7):780–801.

Li SX, Greenwood R (2004) The effect of within-industry diversification on firm performance: synergy creation, multi-market contact and market structuration. *Strategic Management J.* 25(12):1131–1153.

Lieberman MB, Lee GK, Folta TB (2017) Entry, exit, and the potential for resource redeployment. *Strategic Management J.* 38(3):526–544.

Litov LP, Moreton P, Zenger TR (2012) Corporate strategy, analyst coverage, and the uniqueness paradox. *Management Sci.* 58(10):1797–1815.

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

Makadok R, Barney JB (2001) Strategic factor market intelligence: An application of information economics to strategy formulation and competitor intelligence. *Management Sci.* 47(12):1621–1638.

March JG, Simon H (1958) *Organizations*. (Wiley, New York).

Maritan CA, Brush TH (2003). Heterogeneity and transferring practices: implementing flow manufacturing in multiple plants. *Strategic Management J.* 24(10):945–959.

Maritan CA, Florence RE (2008) Investing in capabilities: Bidding in strategic factor markets with costly information. *Managerial Decision Econom.* 29(2–3):227–239.

Moeller S, Brady C (2014) *Intelligent M & A: Navigating the mergers and acquisitions minefield* (John Wiley & Sons).

Montgomery CA, Wernerfelt B (1988) Diversification, Ricardian rents, and Tobin's q. *RAND J. Econom.* 19(4):623–632.

Nayyar PR (1993) Stock market reactions to related diversification moves by service firms seeking benefits from information asymmetry and economies of scope. *Strategic Management J.* 14(8):569–591.

O'Brien J, Folta T (2009) Sunk costs, uncertainty and market exit: A real options perspective. *Indust. Corporate Change* 18(5):807–833.

Palich LE, Cardinal LB, Miller CC (2000) Curvilinearity in the diversification–performance linkage: an examination of over three decades of research. *Strategic Management J.* 21(2):155–174.

Panzar JC, Willig RD (1981) Economies of scope. *Amer. Econom. Rev.* 71(2):268–272.

Penrose ET (1959) *The Theory of the Growth of the Firm* (Wiley, New York).

Penrose ET (1960) The growth of the firm—A case study: The Hercules Powder Company. *Bus. History Rev.* 34(1):1–23.

Porter ME (1987) From competitive advantage to corporate strategy. *Harvard Bus. Rev.* 65(3):28–47.

Puranam P, Vanneste B (2016) *Corporate strategy: Tools for analysis and decision-making* (Cambridge University Press).

Ranft AL, Lord MD (2002). Acquiring new technologies and capabilities: A grounded model of acquisition implementation. *Organ. Sci.* 13(4): 420–441.

Riedel F (2009) Optimal stopping with multiple priors. *Econometrica* 77(3):857–908.

Quora (2014) What are typical due diligence costs that a consulting firm charges for private equity due diligence? Accessed August 21, 2019, https://www.quora.com/What-are-typical-due-diligence-costs-that-a-consulting-firm-charges-for-private-equity-due-diligence.

Roberts HV (1963) Risk, ambiguity, and the Savage axioms: Comment. *Quart. J. Econom.* 77(2):327–336.

Rumelt RP (1974) *Strategy, Structure, and Economic Performance* (Harvard University Press, Boston).

Sakhartov AV (2017) Economies of scope, resource relatedness, and the dynamics of corporate diversification. *Strategic Management J.* 38(11):2168–2188.

Sakhartov AV (2018) Stock market undervaluation of resource redeployability. *Strategic Management J.* 39(4):1059–1082.

Sakhartov AV, Folta TB (2014) Resource relatedness, redeployability, and firm value. *Strategic Management J.* 35(12):1781–1797.

Sakhartov AV, Folta TB (2015) Getting beyond relatedness as a driver of corporate value. *Strategic Management J.* 36(13):1939–1959.

Seth A (1990) Sources of value creation in acquisitions: an empirical investigation. *Strategic Management J.* 11(6):431–446.

Servaes H, Zenner M (1996) The role of investment banks in acquisitions. *Rev. Financial Stud.* 9(3):787–815.

Shelton LM (1988) Strategic business fits and corporate acquisition: Empirical evidence. *Strategic Management J.* 9(3):279–287.

Simon HA (1947) *Administrative Behavior: A Study of Decision-Making Processes in Administrative Organization*. (Macmillan, New York).

Singh H, Chaudhuri S, Shelton R (2009) *Cisco's Acquisition Strategy (1993 to 2000): Value Growth Through Buying Early-Stage Companies*. Case study of the Wharton School.

Singh H, Montgomery CA (1987) Corporate acquisition strategies and economic performance. *Strategic Management J.* 8(4):377–386.

Sirower ML (1997) *The Synergy Trap: How Companies Lose the Acquisition Game* (Simon and Schuster).

Sirower M, Engelbrecht W, Joiner S (2017) Winning in M&A: How to become an advantaged acquirer. *M&A—Making the Deal Work: Strategy*. Accessed August 21, 2019, https://www2.deloitte.com/content/dam/Deloitte/us/Documents/mergers-acqisitions/us-ma-making-the-deal-work-strategy.pdf.

Teece DJ (1980) Economies of scope and the scope of the enterprise. *J. Econom. Behav. Organ.* 1(3):223–247.

Teece DJ, Rumelt R, Dosi G, Winter S (1994) Understanding corporate coherence: Theory and evidence. *J. Econom. Behav. Organ.* 23(1):1–30.

The Storytellers and Mergermarket (2013) Missing chapter: Why emotional buy-in is critical for successful M&A. Accessed August 21, 2019, http://mergermarketgroup.com/publication/the-missing-chapter-whyemotional-buy-in-is-critical-for-successful-ma/#.

Thomas HA (1995) Effects of firm ownership structure on hiring of M&A advisors. *J. Financial Services Res.* 9(2):159–175.

Trautwein F (1990) Merger motives and merger prescriptions. *Strategic Management J.* 11(4):283–295.

v. Werder A (1999). Argumentation rationality of management decisions. *Organ. Sci*. 10(5):672–690.

Williams CD (2015) Asymmetric responses to earnings news: A case for ambiguity. *Account. Rev.* 90(2):785–817.

Wu B (2013) Opportunity costs, industry dynamics, and corporate diversification: Evidence from the cardiovascular medical device industry, 1976–2004. *Strategic Management J.* 34(11):1265–1287.

Yates JF, Zukowski LG (1976) Characterization of ambiguity in decision making. *Behavioral Sci.* 21(1):19–25.

Ye G, Priem RL, Alshwer AA (2012) Achieving demand-side synergy from strategic diversification: How combining mundane assets can leverage consumer utilities. *Organ. Sci.* 23(1):207–224.

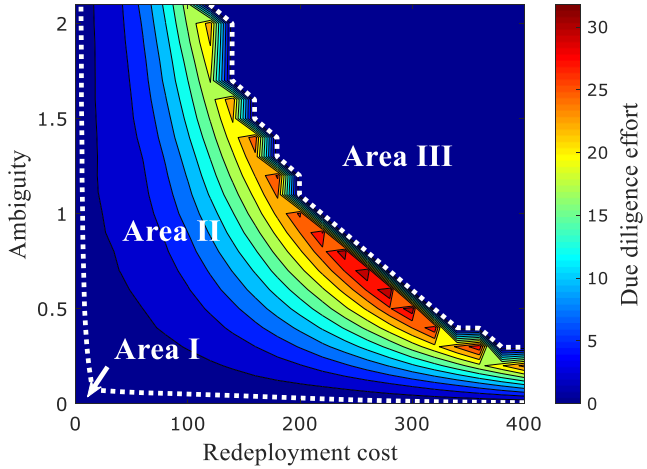
Yu Y, Umashankar N, Rao VR (2016) Choosing the right target: Relative preferences for resource similarity and complementarity in acquisition choice. *Strategic Management J.* 37(8):1808–1825.

Zaheer A, Hernandez E, Banerjee S (2010). Prior alliances with targets and acquisition performance in knowledge-intensive industries. *Organ. Sci.* 21(5):1072–1091.

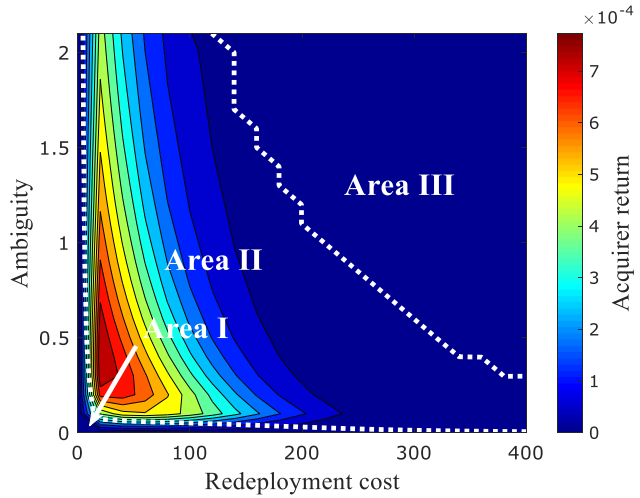
TABLE 1
Summary of Theoretical Predictions

		Focal predictor	Predicted outcome	
			Acquirer due diligence effort	Acquirer return
Type of economies of scope	Inter-temporal (resource redeployment)	Redeployment cost (inverse proxy for relatedness involved in resource redeployment)	H1: an inverse U-shaped relationship	H2: an inverse U-shaped relationship
		Ambiguity (direct proxy for incompleteness of information about economies of scope)	H3: an inverse U-shaped relationship	H4: an inverse U-shaped relationship
	Intra-temporal (resource sharing)	Sharing factor (direct proxy for relatedness involved in resource sharing)	H5: a discrete relationship—zero when the sharing factor is zero and positive but invariant to the sharing factor otherwise	H6: a monotonic positive relationship
		Ambiguity (direct proxy for incompleteness of information about economies of scope)	H7: a monotonic positive relationship	H8: an inverse U-shaped relationship

FIGURE 1
Implications of Redeployment Cost and Ambiguity for Due Diligence Effort and Acquirer Net Return

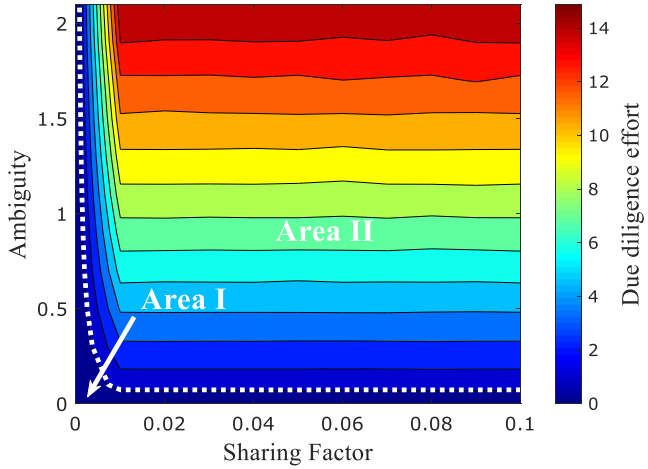


Panel A. Optimal due diligence effort

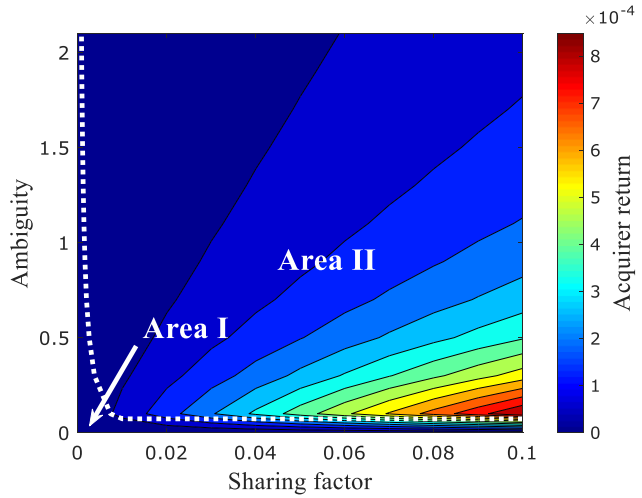


Panel B. Acquirer net return with optimal due diligence effort

FIGURE 2
Implications of Sharing Factor and Ambiguity for Due Diligence Effort and Acquirer Net Return



Panel A. Optimal due diligence effort



Panel B. Acquirer net return with optimal due diligence effort