DYNAMIC IMPLICATIONS OF RELATEDNESS ON MULTI-BUSINESS FIRM VALUE

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Abstract

Our paper elaborates the effects that relatedness has on the value of a multi-business firm. We emphasize that the value results from a dynamic use of benefits of contemporaneously sharing of resources and redeployability of resources to an alternative market. This view extends static and separate considerations of advantages of contemporaneous sharing and resource redeployability. We use a dynamic valuation model to explicate how relatedness influences value of a multi-business firm. We formally evaluate the impacts of the two effects of relatedness. This explication enables us to demonstrate how each independently and jointly affects value. In this sense, we illuminate value in multi-business firms that has been previously undiagnosed. In addition to providing theoretical insight, our results have important empirical and managerial implications.

Keywords:

diversification; resource-based theory; real options

1. Introduction

The concept of relatedness has had immense impact on our understanding of how corporate strategy adds value. The central insight from a long stream of literature is that the incentive to expand a firm is linked to the ability to profitably employ its underutilized resources (Penrose, 1959; Mahoney and Pandian, 1992; Montgomery, 1994). The more a firm has to diversify, i.e., the farther from its current scope that it must go, *ceteris paribus*, the larger will be the loss in efficiency and the lower will be the competitive advantage conferred by the factor" that is shared with the new market (Montgomery and Wernerfelt, 1988: 623).

Accordingly, corporate strategists are generally advised to diversify into related markets because they provide the opportunity for the most value creation. Although it remains unclear whether diversification creates value (Berger and Ofek, 1995; Campa and Kedia, 2002; Vilalonga, 2004), since Rumelt's (1974) seminal work there has been an increasing recognition that related diversification creates more value. Empirical evidence largely confirms that related diversification is more likely (Montgomery and Hariharan, 1991), offers higher accounting returns (Varadarajan and ramanujam, 1987); and offers higher abnormal returns around acquisitions (Lubatkin, 1987; Chatterjee, 1986; Singh, 1984; Singh and Montgomery, 1987).

Why does related diversification create more value than unrelated diversification? Prior work pinpoints two specific explanations. The first explanation centers on "*intra-temporal economies*" generated through the "*contemporaneous sharing*" of resources at a single point in time (Helfat and Eisenhardt, 2004: 1217). That argument has its roots in the concept of economies of scope (Panzar and Willig, 1981: 268) appearing "where it is less costly to combine two or more product lines in one firm than to produce them separately." As described by Porter (1987), contemporaneous sharing of resources across markets can also enable the multi-business firm to better differentiate the products supplied to the markets and, thus, enhance the demands for them. Both effects, greater economies of scope and higher willingness-to-pay, derive from related diversification. The second explanation centers on "*inter-temporal economies*" generated by the flexibility to redeploy "firm resources between businesses over time." (Helfat and Eisenhardt, 2004: 1217). This explanation has its roots in the concepts of flexibility and fungibility, appearing where resources can be withdrawn from one market and redeployed to serve another market (Chatterjee and Wernerfelt, 1991; Anand and Singh, 1997). As described by Anand and Singh (1997: 99), this flexibility is particularly valuable when there is potential for one of the firm's markets to be in decline at some point in the future. These two explanations have three features worth highlighting. First, the contribution of redeployability to firm value has received far less attention in the literature than the contribution of contemporaneous sharing (Helfat and Eisenhardt, 2004). Second, redeployability has typically been portrayed as an advantage available to the firm only once, rather than being repeatedly available over time. Third, the only study (Helfat and Eisenhardt, 2004) which explicitly and simultaneously considers both contemporaneous sharing and redeployability interprets the two as independent and does not seem to recognize that they can have an interdependent effect.[1]

This paper offers a different explanation for the effect of relatedness on performance. We propose, and argue formally, that relatedness creates dynamic benefits to diversification by repeatedly enabling the redeployment of firm resources between businesses over time via exiting some product-markets while entering others. Our formulation is distinct from prior efforts in two ways. First, we highlight that redeployability and contemporaneous sharing are *interdependent*, because when a firm decides to redeploy resources from a declining market to another, it forgoes

[1] Specifically, Helfat and Eisenhardt (2004: 1220) write that "[D]iversification that unfolds over time can be modeled as a series of single diversification moves that result in standard intra-temporal economies of scope."

the opportunity to contemporaneously share resources. Hence, a firm can defer switching from a declining market when the advantage of a contemporaneous sharing surpasses the disadvantages of a temporary decline. Conversely, a firm abandons contemporaneous sharing when a decline in one of the markets is sharp and the switching cost is low. Second, we emphasize that redeployability has *dynamic* implications because costly redeployment implies that current scope decisions affect subsequent scope decisions. Hence, if the costs of switching a resource between markets are high a firm will be more reticent to switch because it will be costly to switch back if conditions change.

The interdependent and dynamic nature of contemporaneous sharing and redeployability make a formal analysis of the effect of relatedness on firm value worthwhile. The analysis highlights, for instance, how interaction between contemporaneous sharing and redeployability—not the mere addition of the two—creates value for multi-business firms. It pinpoints the type of interdependency that impacts value: redeployability mitigates the benefits from contemporaneous sharing. A formal analysis identifies general structural features that contribute to the effect of relatedness on firm value, and it allows us to speak with precision about the dynamic effect of redeployability on firm value. The formal approach we adopt has its origins in established approaches to valuing real options, since in our context, redeployability represents an option to switch. The numerical approach we use is the binomial options pricing model of Cox, Ross, and Rubinstein (1979). As far as we know, this is the first attempt to use real options to address one of the most fundamental topics in corporate strategy - the effects of relatedness on the value of multi-business firms,.

The formal modeling of interdependency between contemporaneous sharing and redeployability is presented in Section 2. There, we construct a model in which a multi-business firm operates two resources to serve two markets. We first specify the context of a multi-business firm, including (a) the way in which uncertain cash flows generated in the two markets evolve over time; (b) operationalization of contemporaneous sharing; and (c) operationalization of redeployability. This allows us to tune the degree of contemporaneous sharing and redeployability to further investigate how they separately and jointly affect firm value. We then highlight that interdependency between contemporaneous sharing and redeployability is not introduced as an exogenous parameter to our model, but rather emerges as an outcome of the decision heuristic applied by a multi-business firm. Finally, we introduce the decision heuristic dictating that the firm optimally chooses its scope decisions (i.e., to contemporaneously share and redeploy resources).

We next apply (Section 3) the developed model to the contexts where (a) only contemporaneous sharing is present; (b) only redeployability is present; and (c) both contemporaneous sharing and redeployability are present. This approach enables us to precisely valuate separate effects of contemporaneous sharing and redeployability on the value of a multi-business firm and to estimate the degree and the direction of their interdepend effect on the firm value. Section 4 discusses the robustness of the results and summarizes theoretical and empirical implications.

2. Model

Our goal is to test and extend qualitative theory that highlights two benefits to relatedness (i.e., contemporaneous sharing and redeployability) but has been silent about interdependencies among these elements. We design a dynamic valuation model with two key elements. First, the modeler specifies the decision context, such as how contemporaneous sharing and redeployability are characterized and how uncertain returns for resources are generated. Second, the modeler dictates the decision heuristic in which the firm will optimally choose between redeployability and contemporaneous sharing in each period. We do not impose that the interdependence exists, but it emerges because we dictate that the firm compares the advantages of one versus the other. In this section we describe each of these steps in detail.

Though our valuation model does not yield “exact” closed-form solutions as an algebraic approach might, there are several reasons why we do not employ an analytical model. First, in our model a firm’s multiple options may interact as complements or substitutes, and it is known in the literature that option interactions may seriously impact value (Trigeorgis, 1993). Modeling option interactions is extremely difficult in analytical approaches, and is usually solved through numerical techniques (Kulatilaka, 1986). Second, the real options in our model are American-type real options (i.e., they can be exercised at any point in time), and for these options it is well known that analytical approaches are nearly always infeasible. Third, adopting analytical approaches requires assumptions unrealistic to corporate strategy, such as perpetually-lived assets. To derive an approximation of the exact solution, we use a numerical approach. In particular, we follow Cox et al. (1979), who developed a simple and efficient numerical procedure for valuing options. Characterizing interacting real options in the context of a multi-business firm is straightforward with a numerical approach and almost impossible with analytical models, which are generally used to value isolated effects of real options.

2.1 The Context of a Multi-Business Firm

The central context we examine is one where multibusiness firms potentially benefit from contemporaneous sharing and redeployability of resources across businesses, and their dynamic interdependence. To illuminate the importance of this interdependence, we will later apply the same model to contexts where (a) only contemporaneous sharing is available and (b) only redeployability is available.

Our multi-business firm has two resources, R_i and R_j, at its discretion. Since, in our model, each resource is resident in separate business units (B_i and B_j) our reference to resources will be equivalent to that of businesses. Each of these resources serves a distinct product market, P_i or P_j, but has the potential to serve the alternative market. Given this context, firm value (V) is determined by:

$$V = C_i + C_j + K + O + I, \qquad (1)$$

where, C_i and C_j represent the expected value of cash flow in business i and j if operated independently for the life of the resources; K represents the extra value derived from contemporaneous sharing of resources across product markets; O represents the extra value derived from the option to redeploy or switch resources repeatedly between product markets available for all periods; and I represents the interdependence between K and O, and captures the value of having the discretion to contemporaneously share resources across all periods. Each of these components are described in more detail below.

2.1.1 Formalization of Cash Flows if Businesses were operated separately

Because future cash flows are uncertain, it is necessary to specify how they will evolve over time. We adopt an assumption typical to real option valuation models (Dixit and Pindyck, 1994), and model cash flows (C_i, C_j) as geometric Brownian processes, dictating that they are more difficult to predict the further one looks into the future. Formally, the process is calculated as:

$$dC_i = C_i(r - \mu_i)dt + C_i\sigma_i dW_i \qquad (2)$$

$$dC_j = C_j(r - \mu_j)dt + C_j\sigma_j\, dW_j \qquad (3)$$

where, W_i and W_j are stochastic standard Wiener processes, such that we allow for the possibility that W_i and W_j are correlated, formally $dW_i dW_j = \lambda dt$; and the modeler determines the risk-free rate, r; the cash flow drifts (trends), μ_i and μ_j; the cash flow volatilities, σ_i and σ_j; and correlation coefficient, λ.

2.1.2 Formalization of Contemporaneous Sharing

Contemporaneous sharing of resources can effect a firm at a point in time in one of two ways: it might influence costs through economies or diseconomies of scope or it might influence revenues by enhancing or reducing willingness to pay. Our operationalization does not distinguish between effects on costs or revenues, but we allow for either or both by introducing a factor influencing cash flows. To formalize contemporaneous sharing, K, a constant factor β is introduced, such that $K = (\beta - 1)(C_i + C_j)$. If $\beta > 1$ then $K > 0$. If $\beta < 1$ then $K < 0$. Our formalization assumes a linear impact on firm value because cash flow of the combined entity, $C_{i\&j} = \beta(C_i + C_j)$.

2.1.3 Formalization of Redeployability

As described above, the value of the redeployment option cannot be characterized analytically. Instead, it is derived numerically as an implicit function, $O = f(S, Ci, Cj)$. S represents the required cost of transforming resources for use in alternative markets (i.e., redeploying R_i to serve P_j or redeploying R_j to serve P_i), and is inversely related to O.[2] O is derived as the difference between firm value with and without the redeployment option, when contemporaneous sharing is assumed zero in both cases.

[2] Our model assumes symmetric switching costs, which corresponds to a similar assumption made by Kulatilaka (1986, 1988) when examining how a single asset might be used in two related markets.

2.1.4 Formalization of Interdependency

We derive the value of this interdependency I as the difference between V and the sum of Ci, Cj, O and K. It is important to note that we do not explicitly specify the interaction, so it is not an artifact of our decision context. Rather, it emerges naturally as a consequence of the decision heuristic described in the next section.

2.2 The Decision Heuristic

In our model the firm seeks to maximize long-term value. The type of decision at the focus of our inquiry is around firm scope. We assume that at time $t=0$ the firm is a multi-business firm, with resource R_i and R_j dedicated to product markets P_i and P_j, respectively. At each time period, $t>0$, the firm re-evaluates whether to remain in status quo or incur switching cost, S, to convert resources for redeployment in the alternative market. S introduces a tendency towards inertia, and the greater is S the greater is tendency toward remaining in status quo. If $S=0$ (i.e., resources were perfectly redeployable), then decisions in different time periods are independent because it is costless to reverse any prior scope decision. Calculating V when $S=0$ is simply a matter of summing the value of the optimal decision in each period ($V_{S=0}$ = V_1+V_2+V_3+ ... V_T). The calculation becomes much more complex when $S>0$, because a current decision to switch or not would affect the scope under which the firm would operate as it enters future periods: it would affect the future switching costs (i.e., the exercise price of future options) and the set of future switching decisions. In this sense, scope decisions are contingent investment decisions that depend on an uncertain outcome, and necessitating the use of a backward dynamic programming process. The dynamic optimization procedure we adopt is the Bellman's principle of optimality (Bellman, 1957), which is amenable to numerical solutions.

In our setting, Bellman's equation takes the following form:

$$V_t = \max_{D=D_t, D_{t+1}, .. D_T} \left\{ F_t(C_{it}, C_{jt}, K, S) + e^{-r\delta t} E[V_{t+1} \mid D_t^*] \right\}, \quad \text{s.t., } V_T = 0, \qquad (4)$$

where, D_t represents the scope decision at time t. The condition that terminal value, $V_T=0$, is necessary for backward induction, and it corresponds to the nature of real assets, which do not have an infinite useful life. The first term, $F_t(\cdot)$, represents the current value of the firm generated by cash flows (C_{it}, C_{jt}) from resources deployed at time t and corrected by S($2S$), if switching of the resource(s) happens at time t. The second term, $e^{-r\delta t} E[V_{t+1} \mid D_t^*]$, represents the discounted future value of the firm, conditioned upon the optimal decision D_t^*. The second term highlights the contingent nature of scope decisions shapes firm value.

Bellman's equation requires us to convert equations (2) and (3) to their discrete time approximations. To calculate discrete time distributions, we use the approach developed by Cox et al. (1979), and adapted by Boyle et al. (1989) to account for correlations between C_{it} and C_{jt}. With this approach, equation (4) can be restated as follows:

$$V_t = \max_{D=D_t, D_{t+1}, .. D_T} \left\{ F_t(C_{it}, C_{jt}, K, S) + e^{-r\delta t} [(p^{uu} V_{t+1}(C^u_{it+1}, C^u_{jt+1}, K, S) + p^{ud} V_{t+1}(C^u_{it+1}, C^d_{jt+1}, K, S) + p^{du} V_{t+1}(C^d_{it+1}, C^u_{jt+1}, K, S) + p^{dd} V_{t+1}(C^d_{it+1}, C^d_{jt+1}, K, S)) \mid D_t^*] \right\}. \qquad (5)$$

In this formalization, C_i and C_j have the potential to take states u or d in period $t+1$. We might think of u as representing an upward movement with probability p^u, such that $C^u_{it+1} = C_{it} * u, u>1$; and d as representing a downward movement with probability p^d, such that $C^d_{it+1} = C_{it} * d, d<1$. The same convention applies for C_j. Because we incorporate two resources, in equation (5) all p's have two superscripts, corresponding to their respective states in C_i and C_j.[3,4,5]

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[3] We checked whether transition probabilities in this approximation are always positive, because the potential of getting negative probabilities in discretization suggested by Boyle et al. (1989) was highlighted in the literature on contingent claim valuation (Gamba and Trigeorgis, 2007). Boyle et al. (1989) suggest that the probabilities are always non-negative, if the time step used for the discretization is sufficiently small. In the results reported in this paper, the transition probabilities are always positive.

[4] Details of the discretization can be found in Boyle et al. (1989). Its implementation in MATLAB is described in Brandimarte (2006: 417-421)

[5] The choice of the discretization step (δt) is generally determined by the convergence of the value function when the number of time steps ($N = T/\delta t$) is increasing. The results reported in the paper correspond to $N = 40$. We report that V_0 converges nicely with an increase in N and its further change when $N > 40$ is not significant.

The subject of our analysis is the relation of V_0^* with contemporaneous sharing *(K)*, redeployability *(O)*, and their interdependence *(I)*. The next section highlights the results of our model.

3. Results

We conducted a comprehensive set of analyses involving contemporaneous sharing (*K*), redeployability (*O*), and their interaction (*I*). We expected the following results to obtain as a result of our dynamic valuation model:

- Value of a multi-business firm (V_0) is increasing in contemporaneous sharing (β), when redeployability is absent.
- Value of a multi-business firm (V_0) is increasing in redeployability (*K*) and, correspondingly, decreasing in switching cost (*S*), when contemporaneous sharing is absent.
- Effects of contemporaneous sharing (*K*) and redeployability (*O*) on the value of a multi-business firm (V_0) are interdependent.

Below, we present our results and discuss how they pertain to our expectations.[6]

(Insert Table 1 about here)

3.1 Influence of Contemporaneous Sharing on Firm Value

In this part of the analysis, we assume that redeployment is absent. In our investigation of the effect of contemporaneous sharing on firm value, we calculated V_0 for a multi-business firm initially operating both resources, R_i and R_j. Table 1 reports the impact of contemporaneous

[6] While the functional form of the stochastic processes, described in Section 2.1.1, is generally accepted in the literature, the choice of the specific parameters (r, μ_i, μ_j, σ_i, σ_j, and λ) is always arbitrary. In the results reported here, we used the following values for the parameters: r = 0.08, $\mu_i = \mu_j$ = 0.03, $\sigma_i = \sigma_j$ = 0.20, and $\lambda=0$. We address the issue of robustness of our findings to the choice of those parameters in Section 4. We apply the following discrete values for redeployability: $S = \{0, 0.02, \ldots, 0.76, 0.78\}$. We apply the following discrete values for contemporaneous sharing $\beta = \{0.90, 0.91, \ldots, 1.00, \ldots, 1.09, 1.10\}$. We also use $T=10$.

sharing (β) on firm value, (V_0). As described in Section 2.1.2, the value of contemporaneous sharing, K, is operationalized with the constant factor β. So, by our operationalization, when redeployability is absent, the value of a multibusiness firm (V_0) is a product of the sum of values of resources (V_0 (R_i) + V_0 (R_j)), operated independently, and coefficient β. In accord with existing theoretical arguments and our expectations, firm value is positively affected by contemporaneous sharing.

(Insert Table 2 and Figure 1 about here)

3.2 Influence of Redeployability on Firm Value

In this part of the analysis, we assume that contemporaneous sharing is absent. Table 2 reports the impact of switching cost (S), inversely related to redeployability (O), on firm value (V_0). As described in Section 2.1.3, O is derived as the difference between firm value (V_0 (R_i & R_j)) with and without the redeployment option, when contemporaneous sharing is absent. The value of a multi-business firm (column 2 of Table 2) is negatively related to the switching cost (column 1 of Table 2).

In addition, Figure 1 indicates the shape of the relationship between switching cost (S) and value of redeployment option (O). One may note that the relationship can be characterized as having a decreasing marginal effect, i.e., with high values of switching cost (S), its further increase leads to very small changes in the value of the redeployment option (O). This finding can be important for empirical operationalizations of the effects of redeployability, because it suggests that a model predicting a linear relationship may be incapable to capture the effect of redeployability on the firm value.

(Insert Table 3 and Figure 2 about here)

3.3 Interdependent Effect of Contemporaneous Sharing and Redeployability on Firm Value

In this part of the analysis, we assume that both contemporaneous sharing and redeployability are present. The goal of this section is to find a component of the value of a multi-business firm (V_0) in excess of separate effects of contemporaneous sharing (K) and redeployability (O) identified in Sections 3.1 and 3.2 respectively. Recall that the effect of interdependence (I) has been predicted to adjust total value of the firm (V_0) based on the specified decision heuristic. Also recall that interdependence is not forced by the modeler in any way distinct from specifying the decision heuristic described in Section 2.2. Technically, I is calculated as the difference between V_0 (R_i & R_j), when both contemporaneous sharing and redeployability are present, K (column 5 of Table 1) O (column 3 of Table 2), and values V_0 (R_i) and V_0 (R_j) of separately operated resources when contemporaneous sharing and redeployability are absent (column 2 and 3 of Table 1) . Table 3 reports values of I for all considered combinations of β and S.

It is important that, when contemporaneous sharing and redeployability are simultaneously present (all entries in Table 3, except for the column in which β=1.00), I is always different from zero and negative. That means that advantages of contemporaneous sharing (K) and redeployability (O) are interdependent in determining firm value (V_0). Thus, when contemporaneous sharing is very high ($\beta=1.10$), the correcting term ($I = -0.3467$) corresponds to a large portion of the value of redeployability ($K = 0.5808$). This happens, because a multi-business firm (R_i & R_j) is incited to multiply its returns by 1.1 by simultaneously using both resources (i.e., contemporaneous sharing) and is less inclined to redeploy R_i to R_j, even if cash flow for R_i is declining. Conversely, when contemporaneous sharing leads to diseconomies ($\beta=0.90$), the negative effect of K ($K =- 0.4989$ in Table 1) is completely compensated for by I ($I = 0.4988$, when $S = 0$ in Table 3), because, the firm focuses on the advantage of redeployability and never shares resources between the two markets. We further graphically illustrate the importance of interdependence between contemporaneous sharing and redeployability in Figure 2. One can note that when the advantages of contemporaneous sharing are high, the relationship between firm value (V_0) and redeployability, operationalized with S, is flatter than the relationship between firm value (V_0) and redeployability when advantages of contemporaneous sharing are low.

This result has some important implications. First, it is not enough to model redeployability as another implication of relatedness, as was highlighted by Helfat and Eisenhardt (2004). Rather, it is necessary to model them together, because the firm, at least in some moments in time, chooses between advantages offered by the two, and the value of interdependence (I) may not be trivial. Second, our results reveal that tests of the relationship between firm value and relatedness relying on crude measures of relatedness are incapable to separate effects predicted by the two theoretically distinct arguments on contemporaneous sharing and redeployability and more care is needed to discriminate between them.

4. Discussion

Our paper explicitly considers how relatedness enhances value of multi-business firms. In two ways, it goes beyond prior work that seeks to demonstrate a relationship between relatedness and firm value. First, we emphasize that redeployability represents a repeatedly available real option to withdraw a resource from a declining market and redeploy it to an alternative market. We illustrate how this option needs to be evaluated in a dynamic valuation model due to inertia introduced by non-zero switching costs and dynamic implications of switching decisions. This view extends consideration of advantages of a single-time redeployment of a fungible resource. Second, we explicate how relatedness influences value through the interplay of and contemporaneous sharing and redeployability, when a firm decides on which of the two advantages is more valuable. This explication enables us to demonstrate how each independently and jointly affects firm value. While prior work has qualitatively described how contemporaneous sharing and redeployability separately affect firm value, it has remained unclear whether those dimensions have independent effects. We demonstrate that this omission is severe. In this sense, we illuminate value in multi-business firms that has been previously undiagnosed. Several of our results are worth highlighting.

First, we found that benefits of contemporaneous sharing are mitigated by redeployability and visa verse, because a multi-business firm can choose which of them is more valuable. When more benefits of contemporaneous sharing are added, the effect of redeployability converges to zero. Alternatively, high redeployability eliminates at least a portion of the benefits from contemporaneous sharing.

Second, we demonstrated that switching costs have a decreasing marginal effect on the value of redeployability and, thus, on the complete value of a multi-business firm. This quantitative finding can be considered an important complement to other efforts to qualitatively elaborate a non-linear effect of relatedness on the corporate value (Rumelt, 1974; Palich et al., 2000). The evidence about the shape of the non-linearity provides an important clue for empirical operationalizations of resource relatedness.

These findings provide strong evidence that relatedness is a complex theoretical concept and influences firm value in multiple ways. It is important to consider at least two theoretically distinct effects of relatedness when investigating value of a multi-business firm –

contemporaneous sharing and redeployability. Moreover, the interdependence between these two types is consequential. Our findings have important implications for future empirical work. The most obvious empirical implication is to employ separate proxies for contemporaneous sharing and redeployability and their interaction in models predicting the value of multi-business firms. A second implication is that switching costs have a decreasing marginal effect on value of a multi-business firm and empirical models have to account for such a relationship.

Modeling complexity, involved in a multi-business firm, has required application of numerical methods rather than analytical techniques. Our findings might be confounded by our arbitrary choices of the model parameters. The values we specify for parameters of the stochastic processes may limit generalizeability of our results. To partially mitigate that concern, we investigated the robustness of our findings with respect to altering values of the drifts, volatilities, and correlation of the specified geometrical Brownian motion processes. In addition, we checked the robustness of our findings to changes in the value of the risk-free rate, bounds of the intervals of considered contemporaneous sharing, highest value of considered switching cost, and life spans for the two resources. Our findings are robust to those alterations.[7]

In conclusion, this research highlights the importance of considering formally how relatedness affects value in multi-business firms. The impact of relatedness goes beyond benefits of contemporaneous sharing. It also expands beyond a single-time redeployment of a resource from a declining market. Finally, contemporaneous sharing and redeployability are interdependent in their effect on the firm value. We use a quantitative model to isolate those components of the value of a multi-business firm. In addition to being theoretically and empirically important, our paper has important implications for managers. Related diversification has increased in frequency, and the dominant explanation is that it allows firms to

[7] Results of robustness checks are available from the authors upon request.

leverage existing resources in new markets. We invite managers to consider that related diversification creates flexibility to withdraw and redeploy resources. We show that this explanation deserves more attention by managers. Finally, we propose a way for managers to modify existing valuation techniques to account for alternative effects of relatedness. This increased precision will lead to better decision-making in multi-business firms.

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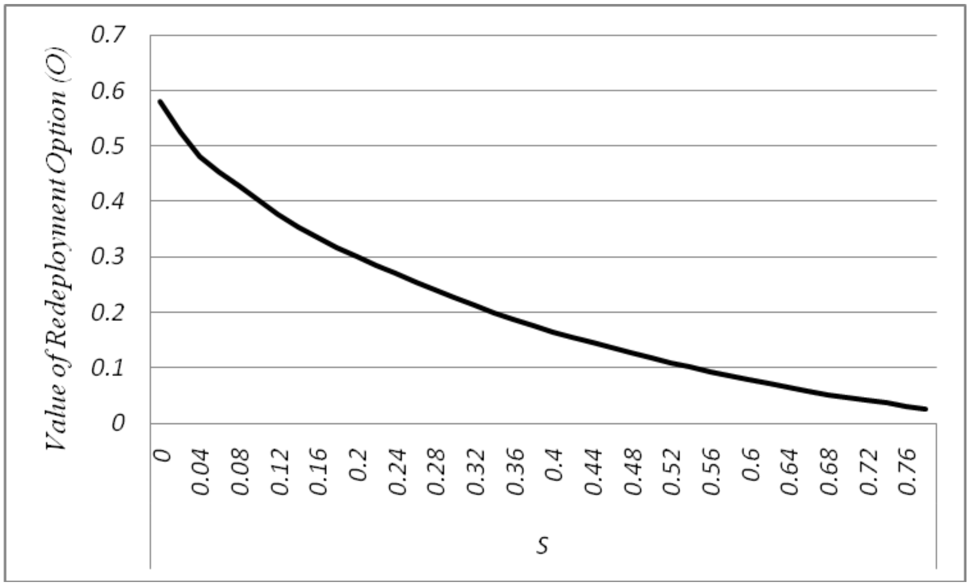
FIGURE 1
Effect of Switching Cost (*S*) on the Value of the Redeployment Option (*O*)[8]



[8] $\beta = 1.0$.

FIGURE 2
Effect of Contemporaneous Sharing and Redeployability on the Value of a Multi-business Firm

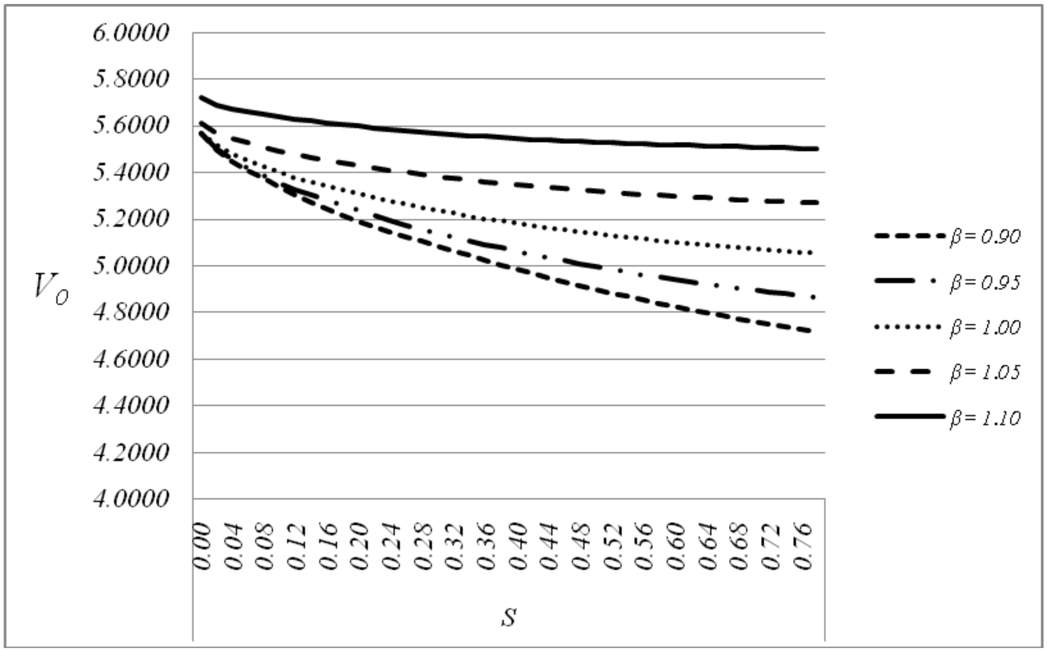


TABLE 1
Effect of Contemporaneous Sharing (β) on Value (V_0) of a Multi-business Firm

		V_0 under alternative configurations of resources			K
		Only R_i	Only R_j	R_i & R_j	
β	*1*	*2*	*3*	*4*	*5*
	0.90	2.4944	2.4944	4.4899	-0.4989
	0.91	2.4944	2.4944	4.5398	-0.4490
	0.92	2.4944	2.4944	4.5896	-0.3991
	0.93	2.4944	2.4944	4.6395	-0.3492
	0.94	2.4944	2.4944	4.6894	-0.2993
	0.95	2.4944	2.4944	4.7393	-0.2494
	0.96	2.4944	2.4944	4.7892	-0.1995
	0.97	2.4944	2.4944	4.8391	-0.1497
	0.98	2.4944	2.4944	4.8890	-0.0998
	0.99	2.4944	2.4944	4.9389	-0.0499
	1.00	2.4944	2.4944	4.9887	0.0000
	1.01	2.4944	2.4944	5.0386	0.0499
	1.02	2.4944	2.4944	5.0885	0.0998
	1.03	2.4944	2.4944	5.1384	0.1497
	1.04	2.4944	2.4944	5.1883	0.1995
	1.05	2.4944	2.4944	5.2382	0.2494
	1.06	2.4944	2.4944	5.2881	0.2993
	1.07	2.4944	2.4944	5.3380	0.3492
	1.08	2.4944	2.4944	5.3878	0.3991
	1.09	2.4944	2.4944	5.4377	0.4490
	1.10	2.4944	2.4944	5.4876	0.4989

TABLE 2
Effect of Switching Cost (S) on Value (V_0) of a Multi-business Firm

		$V_0(R_i$ & $Rj)$	O
	1	*2*	*3*
S	0.00	5.5695	0.5808
	0.02	5.5131	0.5244
	0.04	5.4684	0.4797
	0.06	5.4411	0.4524
	0.08	5.4159	0.4271
	0.10	5.3909	0.4022
	0.12	5.3663	0.3776
	0.14	5.3431	0.3543
	0.16	5.3229	0.3342
	0.18	5.3051	0.3164
	0.20	5.2887	0.3000
	0.22	5.2732	0.2844
	0.24	5.2581	0.2694
	0.26	5.2435	0.2547
	0.28	5.2291	0.2403
	0.30	5.2149	0.2262
	0.32	5.2013	0.2125
	0.34	5.1883	0.1995
	0.36	5.1761	0.1873
	0.38	5.1645	0.1758
	0.40	5.1537	0.1649
	0.42	5.1434	0.1546
	0.44	5.1335	0.1448
	0.46	5.1241	0.1354
	0.48	5.1150	0.1263
	0.50	5.1062	0.1174
	0.52	5.0977	0.1089
	0.54	5.0894	0.1007
	0.56	5.0814	0.0927
	0.58	5.0738	0.0851
	0.60	5.0665	0.0778
	0.62	5.0596	0.0708
	0.64	5.0530	0.0643
	0.66	5.0468	0.0581
	0.68	5.0409	0.0521
	0.70	5.0353	0.0465
	0.72	5.0299	0.0412
	0.74	5.0248	0.0361
	0.76	5.0199	0.0312
	0.78	5.0153	0.0265

TABLE 3
Value of Interdependence (*I*) for Alternative Combinations of β and *S*

Effect of Interdependency between Contemporaneous Sharing and Redeployability												
		β										
		0.90	0.92	0.94	0.96	0.98	1.00	1.02	1.04	1.06	1.08	1.10
S	0.00	0.4988	0.3990	0.2992	0.1994	0.0997	-0.0001	-0.0825	-0.1648	-0.2341	-0.2906	-0.3467
	0.02	0.4816	0.3823	0.2870	0.1921	0.0973	0.0023	-0.0830	-0.1577	-0.2235	-0.2762	-0.3218
	0.04	0.4757	0.3808	0.2859	0.1909	0.0961	0.0086	-0.0691	-0.1431	-0.2003	-0.2519	-0.2945
	0.06	0.4669	0.3720	0.2770	0.1821	0.0907	0.0096	-0.0695	-0.1359	-0.1920	-0.2409	-0.2796
	0.08	0.4572	0.3623	0.2674	0.1735	0.0902	0.0097	-0.0679	-0.1280	-0.1837	-0.2288	-0.2657
	0.10	0.4474	0.3525	0.2577	0.1711	0.0900	0.0097	-0.0620	-0.1199	-0.1737	-0.2153	-0.2514
	0.12	0.4379	0.3430	0.2529	0.1705	0.0900	0.0109	-0.0544	-0.1118	-0.1621	-0.2015	-0.2366
	0.14	0.4288	0.3352	0.2508	0.1697	0.0893	0.0143	-0.0472	-0.1041	-0.1504	-0.1885	-0.2222
	0.16	0.4183	0.3295	0.2473	0.1666	0.0866	0.0168	-0.0428	-0.0980	-0.1410	-0.1784	-0.2100
	0.18	0.4085	0.3239	0.2427	0.1622	0.0841	0.0184	-0.0403	-0.0927	-0.1335	-0.1700	-0.1993
	0.20	0.4008	0.3182	0.2374	0.1570	0.0823	0.0194	-0.0387	-0.0877	-0.1270	-0.1622	-0.1896
	0.22	0.3940	0.3124	0.2318	0.1518	0.0811	0.0200	-0.0369	-0.0827	-0.1210	-0.1546	-0.1803
	0.24	0.3874	0.3063	0.2258	0.1475	0.0803	0.0204	-0.0347	-0.0778	-0.1154	-0.1469	-0.1715
	0.26	0.3810	0.3001	0.2197	0.1443	0.0797	0.0207	-0.0317	-0.0728	-0.1095	-0.1390	-0.1627
	0.28	0.3745	0.2938	0.2140	0.1419	0.0793	0.0212	-0.0283	-0.0679	-0.1033	-0.1310	-0.1541
	0.30	0.3681	0.2875	0.2091	0.1400	0.0790	0.0221	-0.0245	-0.0631	-0.0969	-0.1230	-0.1454
	0.32	0.3615	0.2811	0.2050	0.1384	0.0785	0.0235	-0.0207	-0.0583	-0.0904	-0.1152	-0.1368
	0.34	0.3545	0.2745	0.2011	0.1366	0.0776	0.0249	-0.0172	-0.0539	-0.0840	-0.1079	-0.1286
	0.36	0.3470	0.2681	0.1972	0.1344	0.0764	0.0262	-0.0142	-0.0498	-0.0782	-0.1013	-0.1208
	0.38	0.3391	0.2619	0.1932	0.1318	0.0750	0.0274	-0.0117	-0.0459	-0.0727	-0.0950	-0.1135
	0.40	0.3310	0.2559	0.1892	0.1290	0.0738	0.0285	-0.0095	-0.0421	-0.0675	-0.0891	-0.1064
	0.42	0.3229	0.2499	0.1851	0.1258	0.0726	0.0294	-0.0076	-0.0385	-0.0628	-0.0835	-0.0997
	0.44	0.3150	0.2441	0.1808	0.1225	0.0715	0.0301	-0.0058	-0.0350	-0.0583	-0.0781	-0.0934
	0.46	0.3074	0.2384	0.1764	0.1192	0.0705	0.0307	-0.0040	-0.0316	-0.0541	-0.0728	-0.0872
	0.48	0.3000	0.2328	0.1720	0.1162	0.0698	0.0312	-0.0021	-0.0283	-0.0499	-0.0676	-0.0812
	0.50	0.2930	0.2274	0.1677	0.1136	0.0692	0.0318	0.0000	-0.0248	-0.0457	-0.0623	-0.0753
	0.52	0.2860	0.2219	0.1632	0.1110	0.0686	0.0323	0.0021	-0.0216	-0.0416	-0.0573	-0.0696
	0.54	0.2792	0.2164	0.1589	0.1088	0.0680	0.0329	0.0043	-0.0185	-0.0375	-0.0523	-0.0641
	0.56	0.2725	0.2111	0.1547	0.1068	0.0675	0.0337	0.0065	-0.0153	-0.0334	-0.0474	-0.0586
	0.58	0.2659	0.2055	0.1507	0.1048	0.0668	0.0344	0.0086	-0.0124	-0.0295	-0.0427	-0.0534
	0.60	0.2593	0.2000	0.1468	0.1029	0.0662	0.0352	0.0106	-0.0094	-0.0256	-0.0381	-0.0482
	0.62	0.2526	0.1945	0.1432	0.1011	0.0655	0.0360	0.0126	-0.0066	-0.0218	-0.0338	-0.0433
	0.64	0.2458	0.1888	0.1395	0.0990	0.0647	0.0366	0.0142	-0.0041	-0.0184	-0.0298	-0.0387
	0.66	0.2389	0.1833	0.1360	0.0970	0.0639	0.0373	0.0158	-0.0015	-0.0151	-0.0259	-0.0343
	0.68	0.2321	0.1780	0.1326	0.0950	0.0633	0.0380	0.0174	0.0010	-0.0119	-0.0221	-0.0300
	0.70	0.2252	0.1727	0.1292	0.0929	0.0626	0.0385	0.0188	0.0033	-0.0089	-0.0186	-0.0259
	0.72	0.2183	0.1676	0.1259	0.0908	0.0620	0.0389	0.0202	0.0055	-0.0061	-0.0152	-0.0221
	0.74	0.2116	0.1628	0.1226	0.0889	0.0614	0.0394	0.0216	0.0077	-0.0033	-0.0119	-0.0184
	0.76	0.2050	0.1582	0.1195	0.0870	0.0609	0.0399	0.0229	0.0098	-0.0006	-0.0087	-0.0148
	0.78	0.1987	0.1537	0.1165	0.0853	0.0604	0.0404	0.0243	0.0119	0.0020	-0.0055	-0.0113